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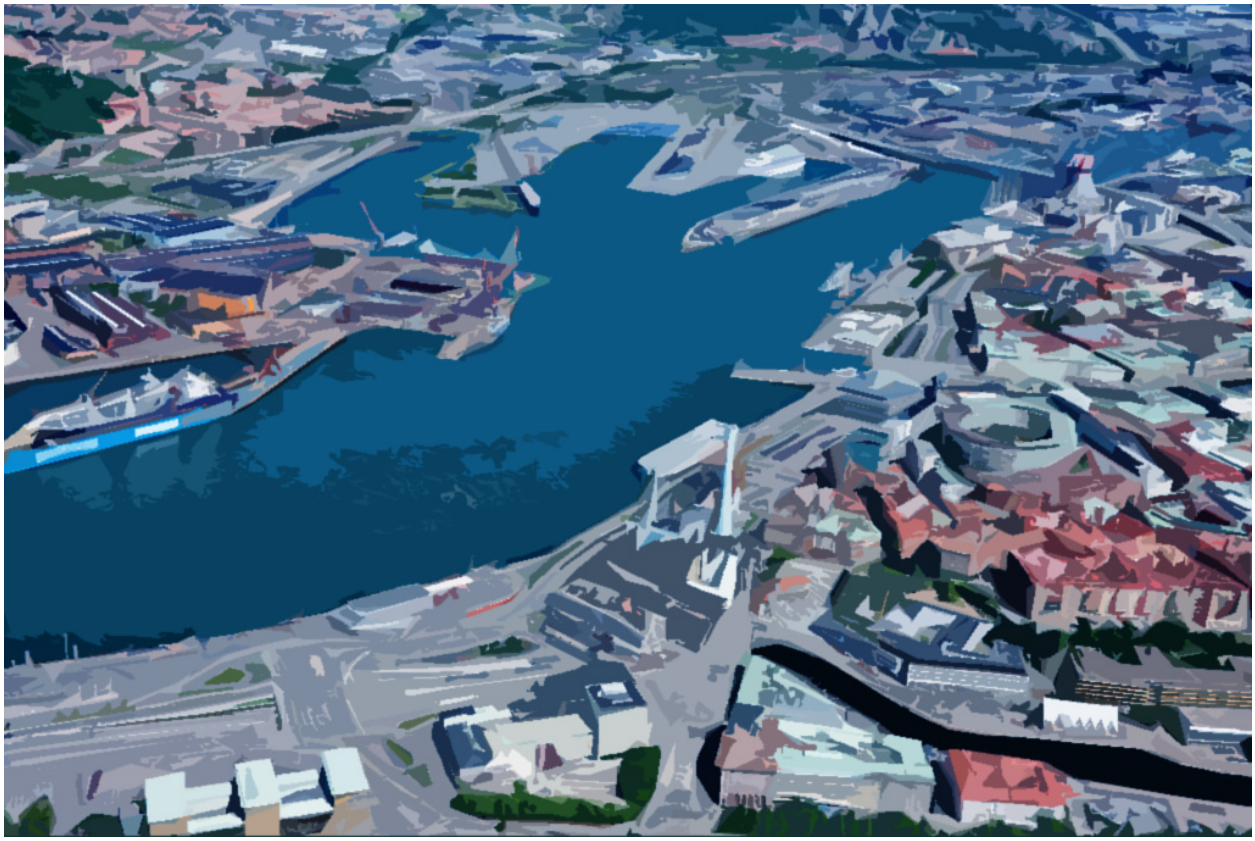

REDEFINING THE URBAN EDGE

WALKABLE SOUNDSCAPES IN PUBLIC SPACE

Master's thesis in the Challenge Lab 2017 - FRT 2017:16

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Gothenburg, Sweden 2017

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Redefining the Urban Edge
Walkable Soundscapes in Public Space

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Cover: Frihamnen and Göteborg central area (modified by the author) [Source: (Hållbar Stad, 2017)]

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Redefining the Urban Edge - Walkable Soundscapes in Public Space
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Abstract

The City of Gothenburg is undergoing densification plans for a more compact urban centre. The River City project will include Frihamnen, a former port area, and is the central part of the urban densification plan. While plans for Frihamnen aim to promote walkability, public transportation, and the creation of inclusive public space, these plans do not apply to its borders and transitions to limitrophe areas. The development will be completed in consecutive stages, first of which will be delivered in 2021 with the completion of 1000 new homes and workplaces, and Jubileumsparken, a commemorative park for the city with the aim to connect the north and south of the river bank. The area will be populated from its center first, while the development plans will continue on its perimeter. These spatial dynamics can encourage isolation and the risk of incremental spatial and social segregation, as the project will take several years to complete. Additionally, despite its central location, the area is delimited by strong infrastructure, which has negative influence on sound quality and pedestrian circulation. Although findings from research and interviews show some interest and awareness in the stakeholders involved, the implementation of soundscape and walkability solutions in outdoors areas becomes nonetheless problematic due to its novelty and often low priority in the local development agenda. The thesis explores the qualities that shape successful public spaces and increase quality of life in densely populated areas; it aims to assess how walkability and soundscape can be better addressed in current urban development practices in Gothenburg and to suggest targeted interventions. Consisting of research for design, the thesis applies backcasting methodology, and takes into consideration best practices, existing theory and current planning for public spaces in Gothenburg. Additionally, semi-structured interviews and a stakeholder dialogue take place in the process, reflecting on the research question: “how can soundscape and pedestrian access be improved and implemented in the city of Gothenburg?”. The findings lead to the identification of design principles for walkability and soundscape, that are consequently applied to the case study following Urban Acupuncture and Everyday Urbanism concepts. The anticipated result is to contribute to new practical perspectives to better address walkability and soundscape in outdoor areas. The findings aim to be applied in Frihamnen and in further urban development in the region of Västra Götaland, as an addition to the existing criteria for designing transitional public space. Added values to the thesis are its impartial and neutral position and interdisciplinary approach, as it aims to bring together urban planning and acoustics perspectives.

Public Space, Soundscape, Walkability, Urban Acupuncture, Everyday Urbanism, Backcasting Methodology

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Pascal Kuta & Fabio Latino, Gothenburg, August 2017

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Introduction

According to the United Nations (2015), the expected world population in the year 2050 will reach 9,7 billion people, 65 % of which will live in cities. (World Health Organisation, 2016). It is also estimated that in 2050 there will be 41 mega-cities in the world (more than 10 million inhabitants). To address population growth and increasing immigration, cities will increase in size and update infrastructure networks to fulfil the needs of their inhabitants. Bigger metropolitan areas will mean increased demand for urban mobility and this will put stress on the network of urban infrastructure, which will need to be expanded. Considering existing means of transportation, a bigger transportation network will increase pollution and it will be likely to affect air and sound quality in urban areas (Estevez Mauriz et al., 2016). Urban areas as we know will change and in order to sustain more population and avoid urban sprawl, cities will need to become more dense. One major aspect of urban densification is making sure that quality of life is preserved. Compact cities aim to increase quality of living as they can allow shorter commuting distances and the opportunity to walk and cycle to places.The World Health Organisation (WHO) demonstrated that in cities, health depends also on shaping the urban environment and not only on the strength of the health system. For this reason, city structures need to be well designed and allow flow and circulation to avoid segregation among inhabitants. City needs to be permeable and accessible to allow diversity especially in their public spaces. Mobility will certainly play an important role, and people will need to be able to walk or cycle to their destinations without having it any danger.

In order to be competitive, cities will need to be safe, accessible and attractive to foster well-being and quality of life. Commuting will represent a big part of everyone's daily life and inhabitants will be likely to spend much more time in public spaces. In community planning, public spaces are part of the third places, that differs from the home (first places) and the office (second places) and that contribute to our overall wellbeing (Oldenburg, 1990). As future cities aim to foster walkability and use of public transportation over car usage, one can argue that third places will dramatically increase in importance, as their quality will contribute to our quality of life.

A well designed urban environment aims to combine aesthetics and functionality. However, while urban design and planning focus very much on materiality and volumes, less attention is put into sound qualities of what is designed. It is more common to see soundscape solutions applied to indoor space than public space for instance. Sound in the urban environment is often dealt with late in the planning process, leaving little room for solutions that can be integrated into urban design

(Estevez Mauriz et al., 2016). Also, sound in urban areas is mainly thought of as a negative aspect, such as noise pollution, while it can also have positive connotation and be an added value.

Research shows that the idea of Soundscape is still underdeveloped in urban planning processes (Estevez Mauriz et al., 2016), while too high sound pressure levels (SPL) can be a risk to health (Basner et al., 2014) that includes loss of hearing, sleep disturbance, nausea and many more health related issues. Additionally, the public cost of noise related issues such as health is one million Swedish Kronor solely in Gothnburg, anually (Västsvenska Paketet, 2016) (Trafikverket, 2016).

According to Schafer (1977), Soundscape is defined in three aspects, key notes (all aspects that make up an audible environment), sound signals (artificial signals that indicate specific events) and soundmarks (which define a unique audible landmark such as the sea organ in Croatia). All of these aspects can have positive and negative aspects to it. While often sound is only reduced to noise and its negative aspects, Schafer focuses also on the design of an environment that is acoustically inviting. This includes for example the use of sounds or acoustical elements that give a specific feeling to a space.

However, urban planning is mostly focused on the visual design and the usage of Soundscape in the aspects of quality of life is often not taken into account (Estevez Mauriz et al., 2016). Often sound is only focused on due to the regulations given by the European Union to reduce noise.

1.1 Purpose and Research Question

In a sustainable future, quality of life is an important aspect. The Frihamnen project in the city of Gothenburg is part of an extensive densification strategy for the next 35 years. Therefore it is of high significance to evaluate and understand people's needs who live in such a dense environment. Soundscape and walkability can have a major influence on the quality of life since they directly tackle the needs of everyday life for the inhabitants, for instance the possibility to have a chat with one's children while walking to a nearby park or similar public space. The research question in this thesis is thus formulated as follows:

How can soundscape and pedestrian access be improved and implemented in planning processes in the City of Gothenburg?

The research question focuses on opportunities for improvement in the aspects of Soundscape and walkability. Since the Frihamnen project is part of a large-scale project with long-term development, it is critical to understand the limitations and possibilities at an early stage. Especially since it lays the foundation and reference for future projects in the city of Gothenburg.

The findings will be important because quality of life is a major aspect of a sustainable future and life in cities, thus they are not only relevant to the project in Frihamnen, but can be relevant to urban densification projects all around the world.

1.2 Challenge Lab

This thesis is part of the Challenge Lab, which was established, in 2014, as an initiative within Chalmers University of Technnology, which focuses on interdisciplinary thesis work of Master's students in close connection of the triple helix (academia, society and industry). Sustainability challenges of the region in the prevailing situation are faced and analysed utilising the Backcasting methodology. Additionally students working in the triple helix operate as neutral actors on these challenges, due to their varied backgrounds.

1.3 Scope and Limitation

The paper investigates how Soundscape and walkability influence the success of public space. The aim of this thesis is to understand the complexity of Soundscape applied to the built environment, specifically in outdoor spaces; in order to do so it illustrates current practice in the city of Gothenburg and compares it to existing knowledge from academic research.
Also, it aims to illustrate the implication of noise and soundscape on quality of life. Additionaly, soundscape and walkability are both considered to draw recommendations for sustainable urban development. To do so the RiverCity project is taken as a case study, and Frihamnen redevelopment plan is analysed. The project aims to understand how soundscape and walkability are addressed and the challenges that might occur in implementing sustainable solutions. The final purpose of this thesis is to add new knowledge to soundscape and walkability application in the city of Gothenburg and to reach out to relevant stakeholders involved in addressing these topics to raise awareness. Finally, this thesis aims to collect relevant knowledge applicable in other urban contexts.

1.4 Outline

The thesis is divided into two phases, that are corresponding to the two phases of the procedure in the Challenge Lab. Hereby the first phase relates to the process in the Challenge Lab and the finding of the research question mentioned earlier in this chapter.
The second phase of the Challenge Lab consists of the research project. The methodology, results and discussion will be presented.

2

Phase 1

The Challenge Lab is divided into two phases, where the first phase marks the beginning of the process. In phase 1, the focus lies on the theoretical background and the proceedings towards finding a research project. The students work hereby in a co-creative, interdisciplinary way to understand and address sustainability issues from a global to a regional scale. In the following chapter, the theoretical background and methodology of the Challenge Lab is described and put into context of finding the specific research question that is the focus of this thesis.

2.1 Frame of Reference

The theoretical framework of the Master's thesis within the Challenge lab is built upon two perspectives, inside-out and outside-in, which are tools and methods described in the following. Furthermore, the design thinking method the Challenge Lab utilises as well as the central methodology of the Challenge Lab, i.e. Backcasting, will also be described.

2.2 Backcasting

The section illustrates the identified dimensions of sustainability and system conditions, which gave base to apply the backcasting methodology adopted in this project.

2.2.1 Dimensions of Sustainability

Sustainable development is defined as *"development that meets the needs of the present without compromising the ability of future generations to meet their own needs"* (WCED, 1987). This definition starts from human well-being and allows development within nature's boundaries (Holmberg, 2000). Furthermore, four dimension of sustainability have been developed by Holmberg and Karl-Henrik Robèrt, namely ecological, economical, social and well-being.
As illustrated in Figure 2.1, well-being stands on societal and economical dimensions, while all three are dependent on Nature's preservation. As Holmberg and Robèrt (2000) mention nature must not be worsened in order to guarantee futures generations' fulfilment of need and well-being.

Table 2.1: Dimensions of Sustainability (Holmberg, 2000)

Nature	Ecosystems, bio-geo-physical cycles and natural resources
Ecology	Effective and efficient use of resources in human activities
Society	Government, Social and Family systems
Well-being	Health and Fulfilment of every individual needs

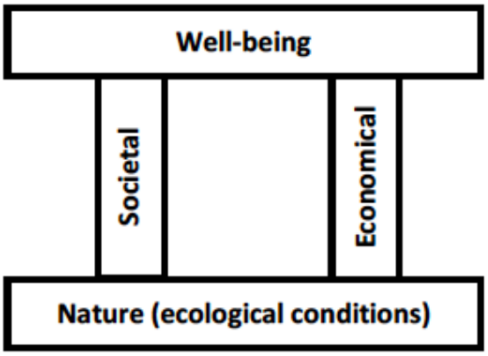

Figure 2.1: Dimension of Sustainability (Holmberg, 2000)

2.2.2 System Conditions

System conditions are defined by Holmberg and Robert (2000) as four different principles regarding negative impacts of humankind. In order to ensure sustainable development, humankind should refrain from these principles.

The first principle, “In order for society to be sustainable, nature’s functions and diversity are not systematically subject to increasing concentrations of substances extracted from the Earth’s crust" (Holmberg and Robèrt, 2000, p. 298), means that humankind should not extract and accumulate more into the atmosphere and lithosphere than the earth is capable of processing.
Secondly, there shall not be “increasing concentrations of substances produced by society” (Holmberg and Robèrt, 2000, p. 298). This principle describes human-made chemicals and waste that are emitted into the natural cycle and should not be increased.
The third principle describes human-made interference within nature such as deforestation and other manipulations of the ecosystem. (Holmberg and Robèrt, 2000, p. 298) say hereby “nature’s functions and diversity are not systematically impoverished by over-harvesting or other forms of ecosystem manipulation”.
Lastly, the fourth principle states that “resources are used fairly and efficiently in

order to meet basic human needs world wide." (Holmberg and Robèrt, 2000, p. 298). It describes that resources and wealth should be distributed equitably among the society in order to be able to fulfil basic human needs all around the world.

2.2.3 The Backcasting Process

Backcasting is a method to obtain early warning when long-term investments in current structure and trends can lead to a dead end (Holmberg, 1998). It consists of a systematic step-by-step approach to deal with complex problems in need of a major change. Backcasting is particularly useful when dominant trends are part of the problem that is also greatly influenced by externalities. The methodology benefits from a wide scope and long time-horizon. The backcasting methodology includes four steps as illustrated in Figure 2.7.

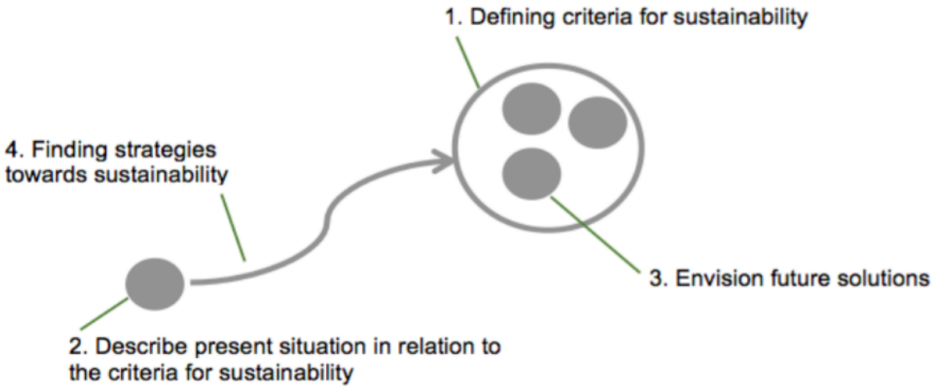

Figure 2.2: The four steps in Backcasting (Holmberg, 1998)

1. In the first step, criteria for sustainability are defined to picture a future scenario.
2. The current situation is then described in relation to the criteria identified in step one.
3. Future solutions are envisioned considering the set of sustainability criteria, without being biased by current situation in this step.
4. The four step aims to connect the envisioned future scenario with the current situation through a strategic approach.

2.3 Outside-In Perspective

In order to understand how global sustainability influences global and local systems, one also has to view issues from the outside-in perspective which gives toolsets for this matter. Tools and methods are Systems thinking (Meadows, 1997), the multi-level perspective (Geels, 2005) and design thinking. These methods are described in the following.

2.3.1 Systems Thinking

Socio-economic systems need to be steered into a sustainable direction in order to enable transitions to sustainable systems. To enable change in a system, the right leverage points need to be identified. Meadows (1997) describes hereby nine leverage points which can enable change in a system.

Table 2.2: Leverage Points by Meadows (1997), ordered in reverse order from short to long leverage

Leverage Point	Description
9	Numbers (subsidies, taxes, standards)
8	Material stocks and flows
7	Regulating negative feedback loops
6	Driving positive feedback loops
5	Information flows
4	The rules of the system (incentives, punishment, constraints)
3	The power of self-organisation
2	The goals of the system
1	The mindset or paradigm out of which the goals arise

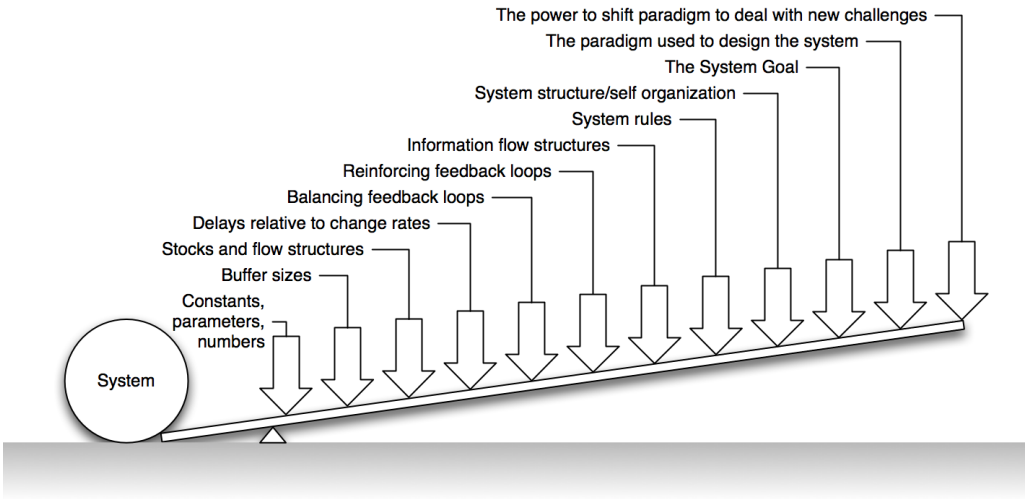

Figure 2.3: Leverage points to intervene a system by Meadows (1997)

Figure 2.3 shows how leverage points can have a different impact on a system, depending on the length of the leverage.

2.3.2 Multi-Level Perspective

According to Geels (2005), change in socio-technical systems is happening on three different levels (Figure 2.4). These levels are niche, regime and landscape. The niche-level describes small markets, in which new ideas and innovation can arise easily. The regime level describes then a rather developed market in which laws and

regulations allow and limit actions through lock-in mechanisms. Also, at regime level, elements are stable through their interconnectivity and alignment between organisations. Lastly, the landscape level describes the broader and non-technological factors such as economic growth, cultural and normative values or regulations.
Since niches are rather independent or separated from the established mechanisms, they are open to change which through a bottom-up process can influence the regimes and ultimately the landscape. Change is much more difficult to accomplish on regime or landscape level due to their already established regulations and norms (Geels, 2005).

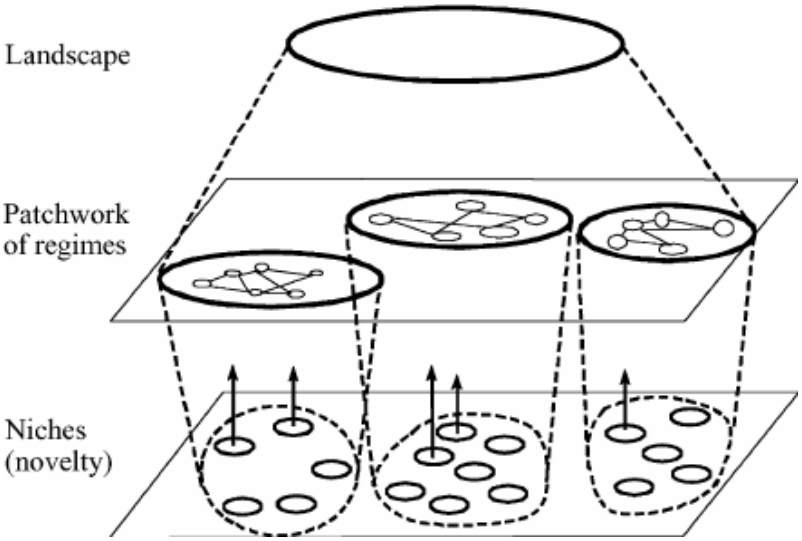

Figure 2.4: Multi level perspective by Geels (2005)

2.4 Inside-Out Perspective

The inside-out perspective is characterised by its identification to strengths, own values and visions which are applied through methods and tools that help understand one's individual position in a system. Additionally, the inside-out perspective explores the interaction of the individuals in the system (Holmberg, 2014). The tool set of the inside-out perspective consists of self-leadership, active listening, guidelines for dialogues and dialogic leadership. In the following these tools are introduced and put into context of the Challenge Lab.

2.4.1 Self-Leadership

Self-leadership can help individuals identify their own values, strengths and visions (Holmberg, 2014). Ryan and Deci (2000) differentiate for this four types of extrinsic motivation that reach from external to internal. The first type is the motivation that lies in complying with external regulations. This type is completely caused externally. The second type is based on introjected regulation, which relates to internal rewards and self-control and is somewhat caused externally. The third type,

which is caused slightly internally, is the motivation of self-identified regulations, that are a result from the identification of matters of personal importance or, in other words, finding a sense of meaning. The fourth and last type is caused internally and based on one's personal values and beliefs. It is this level of intrinsic motivation that is the desired level for leaders to be able to transform complex systems.

2.4.2 Active Listening and Guidelines for Dialogue

Active listening is a central part of leadership abilities and working with as well as involving stakeholders. A circle of reinforcing trust is a basis for collaboration (Sandow and Allen, 2005).

The relation of listening, understanding, trusting and collaboration is hereby the key for a successful system in which every individual within an organisation is working towards the same goal. Additionally, every individuals voice is heard and accepted, which also means that interruptions block the trust building process. Trust develops in the teller, if the voice is listened to and understood, resulting in a feeling of contribution and openness to collaboration, which, reflected upon, opens also up to closing of the circular relationship described by Sandow and Allen (2005).

Recommendations for a successful dialogue are also given by Isaacs (1993). Hereby, assumptions and certainties shall be suspended, secondly, observers shall be observed, thirdly, one shall listen to the ones listening, fourthly, one shall slow down the inquiry, and lastly, one shall be aware of thought and lastly polarisation shall be befriended.

2.4.3 Dialogic Leadership

In order to communicate, Isaacs (1999) defines a four-player model which describes the power of dialogue. In Figure 2.5, the model by Isaacs is shown. The first player moves and brings in ideas, the second one follows and executes. The third player opposes and critises, in order to challenge and bring in ideas for correction. The last player is a bystander who is observing and bringing in new perspectives.

Isaacs (1999) also defines that a leader has to track the action in a conversation and to balance advocacy and inquiry. Additionally every player in the four-player model needs to fulfil the tasks according to their role for a successful dialogue.

Figure 2.6 shows the extended dialogic leadership model by Isaacs (1999). Four practices that can positively influence the quality of a conversation are described. Move means also voicing, thus stating ones own views and opinions in an encouraging manner. To follow also means to listen in order to carefully grab the essence of what is told instead of processing ones own thoughts into the topic. To oppose also implies to respect other point of views and their value. Finally, bystanding also means to suspend own point of views one might have in order to accept different ones. Keeping these four dimensions in mind can greatly increase the quality of a dialogue, thus leaders should incorporate these dimensions in their actions in order to also increase the quality of collaboration (Isaacs, 1999).

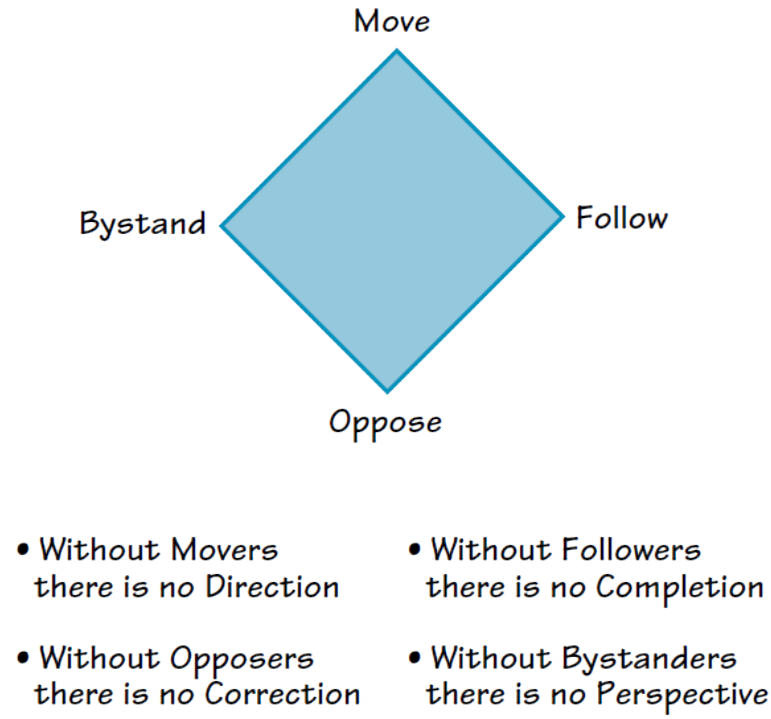

Figure 2.5: Dialogic Leadership – 4 players model, (Isaacs, 1999), adapted from David Kantor (1995).

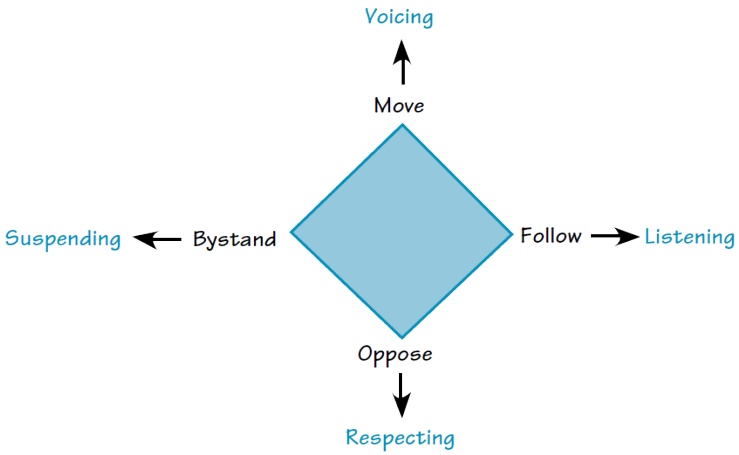

Figure 2.6: Four practices for dialogic leadership, (Isaacs, 1999).

2.5 Design Thinking

The process of design thinking is usually utilised for the conceptualisation of the planning process of a product. Three overlapping stages are dominant, namely, the pre-study, the development and the verification (Figure 2.7).
The pre-study consists of the identification of the challenge, creation of a system, formulation of the needs and requirements for the planned product. The development phase consists of formulating the functions and ideas, while keeping also the pre-study in mind. Also, the development phase concludes with a concept. Finally, the verification phase consists of a visualisation and prototyping of the concept, while still referring back to the development phase and adapting to it.
During and between all stages it is necessary to iterate results in order to improve the quality of each stage as well as keeping the dialogue with the involved stakeholders to find the best result (Söderberg, 2014).

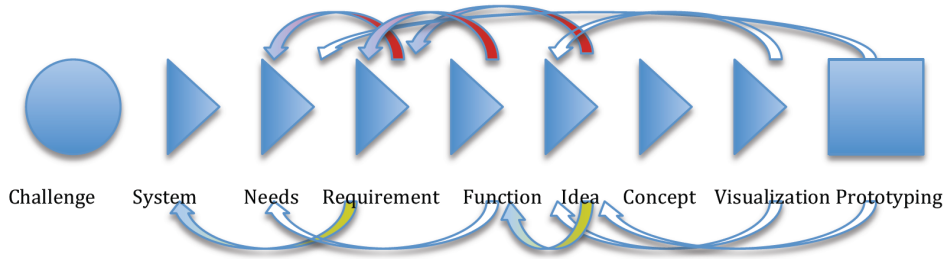

Figure 2.7: Design thinking process by Söderberg (2014)

2.6 Methodology

The aim of the Challenge Lab is to bring actors together for co-creation in processes where the current systems and way of thinking are challenged (Holmberg, 1998). The participants start from broader sustainability challenges to formulate research questions and conduct a research project to address local challenges in the region of Västra Götaland. As the project aims to solve long-term complex challenges concerning society, technological innovation and transformational change, backcasting methodology is adopted (Dreborg, 1996). Phase one is divided into four weeks, in relation to the four steps of backasting methodology. Phase two was carried out in pairs and further research and literature review was adopted.

2.6.1 Step 1: Defining a framework for sustainability

The first week of phase one, students of the Challenge Lab introduced each other and engaged in a Self-leadership workshop and worked together in defining a sustainability criteria, thus a framework for sustainability.

2.6.1.1 Outside-in

In this part, students were asked to define criteria for sustainability. In order to achieve this, participants were introduced to the backcasting methodology (Holmberg, 1998) and to the four dimension of Sustainability (Holmberg, 2000). Consequently smaller groups of four were formed in order to further discuss the four dimensions, namely ecological, economical, societal and well-being. Each group would have a facilitator who would be responsible for conveying results of the discussion. The facilitator would remain in the same group, while the other participants would move within the other dimensions to discuss different topics. Finally a list of criteria for sustainability would be compiled by each group and presented to the whole group.

2.6.1.2 Inside-out

In the first week of phase one participants engaged in workshops to promote self awareness and self reflection, while becoming acquainted to each other and building trust within the group. Initially in groups of four, each participant completed a Coat of Arms; a drawing exercise aimed to present oneself to the group. The Coat of Arms was divided in four sections, which are the following:

1. This is me
2. This makes me concerned
3. Why I choose Challenge Lab
4. This makes me happy

Once drawn, each participant would illustrate the outcome to one colleague, who would then use it to introduce the other in front of the whole group. Consequently, participants attended a workshop led by *SelfLeaders* concerning self-leadership. The workshop held various exercises and aimed to instill trust and openness within the group and to acquaint the participants with the concepts of inner-motivation, self-determination and value-driven leadership. Two questionnaires were presented where students had to identify their values. In smaller groups the participants shared with each other the values of choice and the reasons behind their choices. The exercise aimed to practice active listening. As the thesis were written in pairs, the aim was to combine students with complementary skills; these exercises aimed to help the students understand who they might would write their thesis with.

2.6.2 Step 2: The current situation

The aim of step 2 was to identify the current situation in the region. This was achieved through outside-in and inside-out perspectives, namely literature review and stakeholder dialogues.

2.6.2.1 Outside-in

The present situation was analysed adopting the multi-level perspective as of Geels (2005) through an understanding of the landscape, regime and niche. In order to

enter the system, leverage points would be identified, namely current projects in the region and city of Gothenburg, and investigated in order to find ways of intervention (Meadows, 1997). The Challenge Lab also took into consideration current global trends and put them in relation to the current situation.

2.6.2.2 Inside-out

Three stakeholder dialogues were organised with the following themes: Mobility, Urban Future and Circular Economy. Each dialogue brought together a mixed group of actors from academia, the public and the private sector, to hold talks about various topics. The dialogues took place in a fishbowl setting, where two concentric circles were set; stakeholders and a limited number of students sat in the inner circle. An outer circle of participants from the Challenge Lab would listen and take note, and invited to participate with new questions in the middle of each session. A list of questions was prepared by the students before the dialogue to set an initial framework for the discussion. After the dialogue each of the participants in the inner circle was invited to give feedback of the experience. Students would then reflect on the notes and the feedback to prepare for the next dialogue session.

2.6.3 Step 3: Envision a future situation

After the dialogues, participants of the Challenge Lab would gather the information acquired from previous steps to start identifying more detail relevant ongoing processes in the region. Thought the application of the multi-level perspective and stakeholder dialogue methodology, the participant would work towards finding sustainability solutions. The process was iterative and aimed to narrow down on few topics within Urban Future, Mobility and Circular Economy. For each topic, the aim was to identify main stakeholders, ongoing processes and point of intervention.

2.6.4 Step 4: Finding strategies for sustainability

The last step of phase one aimed to find strategies to achieve a future sustainable scenario starting from the current situation. This was achieved through a research question and a research project. From the findings, students were asked to pair up according to their personal interest. To achieve this, smaller groups were formed to carry on further research that would help the participants to refine and develop the information gathered from the previous steps. Finally, research groups of two were formed and research questions were formulated; each team would then define the project further according to their personal interests, study backgrounds and personal strength.

2.7 Results

This section describes the results from the first phase of the Challenge Lab and puts them in relation to the used theory and methodology, leading to the found research questions.

2.7.1 Sustainability Criteria

The first step of the Challenge Lab was to define a unified criteria for sustainability. The process began with an analysis of the previous years' students criteria in smaller groups in the four main topics, *well-being, societal, nature* and *economy.* The groups were switched to bring in different perspectives and ultimately the results were discussed, ultimately leading to the following criteria described in Table 2.3.

Table 2.3: Sustainability Criteria defined in the Challenge Lab 2017

Field	Criteria
Well-Being	- Everyone should have the right to human basic needs (subsistence, protection), such as health, security, food, water, sanitation, recreation, shelter, energy - Human life should fulfil psychological needs, such as affection, understanding, participation, idleness, creation, identity - Everyone should have the equal opportunity and freedom -to choose or to opt out-to express one's identity-to define and pursue their own goals, objectives and commitments,without limiting others' freedom or harming others
Societal	A sustainable society is a system of individuals built upon the following criteria: - Empowerment - Equity & Justice - Trust (such as between individuals, transparency) - System for well-being (maintain access to food, medical service, support & safety) - Openness to Development and Novelty
Nature	- Substance* emission: Nature is not subject to systematically increasing concentrations of substances. (*a species of matter of definite chemical composition) - Substance extraction: Substances are not extracted in a way it disturbs the balance of natural cycles. - Ecosystem balance: Exist in harmony as one system, enabling ecosystem services and biodiversity.
Economy	The economic system is an instrument that enables the other criteria, to be met efficiently and effective in such a way that: - Resources* are used indefinitely non-depleting. - It ensures a fair distribution of resources* - It is resilient to disturbance and disruption and is flexible enough to adapt to changing conditions - It facilitates transparency and trust *Resources include natural and man-made.

The hereby defined criteria marked the basis for all future tasks in the Challenge Lab.

2.7.2 Self Leaders

Another major part of the Challenge Lab was the identification of personalities and values, which ultimately were used to find the thesis pairs. For this, a day-long workshop *SelfLeaders* was introduced. During this workshop, the personal values of each individual were analysed through SelfLeaders developed system. Hereby, every individual had to self assess their own values out of a set of 106 values in three different stages (*Foundation, Self-fulfillment, Greater good*), which would then be used in active listening situations. After the assessment, pairs of two, met for sessions of 30 minutes, where one was the *storyteller* and the other the *active listener* for 15 minutes each. Hereby the focus lay on the aspect of listening and understanding each other, similar to what Isaacs (1999) described.

2.7.3 Dialogues

In order to find processes with momentum in the areas of *mobility, urban futures and circular products*, three dialogue sessions with stakeholders from the region were executed. The participating stakeholders are described in Table 2.4.

Table 2.4: Dialogue themes and Stakeholders involved

Dialogue Theme	Stakeholders involved
Circular Products	West Swedish Chemistryand Material cluster Innovation and Chemistryindustries in Sweden Chalmers Industriteknik Chalmers University of Technology
Urban Futures	Framtiden AB Göteborgs stad - Kretsloppoch vatten YIMBY Älvstranden Utveckling AB Chalmers University of Technology
Mobility	DenCity RISE Viktoria Göteborgs stad -Trafikkontoret YIMBY Chalmers University of Technology

Dialogues were executed in accordance with the theory described previously in this chapter. Each dialogue took part over a duration of around 3 hours with a break of 30 minutes in between. This break had also the option to mingle a bit with the stakeholders and get additional information and contacts.

2.7.4 Research Question

After having identified potential leverage points, the next step was to bring in the perspectives of the students of the Challenge Lab. In this process, the students divided into smaller groups and identified the issues resulting from the stakeholder dialogues.
This process was supported by recurring presentations and discussions about the current status of each group in front of the large group. The thesis pairs were found with the help of the Challenge Lab facilitators and individual as well as pair talks to see potential to work together. The research question for this thesis is one result of this process, although it has to be said, that even after the initial definition of the question, changes and adaptions were still possible and have been taken place. Since the topics of the Challenge Lab are focused on current issues in the region and stakeholder involvement, the approach to work was chosen to be rather flexible.
In the end, the following research question was identified, that is also the foundation for the next chapters of this thesis:

How can soundscape and pedestrian access be improved and implemented in planning processes in the City of Gothenburg?

3
Phase 2

The chapter illustrates the second phase of the thesis process, which is based on knowledge acquired in phase one as well as interviews and literature research.

3.1 The Societal Problem

Soundscape has gradually become an important aspect of planning our cities since it has become evident, that a healthy soundscape, e.g. less noisy cities, contribute to a sustainable city life (Basner et al., 2014). At the same time, there is a direct connection between the walking behaviour of pedestrians and soundscape (Maculewicz, Erkut, and Serafin, 2016).
The impact on society can be measured and investigated in two parts, the cost of a weak soundscape (noise) and the impact of walkability and weak access to areas of the city. In this section, both impacts are described in detail.

3.1.1 Cost of Noise

Noise from different sources (e.g. traffic, population crowding, construction, etc.) evidently increases stress and impinges on other health related issues (hearing loss, nausea, burnout), while decreasing the quality of life of the exposed inhabitants (Basner et al., 2014). *Trafikverket*, the Swedish governmental agency responsible for traffic planning and administration, researched the issue of the societal cost of noise and found, that the cost of noise related issues in society in Gothenburg alone is around one million swedish kronor every year. Additionally 19% of inhabitants of Gothenburg are exposed to noise levels higher than 55 dB(A) (2014), which is more than EU directives allow (Västsvenska Paketet, 2016)

Overlooking the issue of noise can increase the number of exposed inhabitants and thus increase the cost for society to deal with the issues following this.
Secondly, human interference into the soundscape may affect the ecosystem balance of animals living in the area. Noisy environments have evidently negative effects on animals such as birds and shall not be forgotten (Shannon et al., 2016).

Thirdly, sound in studies is usually focused on the negative impacts such as noise and therefore noise reduction, but the quality of life aspects or a good soundscape is often forgotten in research. This leads to a rather negative perception of sound studies in research, planning processes and the general public. With this in mind, it

is generally difficult to recommend the positive impact of soundscape as a tool for quality of life instead of dealing with noise reduction only (Estevez Mauriz et al., 2016).
Figure 3.1 illustrates the thought process of the connection of soundscape in society and the value it can give, but also the problems it can cause. In this Figure it is visible that the main problem points, marked in red, are knowledge gap, cost, priorities and noise pollution, which are all interconnected. Additionally, what could improve the situation are, marked in green, reputation or popularity of a good soundscape project, the UN sustainability criteria and values (the values we base our society on). All of these issues are interconnected and it is important to understand their connections in order to find solutions. On the left side it is visible that three questions are defined, *why bother?*; *why is it a problem today?* and *what are the factors influencing sound?*, which all are related to the soundscape situtation. The questions are giving guidance about the problems, but also about potential solutions to reduce the negative aspects. The mindmap itself shows relations and which areas influence each other and what other areas are to be considered such as the diversity of a society by integrating individuals with disabilities that can benefit from a positive soundscape.

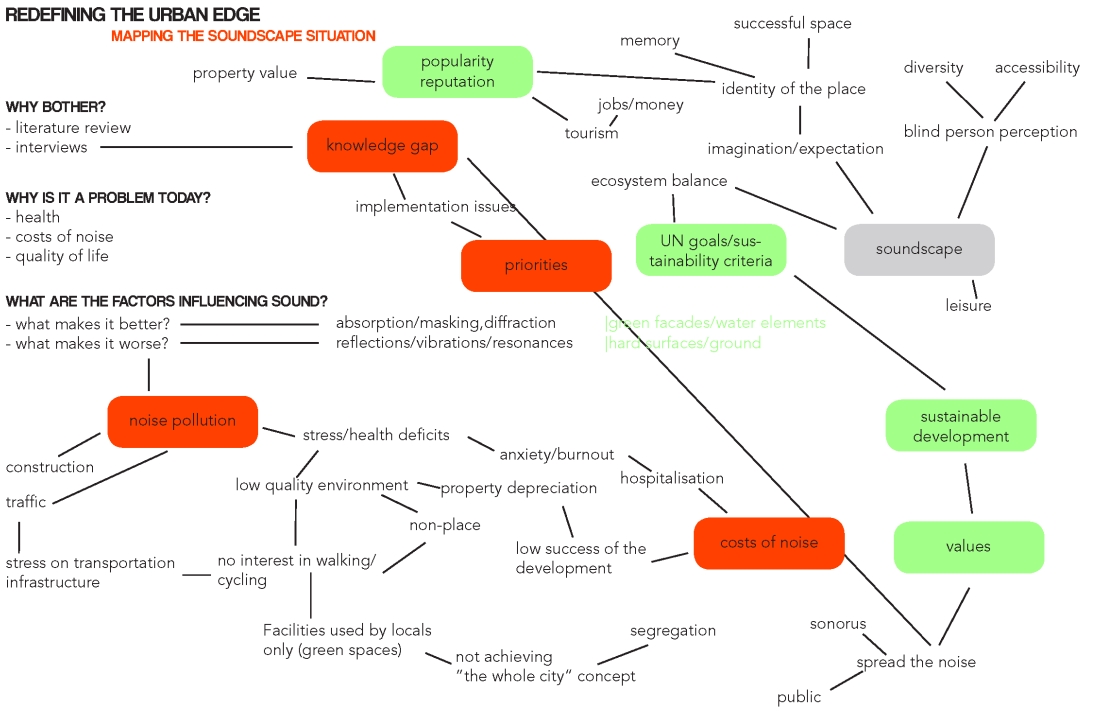

Figure 3.1: Mindmap about the connection of Soundscape in society and the problems or benefits it can cause.

3.1.2 The importance of Pedestrian life

As discussed in *subsection 3.6.2*, a well connected built environment allows movement of people within its districts and limits spatial segregation. From a spatial perspective, an equitable city is one where inhabitants can move freely and have access to equal services regardless of where they live (Gehl, 2010); this includes recreational areas and public space, as well as access to public transportation. In the 1960s and 1970s car industry grew and vehicles started populating cities; in those years only two types of street existed, namely traffic streets and pedestrian streets. At the same time many new developments were built where pedestrian and traffic routes were completely separated. (Gehl, 2010) The idea leading this kind of layout was to create a safe and secure pedestrian environment, while allowing car traffic to flow efficiently through the city and to speed at its full potential.

Figure 3.2: National Theatre, South Bank (1976) by Denys Lasdun

These kind of developments revealed to be unsuccessful nevertheless, as pedestrian traffic tend to choose the fastest route and not the designated car-free route. Also, the absence of traffic in the evening and night raised safety and security concerns, as the overlooked spaces would favour antisocial behaviours. Some positive examples also exist, one of which is the National Theatre in London South Bank.

Figure 3.3: National Theatre by Denys Lasdun after the pedestrianized ground level

The National Theatre is a good example for successful regeneration of public space and restoration of pedestrian life. Built in 1976 by Denys Lasdum, the development faced a renovation to activate its ground level and to attract pedestrian life to the river bank.

Figure 3.4: National Theatre by Denys Lasdun after the renovation and pedestrianised ground level

Alongside limiting traffic of vehicles in the area, the project also implemented programs happening throughout the day and a mix of businesses with different opening hours.
Oldenburg (1990) states that in a healthy society people need access to places other than home and working space; this places are called third places. Third places are where public life happens; they are usually informal places where people from different groups tend to mix and interact with each other. Places where conversation happens can be part of this third realm. People playing a game that need conversation will create the prerequisites of a third place, while a room with people playing video games does not make a place of this kind. Another informal third place could be a buss stop or a bench where people might initiate conversations with each other. Since conversation is one of the main prerequisites of a third place, sound qualities of the latter are very important, as a noisy environment would not allow such interaction to happen.

Urban mobility is changing. The dramatic reduction of parking lots, along with the increase of pedestrian and bicycle networks aim to change how people move in the city. As people are expected to commute more via public transportation the time spent in public spaces such as streets, parks and stations will be likely to increase. These connective spaces will increase in importance and their qualities will need to be rethought. One can argue that as automotive industry invests in improving sound qualities of the interior of their vehicles to improve passengers' well-being, so will cities need to invest in the soundscape of public spaces for commuters and inhabitants.

3.2 Research Objectives

In order to conduct the research described in phase 2, goals and objectives of the research need to be defined. Such goals and objectives guide the analysis and development of the project and finally enable the outcome to be focused on specific targets. Table 3.1 shows the objectives defined for this thesis. There are three main goals which have been connected to more detailed objectives. *accessible & inviting walking routes*, *reducing the noise (SPL)* and *preserving Soundscape*.

Table 3.1: Research Goals and Objectives of Soundscape and Walkability (adapted from Costa (2014))

Goals	Objectives.
Creating accessible and inviting walking routes	- Ease of movement, a welcoming environment - To support diversity (user groups, program, etc.). - Creating continuity and enclosure (Safety) - Avoiding spatial segregation - Benefit for the whole city (Supporting equitable environments) - To support local economy (small businesses).
Reducing the noise (SPL)	- to ensure health. - to ensure possibility of conversation/interaction between inhabitants. - to ensure social integration between inhabitants.
Preserving Soundscape	- design a playful and interesting environment for the inhabitants. - make it easier to engage in conversation. - make the public spaces more attractive for visitors.

3.3 Hypotheses

After defining the research objectives, specific hypotheses need to be defined in order to be able to conduct the research. In this thesis, the following hypotheses are identified and represent the foundation of the research:

- Soundscape is often mistaken for noise pollution;
- Sound pressure level can cause health deficits, therefore is linked to wellbeing;
- Soundscape has an impact on walkability, as it influences pedestrian circulation and presence in the space;
- Walkability and Soundscape are understood by the stakeholders involved, who have clear plans to address the two;

3.4 Methods

In this section we are going to illustrate the method used in our research work. As shown in the diagram figure 3.5, the process can be divided in different parts where different methods were used. Firstly, an extensive literature research took place which was aimed to identify the case study, current best practices in both soundscape and walkability as well as give insight into Swedish and European regulations. Additionally, stakeholder interviews took place with relevant stakeholders from the region of Västra Götaland.

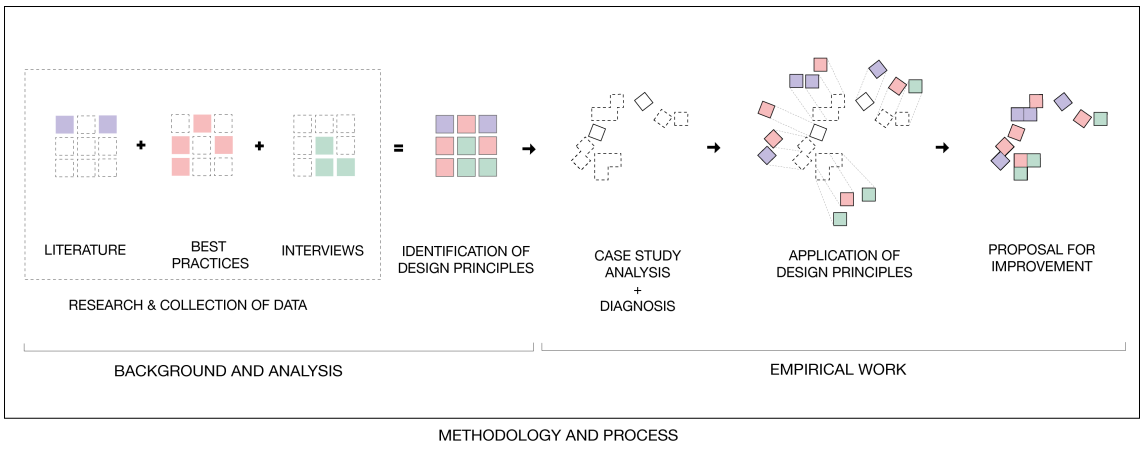

Figure 3.5: Methodology and process. *author's work*

The interviews were conducted in a semi-structured way, asking the stakeholders freely about the their perception of the topic and their needs and proposals. This was done in order to get answers as uninfluenced as possible towards the topic of this thesis. The criteria for the selection of the interviewee are the following:

- Involvement in the RiverCity project
- Interest shown (in soundscape and walkability)
- Availability

Among the interviewees were stakeholders from the major planning agencies in the city of Gothenburg such as Stadsbyggnadskontoret, Trafikkontoret and Trafikverket, but also from research institutions such as Chalmers University of Technology and Johanneberg Science Park, which represents the collaboration between the city of Gothenburg, Charmers University and private enterprises in the region. The main topics of the interviews are shown in Figure 3.24.

Table 3.2: Institutions that were interviewed during the process

Institution	Reasoning
Stadsbyggnadskontoret	Main authority for city development and planning
Trafikverket	Main authority for infrastructure across borders
Chalmers University Of Technology	Research in Soundscape
Johanneberg Science Park	Research in Controllable Urban Soundscape
Älvstranden Utveckling AB	Responsible for some of the building sites investigated

Additionally, a Lynch analysis took place in order to identify elements that characterise the site. The method aims to convey the readability of the site from a pedestrian point of view. Adding to personal experience, paths from data collected from a web mapping service were collected, which allowed to plan routes on foot or cycling given two points on the map. The Lynch method has been adapted to fit the research objectives.

Furthermore a SWOT analysis was realised to have a preliminary understanding of the investigated area. This method focuses on the strengths, weaknesses, opportunities and threats of a project. In order to understand more about the area, the analysis was executed from a neutral viewpoint by using literature and planning reports by the City of Gothenburg as well as critical articles towards the development (Stadsbyggnadskontoret, 2015),(SpaceScape, 2014), (Estevez Mauriz et al., 2016).

3.5 Case Study Rationale

The city of Gothenburg is growing and the municipality has made long-term plans that will reach completion in 2040. The aim for the coming future is to connect the urban fabric across the *Göta* river, which has divided the city structure limiting the city centre's growth to the north. An expansion towards the North of the river would connect the city core with Kvillebäcken, Lindholmen and Backaplan. One of the areas that first will be transformed is Frihamnen, the old city port. The plan for Frihamnen is to create a mixed development of housing, office, retail and leisure facilities that will attract people throughout the day; it will house 15000 inhabitants and will add thousands of jobs to the city. The first phase of the development will be completed in 2020, when Gothenburg will celebrate its 400 years. One of the main attraction to the area will be a new urban park that will connect to the water. Following this momentum we are going to take Frihamnen as a case study of our thesis research and investigate how walkability and soundscape are addressed.

3.6 Definition of Soundscape and Walkability

This section, based on literature review, aims to identify a definition of soundscape and walkability, which may fit our research purpose.

3.6.1 Soundscape

Soundscape was first defined by Schafer (1977) with three key aspects, *key notes*, *sound signals* and *soundmarks*.
Key notes are all elements that make up an audible environment. This includes all natural sources such as trees in the wind or similar. *Sound signals* are man-made audible signals that are used to indicate specific information, such as warning signals. *Soundmarks* are unique audible environments that can be both natural and man-made, such as the sea organ in Croatia, which utilises man-made architecture to create sounds made by natural waves. Keeping these three key aspects in mind, soundscape is defined by all audible information, both positive and negative. Therefore soundscape planning can be a powerful tool to define the audible environment of an area in a positive way, while at the same time reducing unwished noise pollution.

Following the information extracted from the literature review, a good and healthy soundscape can be defined by the following objectives:

- negative sounds such as traffic noise and similar has to be under 55 dB(A) (World Health Organisation, 2016).
- the sound environment is able to foster use of spaces (Gehl, 2010).
- a conversation can take place without the need to shout or speak louder (Gehl, 2010).
- small sounds in the environment like birds singing can still be heard (Shannon et al., 2016).

- animals living in the environment cannot be disturbed significantly (ecosystem balance) (Shannon et al., 2016).
- it provides with a sound environment that is playful and enable the inhabitants to imagine the place without seeing it (e.g. disabled inhabitants) (Gehl, 2010).

Figure 3.6 shows the different categories of soundscape, that can be part of it. They are consistent with the theory of Schafer (1977) that every audible object is part of our soundscape and can be perceived differently.

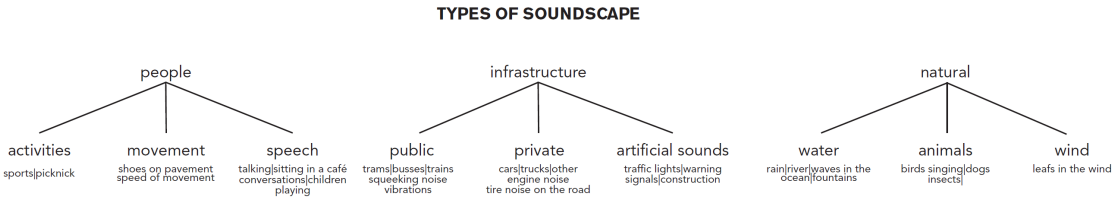

Figure 3.6: Visualisation of the types of Soundscape in three categories (adapted from Raimbault and Dubois (2005)).

3.6.2 Walkabilty

Walkability is the measure of how accessible and friendly an area is to walking. It has health, environmental and economic benefits; it includes the quality of pedestrian facilities, roadway conditions, land use patterns, community support, safety, security and comfort for walking (TDM, 2014). As it is mentioned in traffic engineering, transportation planning, urban design, public health and sociology, walkability is a shared and complex discourse; many actors are involved in creating pedestrian networks and each own its own definition of it. To illustrate what walkability is and the major lines of thoughts in this context we will refer to the work of Hutabarat Lo (2009).

Walkability influences pedestrian flow and their movement and presence in the city. As it refers to the action of moving from a place to another place without the use of a motorised vehicle, such as walking, we can start by asking who are pedestrians and why do they decide to walk in the first place. As quoted in Hutabarat Lo (2009), the Compact Oxford Dictiorary (2006) identifies the pedestrian as a person who is walking rather than travelling in a vehicle. Walking is then an alternative to other ways of transportation, such as cycling, driving and using public transport. According to Hutabarat Lo (2009) pedestrians walk for three main reasons:

- To get to a destination (as commuting)
- Transferring from one mode of transportation to another (to transit from a car to a train for instance)
- To access destinations (at the end of a journey, getting into a building after parking the car for instance)

Walking is part of our nature as human beings, from when we take our first step as children, and part of our daily life as adults. While walking is a way to get from one point to another, it is also for other purposes; it is a way for other activities and interaction to happen, such as leisure and recreational activities (Gehl, 2010). Although natural to us, the cities we inhabit often do not support walking as much as car transportation. While in the US and in China and Thailand, car dependency is still very high, in Northern EU modernist planning of vehicle-dependent development declined in 1970s following the energy crises as well as the the aims to create smarter and more sustainable cities. Influenced by the excitement of the automotive industry, modernist planning favoured highways and fast movement of motorised vehicles. Distances were no longer an issue of concern, and as a result land-use changed accordingly. The spreading of low density developments, free parking and the creation of mass produced suburban areas, such as in the US, supported car-oriented lifestyles. Walking was not encouraged as distances between destinations were too long. The question of walkability was not asked as much effort was spent in achieving more dominant goals, such as vehicle flow. Post-modernist planning instead, focused more on non-motorised transportation, giving more thought to pedestrian life. Big investments and research have been carried on focusing on creating road networks and highways efficient for traffic, while defined criteria for walkability and pedestrian networks are still missing and further research towards understanding walkability factors and metrics is needed. (Hutabarat Lo, 2009).

According to the same author in fact, walkability is measured via criteria for performance used for motorised traffic analysis, which lacks to acknowledge the difference between vehicles and people. To understand pedestrian behaviour for instance is not enough to consider traffic flow, density, delay and speed. People are not "atomistic and antisocial entities" (**p. 151**; Hutabarat Lo, 2009) on the contrary their movement gets influenced by building form, land-use context, street connectivity, amenities or vitality (Gehl, 2010). The very basic requirement of a street is that it has to lead somewhere people want to go. The same is valid for pedestrian connections and bicycle lanes "You cannot make people use streets they have no reason to use" (Jacobs, 1961).

Referring to literature from various fields Hutabarat Lo (2009) illustrates that most authors consider land use and streetscape factors as influential in creating favourable environment for pedestrians and as directly related to the discourse of walkability. The factors identified by Hutabarat Lo (2009) are the following:

- Presence of continuous and well-maintained sidewalks.
- Universal access characteristics.
- Path directness and street network connectivity.
- Safety of at-grade crossing treatments.
- Absence of heavy and high-speed traffic.
- Pedestrian separation or buffering from traffic.
- Land-use density.
- Building and land-use diversity or mix.

- Street trees and landscaping.
- Visual interest and a sense of place as defined under local conditions.
- Perceived or actual security.

Walkability is greatly influenced by the perception we have of a given space. The experience of a space is influenced by how we arrive at it - wide and bright urban squares will feel even wider and brighter if we access them through narrow and darker streets, due to juxtaposition (Carmona et al., 2010). The visual-aesthetic dimension of urban areas is therefore important and needs to be considered. According to Jacobs (1961), walkability increases in urban centres if the facade of buildings provide engagement with passers-by on the ground floor, as in the presence of shops and other businesses along the sidewalks of a neighbourhood. Active facades add variation and visual connection, as well as a sense of curiosity which invite pedestrians to walk further. Moreover, the feeling of safety is increased as passive surveillance can influence people to walk through an area or not. Local surveillance is easy to provide and it does not require equipment such as CCTV cameras, which have been shown to deliver debatable effects on antisocial behaviours in general (Minton, 2009). As for Jacobs (1961), active facades on the ground floor increase the feeling of safety as one can be seen and heard in case of necessity. Consequently, Post-modern urbanism aims for mixed use development, as a lively street aim to be active throughout most of the day.

In 2006 the World Bank commissioned a study to devise a walkability index (GWI), "which would rank cities across the world based on the safety, security, and convenience of their pedestrian environments" (Krambeck, 1999) which is illustrated in table:3.3. The purpose of the study and the index was to generate awareness of the importance of walkability. A low score in GWI (table:3.3) combined with the absence of accessible pedestrian routes might lead to inequality. Low-income and minority groups suffer the most from disconnected neighbourhoods that do not encourage social mixing, access to services, or free-movement. Segregated neighbourhoods rank low in desirability, which can discourage private investment, and new movers. Spatial segregation can cause no-go zones in the city where people feel unsafe to walk through, especially at night. Although the absence of street life and pedestrian circulation is not causing the rise of antisocial behaviours directly, it is linked to decreased level of trust between people and consequently a lost sense of community(Jacobs, 1961; Gehl, 2010).

Walking also allows a greater engagement with space than car usage. From literature we learn that the experience of a space is accessible through movement in space and visual legibility (Carmona et al., 2010), however the visual dimension needs to be integrated in a multisensory experience and cannot be isolated as when driving in a vehicle. As a result car dependency can have alienating effects on people as it allows movement through places without providing engagement with the surroundings.

Table 3.3: Components of the Global Walkability Index (GWI)

Component	Variable
Safety and security	Proportion of road accidents that resulted in pedestrian fatalities
	Walking path modal conflict
	Crossing safety
	Perception of security from crime
	Quality of motorist behavior
Convenience and attractiveness	Maintenance and cleanliness of walking paths
	Existence and quality of facilities for blind and disabled persons
	Amenities, e.g. coverage, benches, public toilets
	Permanent and temporary obstacles on walking paths
	Availability of crossings along major roads
Policy Support	Funding and resources devoted to pedestrian planning
	Presence of relevant urban design guidelines
	Existence and enforcement of relevant pedestrian safety laws and regulations
	Degree of public outreach for pedestrian and driving safety and etiquette
Source:Hutabarat Lo (2009) and Krambeck (1999)	

3.7 Best Practices

This chapter aims to collect existing examples of successful practices to improve walkability and soundscape in cities. The following case studies have been selected because they aim to create inviting public spaces that are less harmful for health, and more accessible to the society.

These best practices regarding sound can be categorised into two main fields, which are sound masking and planning strategies. In terms of sound masking, there are two major examples given below.

The first example consists of pocket parks in the centre of cities, that work as small kinds of oasis, which provide a green space on a small area. Especially in denser cities, these parks are used. One example of a *pocket park* is Paley Park in New York City, located at 3 East 53rd Street between Madison and Fifth Avenue, which implements the idea of using green facades as absorbers while having a water fountain as a visual and acoustically interesting element. Hereby, the water fountain

spreads all around one wall of the park and generates a relaxing sound, that masks the traffic noise of the busy streets (The Cultural Landscape Foundation, 2016).

Another example is the busy city of Cairo, Egypt, which is facing incredible sound pressure levels on one of its main squares, Ramses square. Investigations show that the square and other areas of the city are facing an average of around 80 dB(A) during daytime (Kamal and El-Rahman, 2015),(Ali and Tamura, 2003), which is far beyond regulations. Rehan (2016) has developed an approach on how to deal with the issue, which is mainly by restructuring the square with different kinds of water structures that mask the sound similarly to the pocket park in New York.

The second category of best practices involves planning strategies where soundscape is included in the very beginning of an urban planning process. Urban sound planning can improve the success of spaces and reduce the cost of a later adaptation such as in masking strategies. The first example is the National Park Service in the United States of America. The administration takes care of soundscape in the Yosemite National Park in order to ensure a healthy sound environment for the animals living in this area (National Park Service, 2016).

Another example of best practices in terms of soundscape planning as part of the urban planning process was introduced by Mags, Davies, and Bruce. (2009). In their paper they introduce a recommendation of a structure of how urban sound planning can be executed. In their proposal, the planning process is involving soundscape while concentrating on the roles of the developer, architect and local planning authority. They identify different steps where tools such as soundwalks for the involved parties or simulations can be implemented to give advice of sound planning into the process. Additionally, these tools help the planners to verify their planning proposals in the process itself. However, the proposal is mainly focussed on the procedure in the UK and adaptility to other areas has to be evaluated.

Walkability best practices are strongly related to planning of public space and road networks, which is usually included at an early stage in planning processes. According to Hutabarat Lo (2009) although, while designing road networks pedestrian traffic is compromised because planners tend to prioritise solving other goals. Therefore one can argue that not all public spaces are equally successful and accessible, sometimes bringing little to no benefit to the areas they should serve. Badly designed public areas can in fact negatively influence a neighbourhood, facilitating antisocial behaviours and creating no-go zones where people do not feel safe to walk (Jacobs, 1961). From 1960s, post-modernist planning ideas made clear that there is not one formula that fits all cases, as each area is different from another as the variables are not easily comparable. Nevertheless we could divide best practices in early planning practices, and later interventions of urban regeneration. In this thesis, the best practices referring to walkability are categorised in order to extract design principles that can be applied to our research scope.

"ZUS works with a belief that every place has the potential to become unique and thrilling" (Zus, 2017 http://www.zus.cc)

Lunchtsingel is a wooden pedestrian bridge of 390 m, designed by the studio ZUS (zone Urbaines Sensibles) part of a bigger project of generation in the city of Rotterdam. The project known as Schieblock, is an urban laboratory and the bridge connects the space with other fragmented parts of the city centre. The Luchtsingel connects Rotterdam North to the center and revitalises a forgotten area. The bridge was partly crowdfunded and also supported in the development by the Rotterdam City Initiative 2012, a platform that brought together municipality, citizens and investors. The project is relevant because of the aim of reclaiming a dismissed and underused part of the city for its social agenda and because of its architectonic features.

Made of a steel structure, it is cladded with timber. We can assume that the cladding was chosen for its cost, lightweight but also for its acoustic properties. The bridge lays between high rise concrete buildings and crosses a railway (Figure 3.7); by cladding the steel structure with wooden battening, a perforated resonator can be created that dampens medium-to-high-pitched sounds of the train passing through the site as explained (urbanID 2015)

Figure 3.7: the Luchsingel bridge crosses a busy road and a railway, photo by urbanidentity.info

Figure 3.8: wayfinding strategies to the Luchsingel by ZUS, photo by urbanidentity.info

One example of accessible bridge in the city of Gothenburg can be found on Dag Hammarskjöldsleden. The bridge is constructed in reinforced concrete and connects the area of Slottsskogen with Ängagärden. It is attached to a protected bike-lane that runs along the highway and leads to the city centre.

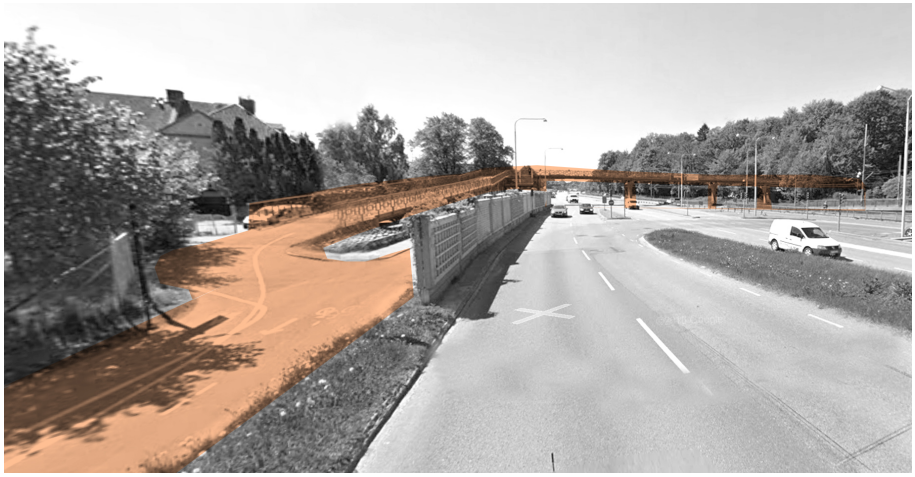

Figure 3.9: example of accessible pedestrian bridge in Gothenburg

Figure 3.10 shows the fencing applied along King's Cross boulevard during construction work. Similarly to Frihamnen, King's Cross area in London has been going through a big urban development. The area is a busy centre of the city, which

had to be fully functional and accessible alongside the construction work. King's Cross Boulevard is the main artery that cuts through the development and leads to St. Pancras station. In the image is visible how the hoarding fulfil more functions at the same time as it defines a clear route due to its consistent appearance; at the same time it adds aesthetic qualities to the environment. In this case the surface is covered with vinyl to look like a hedgerow, which gives the illusion of some depth. Construction hoardings can be a versatile tool to create pleasant and engaging environments in the case of prolonged construction work as shown in figure 3.11. As for Carmona et al. (2010) and (Gehl, 2010) it is important to include local inhabitants through participation strategies, which can be in the form of illustrative material or temporary placemaking strategies (fig:3.11)

Figure 3.10: Visual barriers applied to King's Cross Boulevard in London, under construction work. Available at http://c8.alamy.com (modified by the author)

Along the path, trees and some street furniture are added, such as bike racks and seating areas. These combinations aim to create a pleasant background, which also adds variation while walking along the boulevard. The hoarding though does not function as visual barrier only; it aims to engage the people passing by, therefore perspex window panels are added in strategic points to allow pedestrian to look at the work in progress; these kind of panelling also allow some light to get though and this is especially important in narrow streets. Also, some panels are informative about the area and its history.

Figure 3.12: Inhabiting King's Cross Boulevard development site. Available at www.kingscross.co.uk

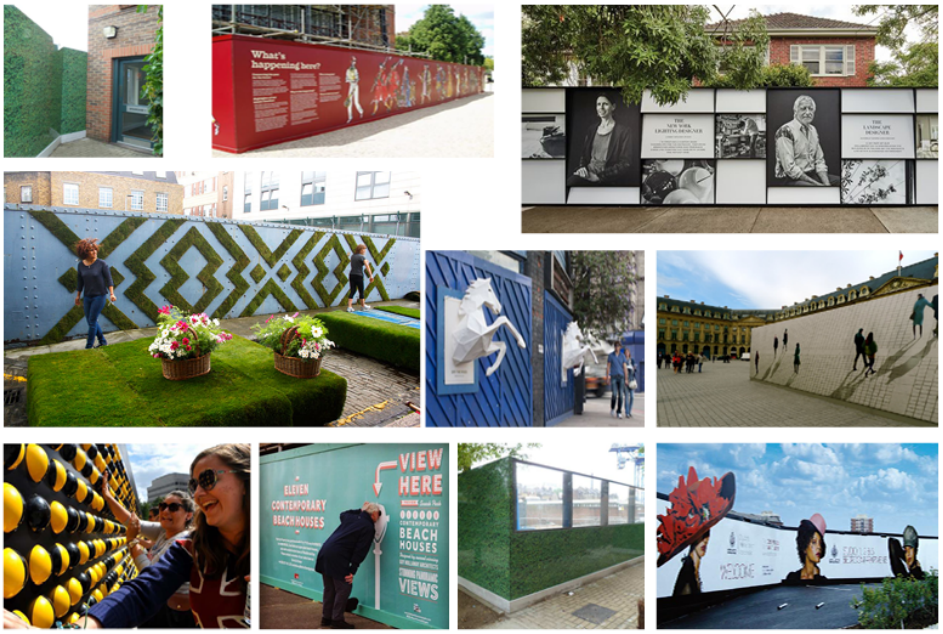

Figure 3.11: example of construction hoardings. Composed image modified by the author https://s-media-cache-ak0.pinimg.com/originals/d3/73/a3/d373a31a8fe9a694c4c84e5ded4fcbd0.jpg

Figure 3.12 shows people engaging with the site in various ways, such as having lunch on one of the benches or swimming in the pool set up for a temporary event during the summer. This example shows how it is important to keep the site relevant and engaging for its future success.
Table 3.4 shows a short summary of the projects discussed in this chapter and why they are important for the research conducted in this paper.

Table 3.4: Best Practices

Category	Project	Location	Rationale
Soundscape Utilisation	Paley Park	New York, USA	Masking of the noisy environment in one of the busiest places of the world to create an oasis for the people living there.
	Ramses Square	Kairo, Egypt	Utilisation of a waterwall as masking of a busy street to generate a nicer sound environment and at the same time more visual appeal.
Planning Strategies	Yosemite National Park	California, USA	With its inclusion of Soundscape as part of the integral planning for sustainability, Yosemite National Park shows the importance of it.
	Soundscape beyond noise control	Salford, UK	Design proposal for utilisation of Soundscape early in planning processes to improve quality of life and make the process easier.
Pedestrian Bridge	Luchtsingel	Rotterdam	Regeneration of underused space. Relevant for its acoustic qualities and development process.
Overpass	N/a	Slottskogen, Gothenburg	Accessible crossing over infrastructure. Connection to bike lane and walking route protected from traffic.
Temporary Pedestrian Linkages	King's Cross Boulevard	London, UK	Examples of placemaking and visual treatment of construction works in regeneration projects
Ground treatment for soundscape	Museum Park - OMA	Rotterdam	Ground treated with loose gravel and surrounded by trees, the park allows visitors to focus on the sound of their own steps creating a relaxing atmosphere
Material combination for soundscape	Sjövikstorget - Thorbjörn Andersson, Sweco architects	Stockholm	The floor of the square is designed alternating different materials and changing height in specific parts to attenuate sound levels and provide more space to different uses.
Moulding Terrain	Elisabethenanlage - Vogt Landschaftsarchitekten	Basel, CH	The park is in close proximity to an high trafficked street. It applied dense vegetation with tree belts, added to the variation of the purposed landscape.
Large Objects	Limmatplats (tram stop and kiosk) - Baumann Roserens Architekten	Zurich, CH	Six steel and glass cylinders with diameters going up to 10m spread and distribute traffic noise, reducing the perception of noise in the square
Art in public space and Water installation	Fontaine du carnaval - Jean Tinguely	Basel, CH	The sculptural fountain merges water elements and art in public space. It represents a landmark for the city and way-finding element as it helps people to orientate in the space. The variation of water sprinkles creates sound that is never monotonous. Water masks the traffic noise of the close by road.
Urban regeneration	Harbor Plaza	Suisun City, CA	Formerly negletted area of the city, the area is close to the water and has been regenerated through community engagement in the creation of an harbour park.

3.8 Design Principles for Walkable Soundscape

In this chapter, the design principles based on the literature review and best practices are summarised. Figure 3.13 illustrates the design principles that will be described in more depth in this section.

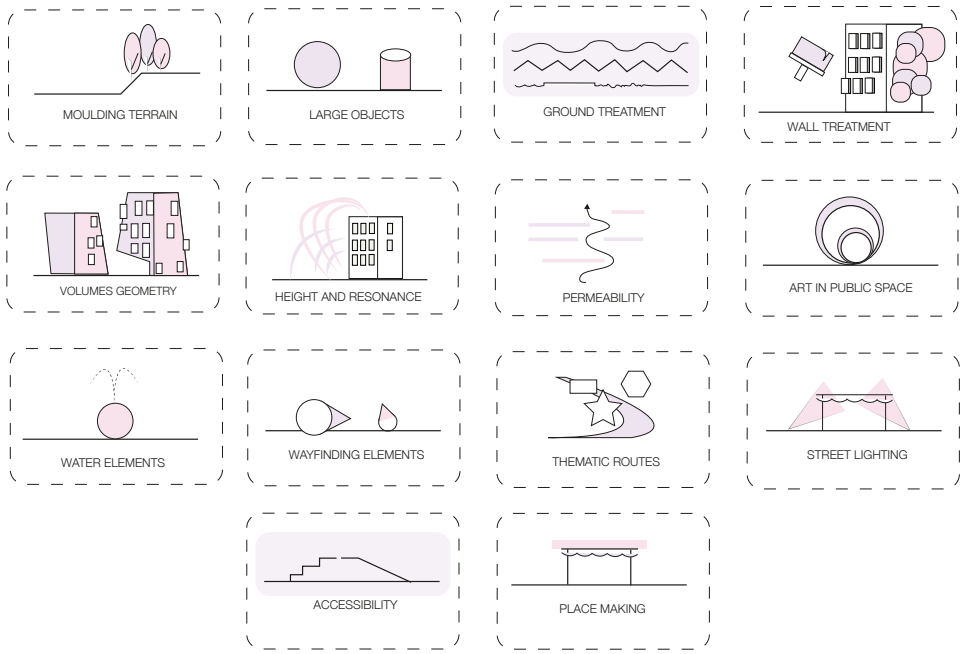

Figure 3.13: Collection of Design principles extracted from research.*author's work*

3.8.1 Ground Treatments

Acoustically hard and not porous ground surfaces such as concrete pavements and squares can reflect sound, increasing noise perception. Adding variation to the type of flooring materials used in a space will improve its sound qualities. Each material responds to sound in a different manner; it is known that hard materials tend to reflect sound more than soft ones; a grassy area performs acoustically better than one covered with concrete for instance. Grass and soil have the capacity to absorb sound. Ground treatments aim to reduce noise at its source creating artificial ground roughness, and introducing soft strips or patches(Hosanna, 2013). Materials like stone pebbles and bark chips perform very well in noisy environment as they create a masking sound when walking on them. These kind of masking sounds can be adopted and combined to create designed soundscapes that can have a relaxing effect on people. Buried resonators can also be applied. Resonators are hollow containers made of hard material that are layered under a street or pavement which subject to high traffic. The effect of a resonator depends on its cross-sectional area and length and on the container's volume. A formation of resonators buried under an acoustically hard surface can reduce noise levels. It is possible to combine acoustic resonators and porous asphalt; resonators have the capacity to attenuate

sound during propagation over the road surface, and reduce the sound amplification. The combination of the two materials can aim for a sound reduction up to 3 dB(A)(Hosanna, 2013). Floor treatment can also be helpful in creating way-finding paths in public realms. Strategies similar to the ones used to guide blind people in public space, floors can be improved with colours and patterns to lead people through the city.

3.8.2 Moulding Terrain

Modulating the terrain by creating height differences and slopes will create an impact on the sound quality of a space by screening off sound, filter it or reflect it (Maag, Kocan, and Bosshard, 2017). People will sense different sound experiences according to where they are standing, whether they are more or less sheltered from the sound source. Sloping terrain and niches can be integrated to create a more interesting soundscape experience and to add variation in a monotonous space.

3.8.3 Wall Treatments

Walls and floor behave in similar way in terms of acoustics; as mentioned, flat surfaces reflect sound, can enhance noise and create annoyance, especially in areas subjects to heavy traffic. This is even more evident when two walls face each other in close proximity. To minimise this effect it is necessary to implement specific cladding materials that reduce sound reflection and that act as absorbers (Hosanna, 2013). Examples of wall treatments can be vertical gardens and green facades or softer cladding such as timber slat panelling. Walls made of irregular constructing elements such as stones of different size and shape perform acoustically better than even surfaces. Walls of this kind can be find in small medieval towns for instance (urbanidentity.info).

3.8.4 Volumes Geometry, Height and Resonance

General building shape has small impact on the level of noise, nevertheless design implementations on the lower grounds of the facade can improve the acoustic environment experienced by pedestrians. Findings from Estevez Mauriz et al. (2016) show how add-on small barriers, absorptive layers, and shaped balconies can alleviate exposure to noise that pedestrian are subject to in urban areas. The study also shows how setbacks in the facade can contribute to noise reduction on the street level up to 4 dBA.

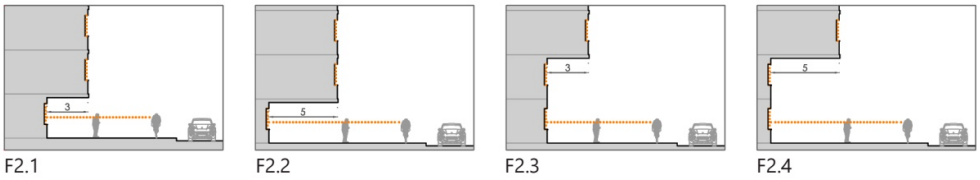

Figure 3.14: Example of study of the sound performance of building facades adding a setback. Source: Sonorus (Estevez Mauriz et al., 2016)

3.8.5 Water Elements

Water fountains used in public spaces add several benefits. Moving water generates a relaxing sound that also masks traffic noise from busy streets. In hot weather, water element have a cooling effect as the water evaporates in the air and this gives the sensory effect of a lower temperature. As seen in Granary Square in London after personal observation conducted by the author, water fountains also become an engaging tool for passersby and especially families with children. The implementation can therefore be a successful act of place-making as it adds characteristics that people engage with and recognise.

3.8.6 Way-Finding

As cities can be confusing and difficult to navigate, it can be necessary to add features that help orientate users in the space. These features are widely adopted in public buildings like airports, and on public ground like pavements and street crossings; they can include visual signage, but also rough and tactile surfaces and sound devices for people with disabilities. Way-finding implementation although can be more or less integrated in the environment as they can be an architectural quality, such as materials that give the feeling of continuity and flow, or being elements and street furniture that is added on a later stage. Each urban street should be designed as an artistic unit in order to provide pedestrians with a sense of discovery(Bohl, 2002). Scale and proportions play an important role here as they help people to relate to the space and easily orientate. On a macro scale, one main difference between town centres and suburbs is that the latter often lack identity and continuity. In suburbs, streets tend to be wider than the height of the buildings that line them, not allowing a sense of enclosure hence little engagement with the space. It is also more difficult to cross, and larger distances and lack of human scale elements make it difficult for pedestrians to know where they are directed. (fig.3.15). In urban centres, streets reveal where they are leading to through the use of scale and materiality, and when leading to prestigious buildings they tend to be wider. Way-finding consist of creating a legible path that help passers-by to navigate the space successfully, and this can be achieved through many techniques according to the context and socio-cultural references.

3.8.7 Large Objects

Large object such kiosks, bus shelters or pillars and columns minimise the sound annoyance in public spaces by interfering with the propagation of sound waves through the space. This is especially true for round surfaces or arched forms. Additionally, these objects add character and a sense of place that will help people navigate the space.

3.8.8 Street Lighting

Well lit streets give a feeling of safety and create a sense of continuity that will encourage pedestrian movement also during night hours. Although appreciation for the urban environment is multistory, visual experience can be said to be the primary (Carmona et al., 2010). Nasar (1998) found that people evaluated their environment with criteria that were broader than visual sensory. Given special attention are Upkeep/civilities and Order, which refer to places that seem inhabited and looked after, and that present coherence, legibility and clarity.

3.8.9 Place-Making

Urbanisation is an incremental process which can create problems such as uneven development and underperforming areas, traffic-dominated streets, little-used parks, and isolated or segregated neighbourhoods. Governance plays a major role in urbanisation and can hold back positive change more than money, infrastructures and ideas. Placemaking is not a new idea, and it goes back to Jacobs (1961) who aimed to change urban planning in New York in 1960s. Placemaking starts as bottom-up approach of urban governance and aims to inspire people to collectively reinvent a place in the city and make the heart of their community. It follows the idea that "the community is an expert" and that the focus must lay on the place rather than on a design.
Place-making is generally achievable through the following steps (Whyte, 1980):

- *integrate diverse opinions into a cohesive vision,*
- *translate that vision into a plan and program of uses, and*
- *ensure the sustainable implementation of the plan.*

From an architectural perspective, the "making of a place" is also the result of design choices; sight plays an important role in our everyday experience of the city and an aesthetically pleasing environment is more likely to be successful. From a sound perspective, many solutions that mitigate noise do also add to the aesthetic quality of a space and soundscape itself adds to the experience of a given place. Aesthetic values and sound qualities are of particular importance in outdoors areas intended for rest and relaxation as in city parks and recreational ground (Hosanna, 2013). Research shows how sound environment and scenery independently influence well-being and stress levels, impacting directly health levels and quality of life. Nevertheless, there

is the need to consider an environment as a whole in order to reinforce sense of place. Buildings, street furniture, landscaping and space need to be considered as a whole in order to create a coherent solution (Carmona et al., 2010). Successful places do not need to be extravagant, according to Carmona et al. (2010) in fact, successful urban environment are the simplest; wide sidewalks and active facades on the ground floors for instance, leave to the user room to walk safely and to engage with the surroundings (fig:3.15).

Figure 3.15: The suburbs compared to a town centre (Bohl, 2002)

Simple street furniture and multipurpose spaces also contribute to the success of a space as these additions support further engagement and some degree of temporary spatial appropriation.
From Bohl (2002) the architectural element that contribute to the overall sense of a place are the following:

- *Height of buildings*;
- *Scale and massing*;
- *The extend to which building are attached or detached from one another*;
- *The spacing between the building and the street*;
- *The proportion of windows, doorways, porches, and other feature*;
- *Architectural style*;
- *Material, finishes, and textures*;
- *Other characteristics of the buildings in relation to their environment that would create uniqueness, such as shadow patterns, landscaping, the location and entryways (fig.3.16), and also the response of the building to topography and weather*

While vision and aesthetic qualities prevail in our experience of the space (Carmona et al., 2010), our engagement with the space is a multisensory one that includes hearing, hence we identify additional elements for place-making, which are the following:

- Sound pressure levels (dBA);
- Soundscape;

Figure 3.16: A French building covered by an overgrown vegetation

3.8.10 Permeability and Accessibility

We define permeability as "the extent to which an environment allows people a choice of routes through and within its cadastral pattern" (Carmona et al., 2010). Cadastral pattern indicates the subdivision of land and therefore the network of streets that it derives form it.
Permeability is also related to accessibility. As urban design aims to make better places for people, these places are accessible when they are designed for all the possible users of the built environment (Carmona et al., 2010). Accessible environments are more equitable and therefore foster social sustainability and support integration in cities. Disability, age and socio-economic background can all influence how people use the space. The 'medical model' defines disability considering disabling factors on the individual rather than in society or in their environment. For the scope of this thesis we adopt the 'social model', which instead takes into consideration barriers imposed by the environment and society. This model emphasises how the environment disables the individual who has disabilities. Referring to the US-based Centre for Universal Design in Sawyer and Bright (2007), Carmona et al. (2010) defines the following principles for a barrier-free environment:

- Equitable - usable by people with diverse abilities and appealing to all users;
- Flexible - the design should cater for a wide range of preferences and abilities;
- Simple and Intuitive - the use of design should be easy to understand, regardless of experience , knowledge, language skills or current concentration level;
- Perceptible - the design communicates effectivly to the user, regardless of ambient condition or the user's sensory abilities;

- Tolerance for error - the design minimises the hazards;
- Low physical effort - the design can be used efficiently and comfortably with a minimum fatigue;
- Size and Space for approach use - appropriate size and space is provided for approach, reach and use, regardless of the user's body size, posture or mobility.

3.9 The Rivercity Vision: Case Study Analysis

3.9.1 Frihamnen

Frihamnen is an old port in the city of Gothenburg. The city is the biggest harbour of Scandinavia and Frihamnen is located on the north bank of the river Göta. The area was built in the 1920s as the most inner harbour on the river. It faces the city centre and resembles it in size. Currently in disuse, it will go through long-term plans of regeneration that will last until 2040 (Estevez Mauriz et al., 2016).

3.9.2 Analysis of the current Situation

In the planning processes of Frihamnen and the city of Gothenburg, different institutions are involved and have different fields of responsibilities one needs to understand. These are namely the city of Gothenburg and its' planning departments *Stadsbyggnadskontoret* (city planning office), *Miljöförvaltningen* (environmental planning part) and *Trafikkontoret* (traffic office). Apart from that there are institutions outside of the city's borders involved such as *Trafikverket* (traffic planning in the country) or *Västra Götalandsregionen* (the county's planning authority).

In this case, Stadsbyggnadskontoret has the main authority regarding the plans for the area of Frihamnen. This includes everything that is inside of the area such as building sites and situations of parks, but also the responsibilities to adjust these plans to the regulations given by the state. Since urban planning is not only restricted to one area at a time, connection areas such as streets and other traffic related issues are handled by Trafikkontoret, who have to work closely with Stadsbyggnadskontoret on these issues. Trafikkontorets main purpose is to work with the streets in the city of Gothenburg, while also making sure plans follow regulations. Streets and other infrastructure that is relevant for the whole country, and not only the city, is then under supervision of Trafikverket, who have the authority regarding railways and highways, which are also part of the plans of Frihamnen. Finally Miljöförvaltningen and Västra Götalandsregionen give advice in terms of environmental issues and long-term environmental strategies to the plans by Stadsbyggnadskontoret.

In this research, an analysis of the current situation, namely the planning for Frihamnen, in two major perspectives, soundscape mapping and a lynch analysis with walkability focus, was conducted. Additionally, information gathered from official documents and existing reports is shown in a SWOT analysis in Figure 3.17.

Figure 3.17: SWOT analysis of the current situation in Frihamnen.

3.9.2.1 Soundscape mapping

Current noise studies in the City of Gothenburg show generally high sound pressure levels around public spaces (Miljöförvaltningen, 2013). The Frihamnen development plan, an urbanisation project in the City of Gothenburg, such as the order of the construction sites, will increase the noise level for over 20 years in the area, making a comfortable life and usage of the public spaces such as parks impossible.
The area around Brunnsparken shows on average a SPL of more than 65 dB(A) in 2 m height above ground level (Stadsbyggnadskontoret, 2015) and including private and public transport such as trams. This is not a single case in the city, but moreover just an example of how public space all around the city is doing in soundscape. Current noise planning for the area of Frihamnen shows already values exceeding 55 dB(A) in places like the Stadspark at Kvillepiren, as well as the park area of the sauna, that is planned to go up to 55 dB(A) in SPL. ((Stadsbyggnadskontoret, 2015), Figure 3.18) However, this preliminiary noise study is highly underestimated and does not represent the actual values (Estevez Mauriz et al., 2016). It is therefore probable, that the public spaces planned in Frihamnen might be uninviting due to the high SPL that can be similar to highly frequented areas such as Brunnsparken in the central part of the city. This effectively endangers the success of the planned area.

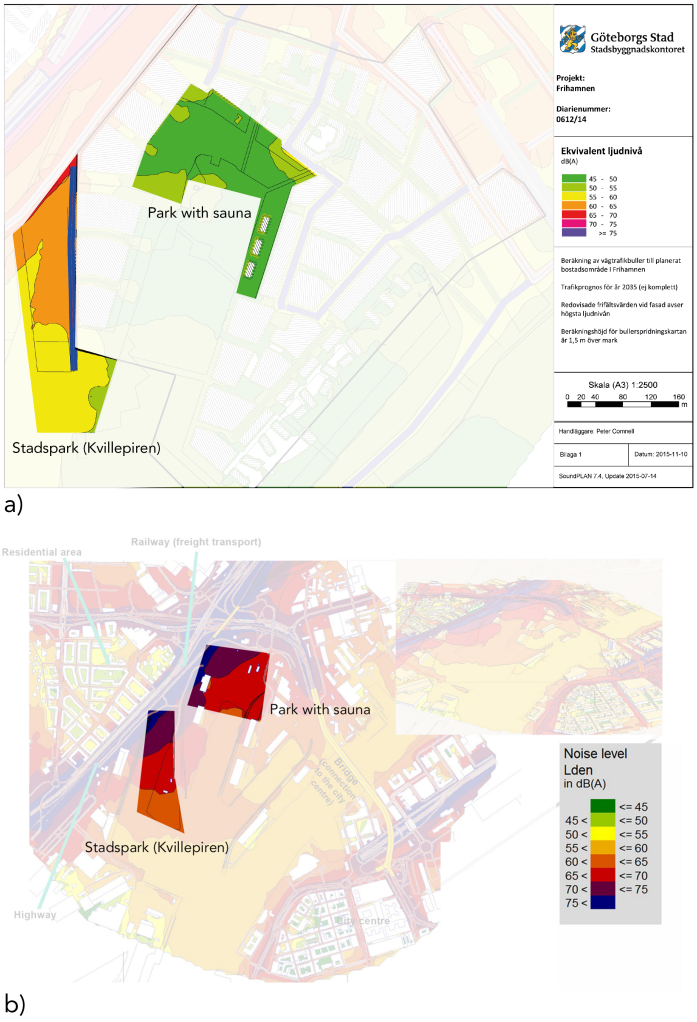

Figure 3.18: (a) Highlighted areas of public parks in Frihamnen with SPL according to planning by Stadsbyggnadskontoret (2015) with realised buildings (2035). (b) Highlighted areas of public parks in Frihamnen with SPL according to noise estimation by Estevez Mauriz et al. (2016) without realised buildings (2015).

Not included is the added noise in the area for the next 20 years due to construction order. According to the plans ((Stadsbyggnadskontoret, 2015), (Estevez Mauriz et al., 2016)), added noise of construction will interfere with the planned noise studies immensely and make it impossible to have a welcoming sound environment until all of the construction is finished. In Figure 3.19 one can see the planned construction order for the upcoming years of execution (Stadsbyggnadskontoret, 2015), which is estimated and based on simulations by Estevez Mauriz et al. (2016) and Stadsbyggnadskontoret (2015). It is evident that for the duration of the construction, building noise is added as visible in Figure 3.20. Additionally to the building noise, the traffic on the highway around Frihamnen is still in use and adds noise to the environment (Figure 3.21). In Figure 3.22 the noise of combined construction and traffic is shown. It is visible that noise pollution for extensive parts and periods of time in Frihamnen is exceeding recommendations by World Health Organisation (2016) for a healthy environment.

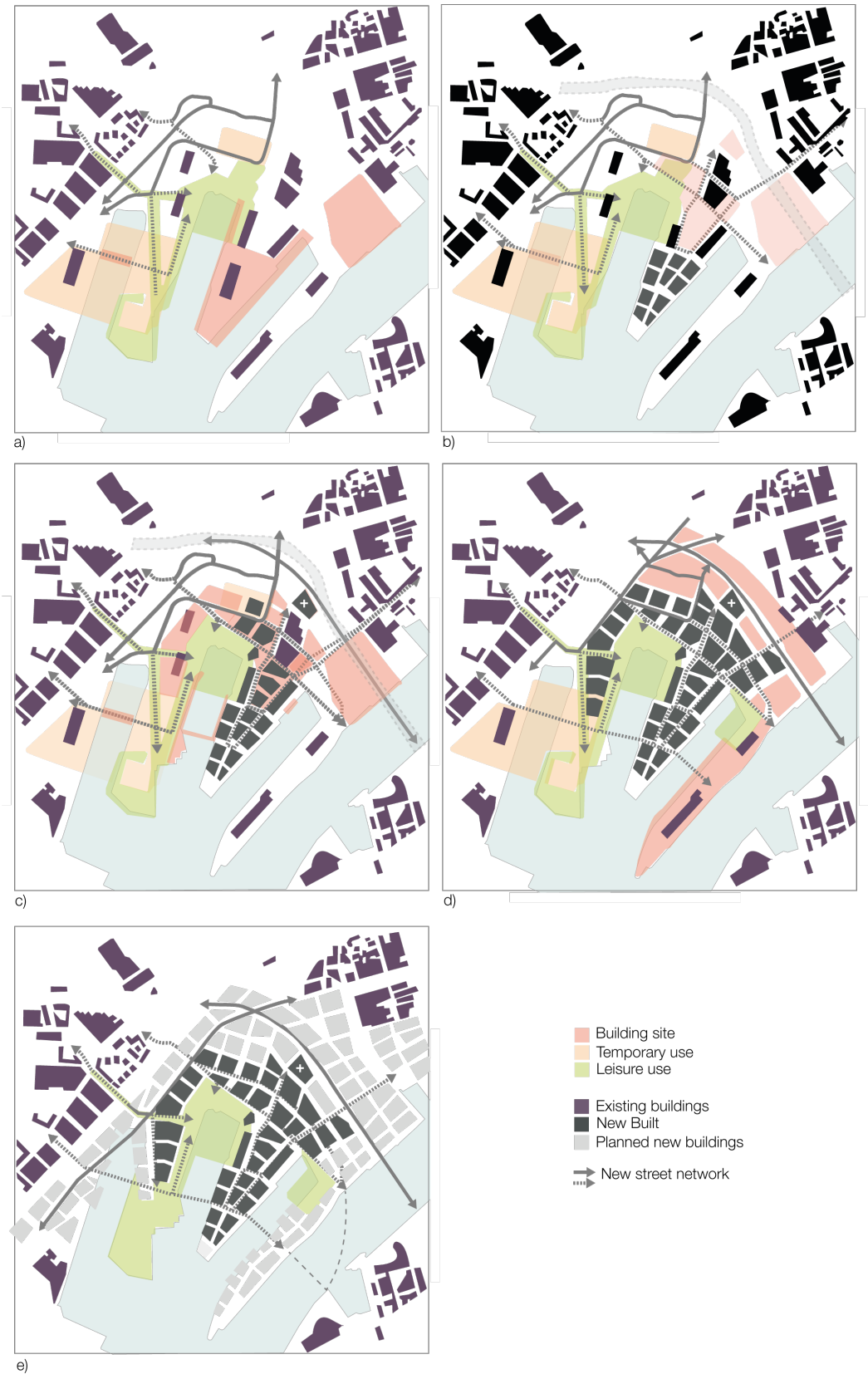

Figure 3.19: Frihamnen during the construction stages. (a) beginning of the construction (2017). (b) First apartments and shops open (2021). (c) Additional construction finishes (2027). (d) Last steps of construction finish (2032). (e) End of the project construction (2035).*author's work*

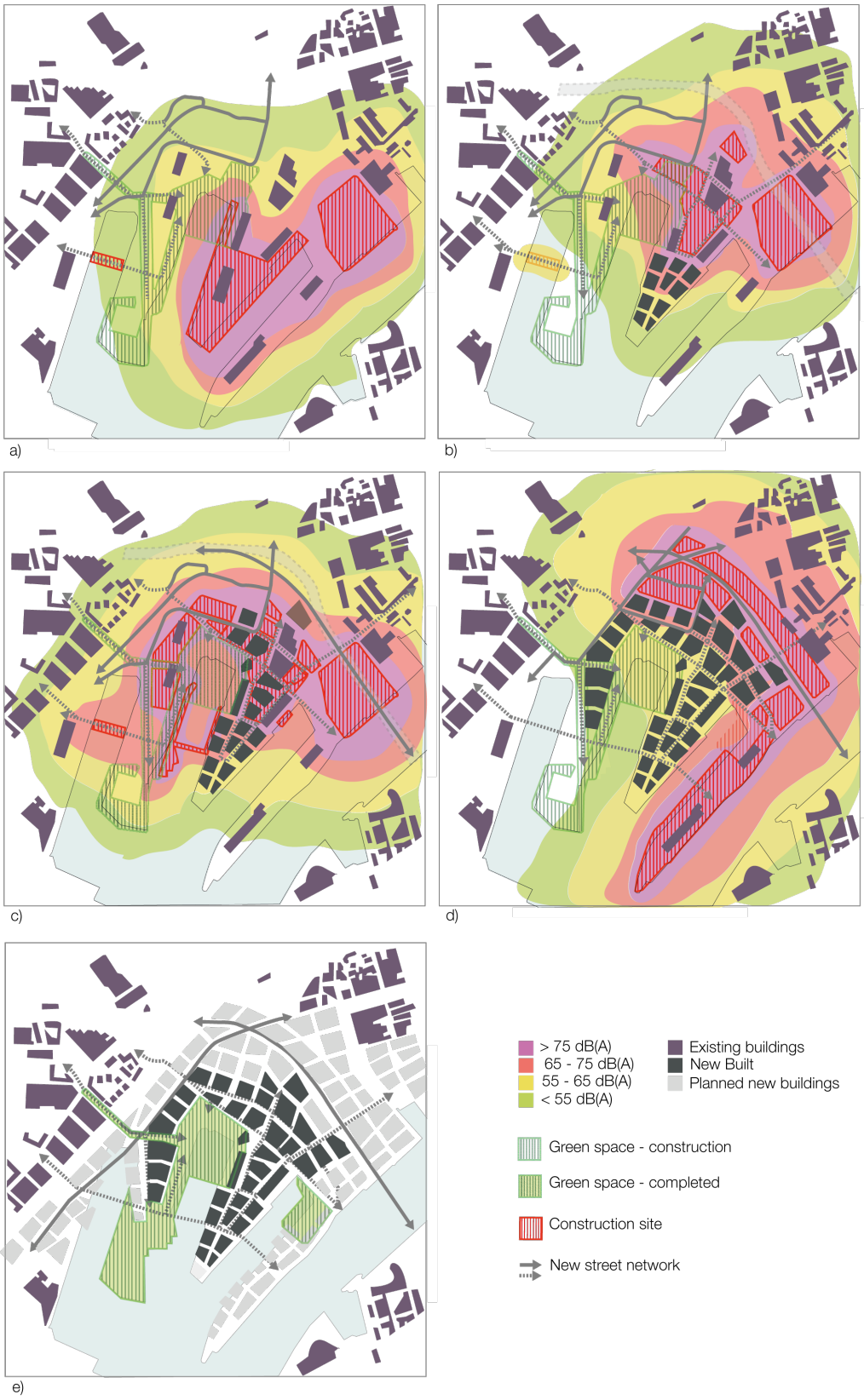

Figure 3.20: Isolated noise level in Frihamnen during the construction stages. (a) beginning of the construction (2017). (b) First apartments and shops open (2021). (c) Additional construction finishes (2027). (d) Last steps of construction finish (2032). (e) End of the project construction (2035).*author's work*

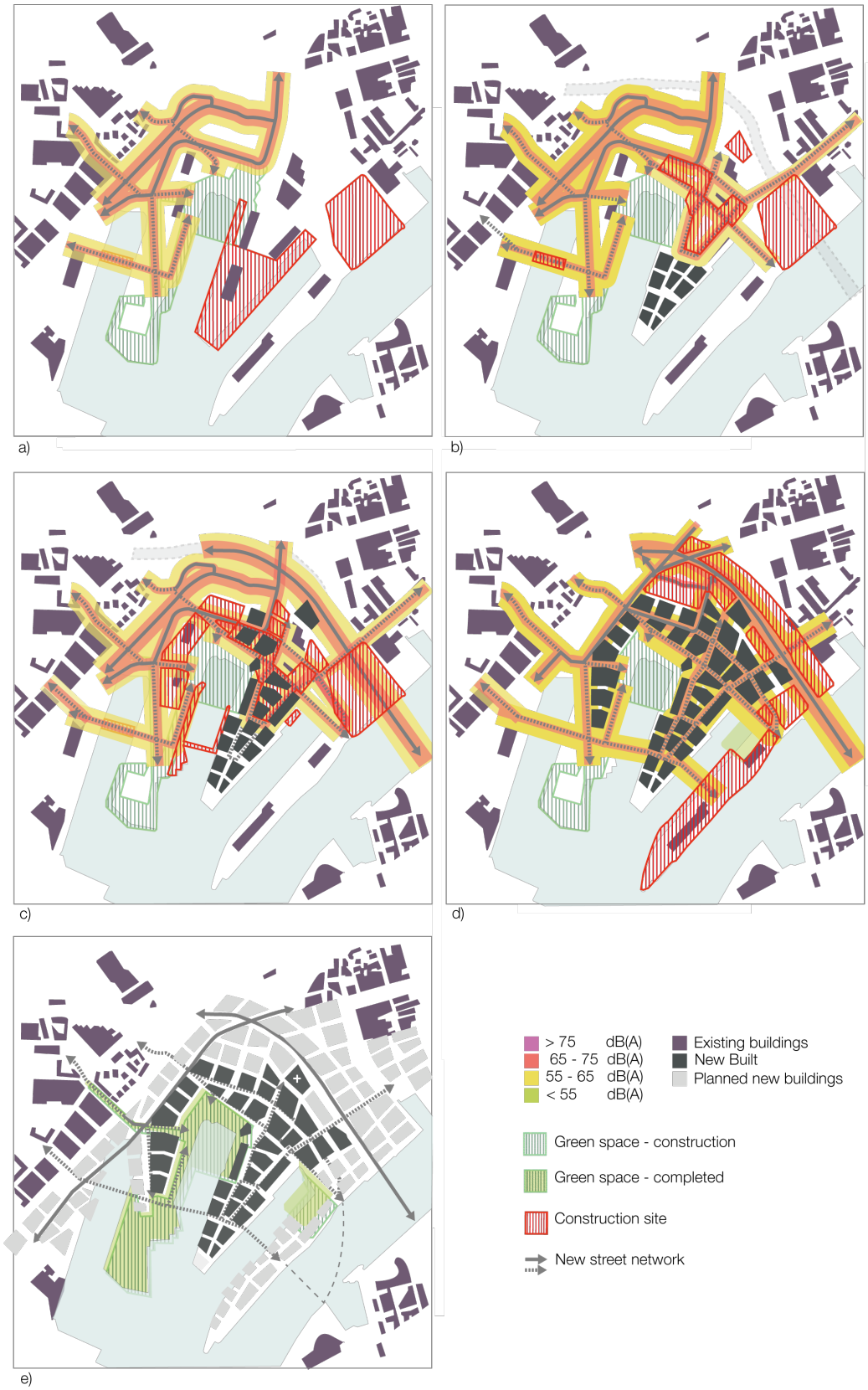

Figure 3.21: Isolated noise level in Frihamnen during the construction stages of street network. (a) beginning of the construction (2017). (b) First apartments and shops open (2021). (c) Additional construction finishes (2027). (d) Last steps of construction finish (2032). (e) End of the project construction (2035). *author's work*

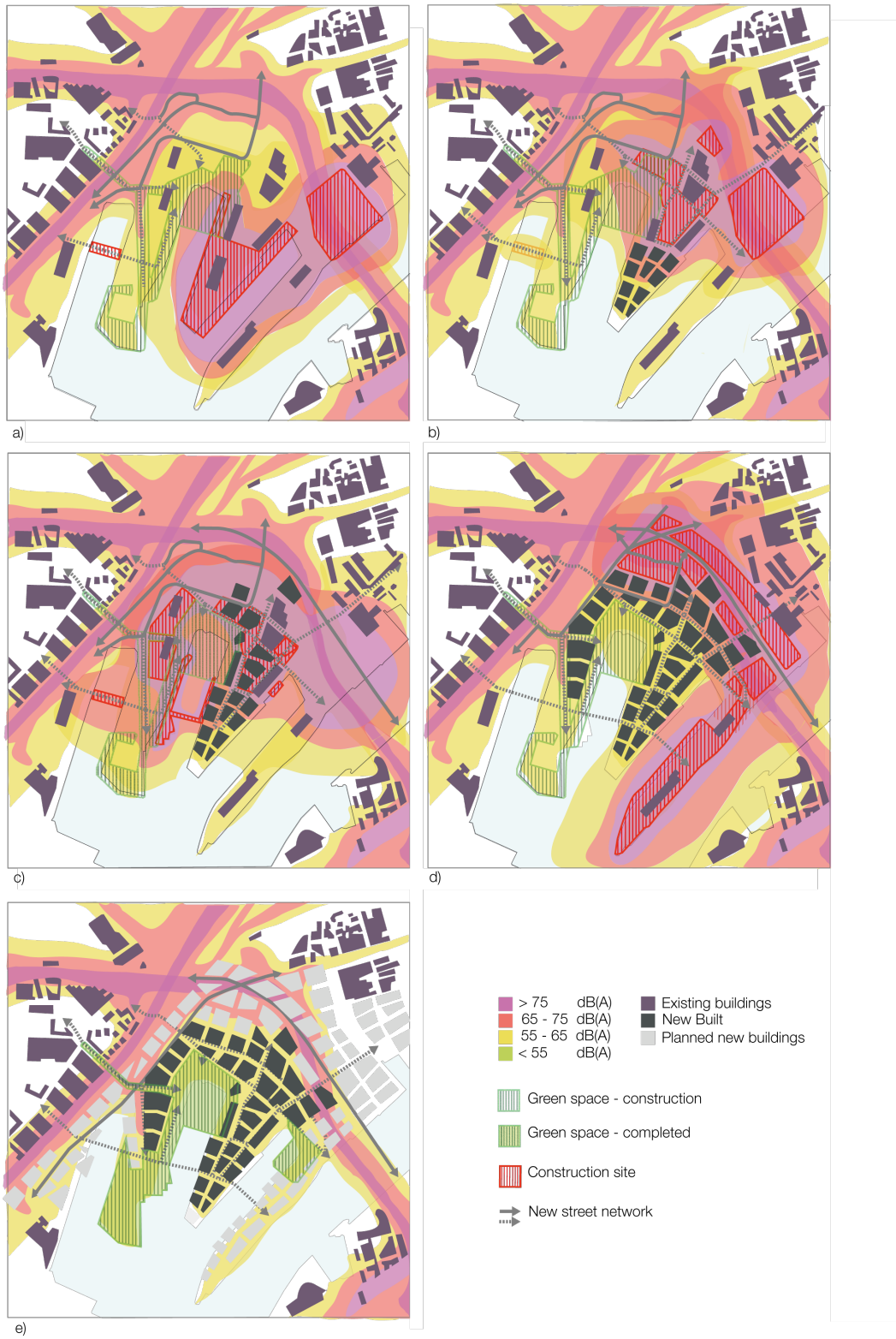

Figure 3.22: Noise level in Frihamnen during the construction stages in context. (a) beginning of the construction (2017). (b) First apartments and shops open (2021). (c) Additional construction finishes (2027). (d) Last steps of construction finish (2032). (e) End of the project construction (2035).*author's work*

In order to gain a better understanding of what specific sound pressure levels in dB(A) mean, and to be able to compare the predicted noise to current places, measurements in the City of Gothenburg were conducted. These took place in public spaces in the busy areas of the city, namely, Brunnsparken, Centralstation, Trädgården and Avenyn. The device used is a Clas Ohlson ST-805 with the serial number *08060749*. Measurements were averaged over 10 seconds in dB(A). Figure 3.23 shows generally the places and the resulting averaged sound pressure levels of that area. Table 3.5 shows the detailed places and results.

These measurements show that many public spaces in the city already exceed the recommendations by the World Health Organisation (2016), thus not enabling a sustainable city life if pedestrians are exposed for too long in these areas. Planning for Frihamnen exceeds these values as well and a park in the middle of the new development area is likely to be as noisy as, for example, the area of Brunnsparken (Stadsbyggnadskontoret, 2015).

Figure 3.23: Map and sound pressure levels (in dB(A)) of the measurements executed in public spaces in the City of Gothenburg.*author's work*

Table 3.5: Results of the measurements conducted in public spaces in the City of Gothenburg

Area (description of place)	Measurement result in dB(A)
Brunnsparken (sandy ground)	62
Brunnsparken (water fountain)	68
Centralstation (Bridge)	66
Trädgården (green space in the middle)	52
Avenyn (Main Street)	68

Additionally, interviews as described in the method section were conducted. The main results of the stakeholder interviews are shown in Figure 3.24. Three main viewpoints were identified, *technical*, *legislative* and *personal*. Quite often a knowledge gap of soundscape was mentioned, indicating an issue of expertise in this field that might lead to an underdevelopment. This is undermined by the statement of not having enough experts in that field, which was another often mentioned issue. Most importantly, there is also a difficulty in identifying the responsibilities of soundscape in planning procedures, as they are not precisely set.

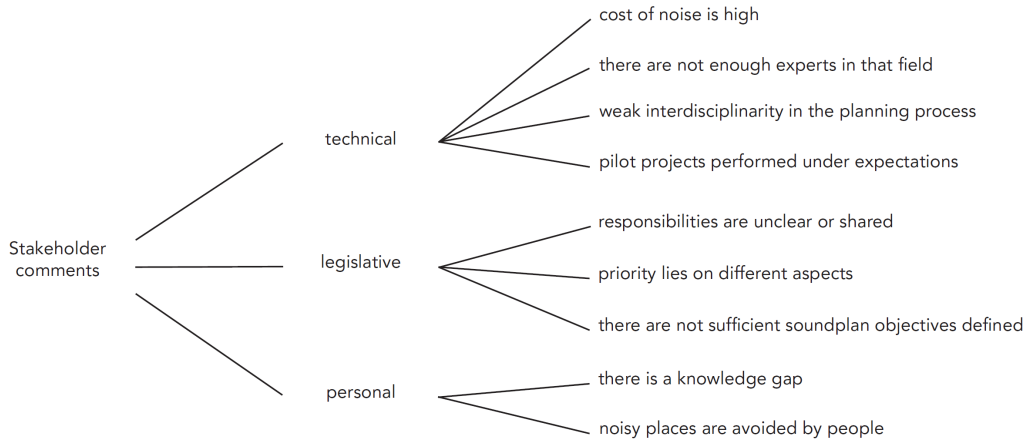

Figure 3.24: Visualisation of the most discussed statements during the stakeholder interviews in the thesis process (adapted from Raimbault and Dubois (2005)).

3.9.2.2 Lynch analysis with walkability focus

Figure 3.25 illustrates pedestrian connection on the site at current stage. Considering Frihamnen and its context, strong existing infrastructure is dividing the site in four distinct areas; the barriers identified are Lunbyleden highway and the railway (Göteborg hamnbana) to the north-west, and Hjalmar Brantingsgatan to the East. Under-paths and pedestrian bridges are present, although they weaken and get lower in quality the further one goes from the crossroad. Travelling South along the Hamnbana for instance, one of the pedestrian connections to the residential area features stairs only.

The image also shows landmarks, which as Lynch (1960) we identify as reference-points that the user does not enter and stay external. Some are distant and visible from afar, others in closer proximity. We define landmarks as reference-points while moving in the city and that the general user would mention while giving directions. The ones we identified include the near Ramberget park to the West, and the sauna in the harbour; also Backaplan is marked as a landmark for its shopping complex and bus station, which stays on the North. Furthermore, the map shows nodes, which are identified as unofficial crossroads of two or more routes as in Lynch (1960). The lines representing pedestrian routes, increase in thickness whenever the route is used two or more times for different journeys.

Figure 3.26 shows the first stage of the development in Frihamnen. As the construction of the development evolves outwards, its edges and boundaries will be last to be built and subjected to prolonged construction works, which will last years. Pedestrian connections will suffer since, if not closed during the construction stage, they will result quite unpleasant to walk through and probably avoided. This state will weaken the already feeble pedestrian routes to *Backastan* and *Lundby* discouraging flow or people from both sides.

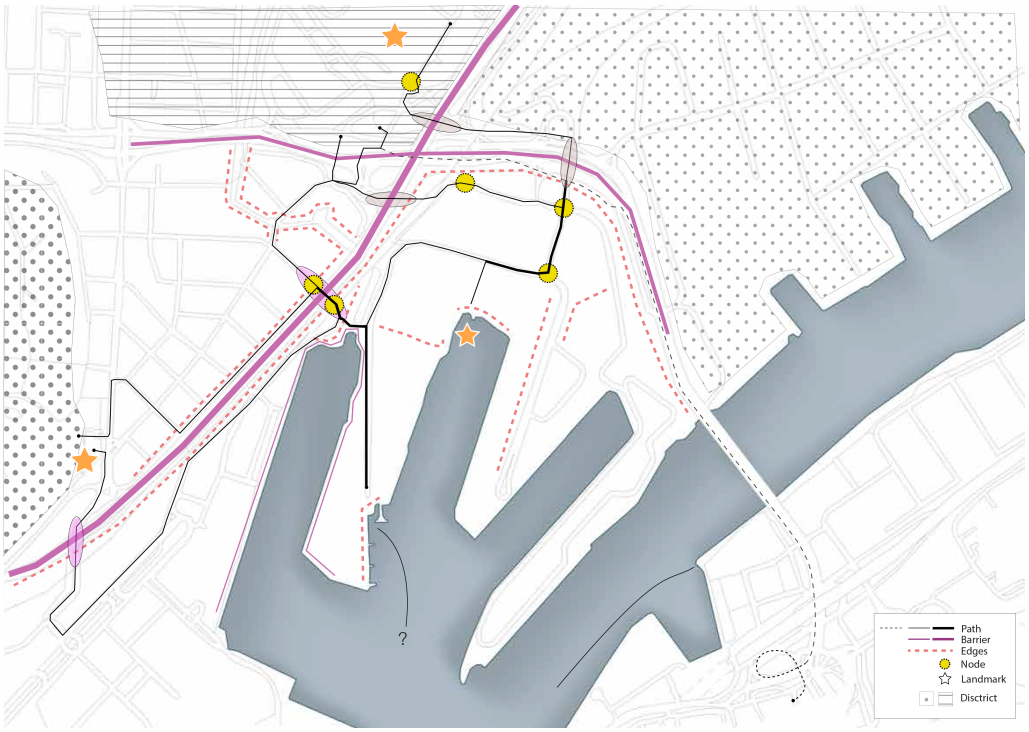

Figure 3.25: Current walkability map (adapted from Lynch (1960)).*author's work*

Figure 3.26: Predicted walkability map after the first stage of construction (adapted from Lynch (1960)). *author's work*

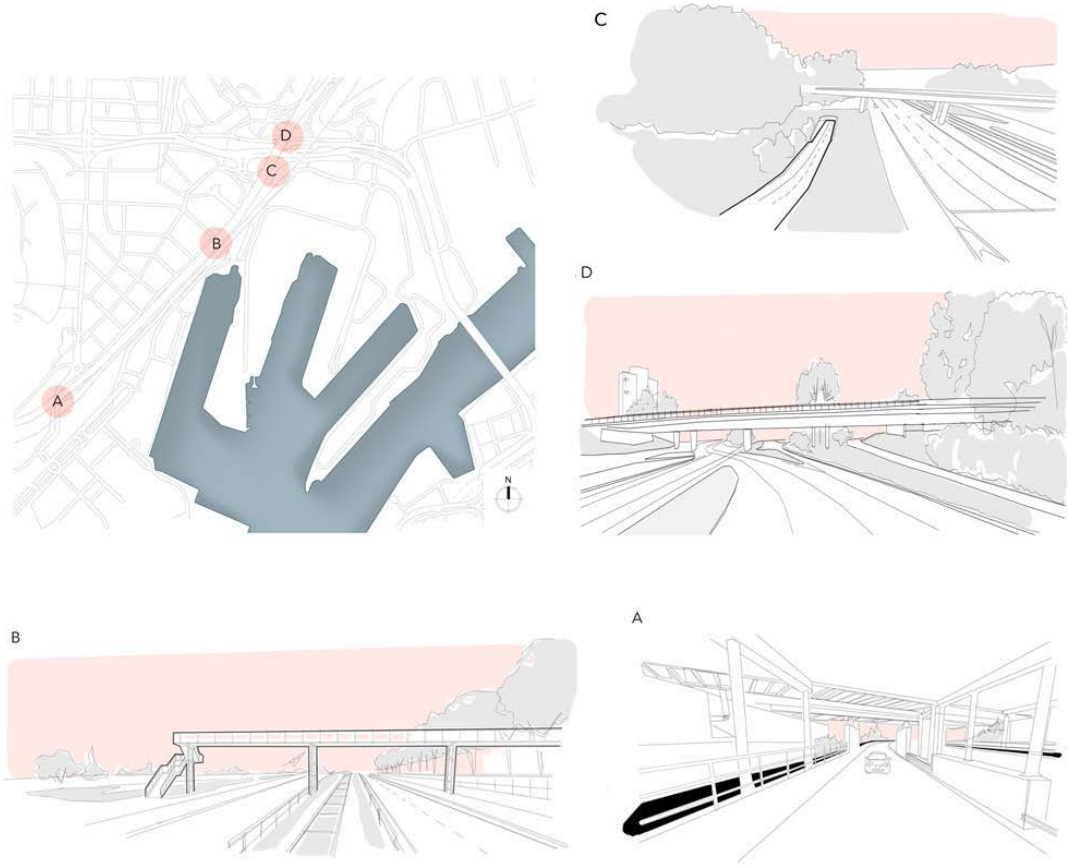

Figure 3.27: Expected connections to Frihamnen across the highway and Hamnbana. *author's work*

Figure 3.27 illustrates sketches of the pedestrian connection encountered when crossing Lunbyleden highway and the Göteborg hamnbana. It is possible to see how the closer to the crossroad the better the connection across the infrastructure is (C, D). The further one goes from the main intersection the more the quality lowers and the accessibility is compromised. One is a pedestrian bridge (B) that is not accessible as it provides stairs access only, while connection A is accessible, although quite narrow and less maintained than C and D. Also, if we consider the acceptable walking distance of 500m (Gehl, 2010), the amount of space between the two accessible connections A and C is too long. The pedestrian bridge (B) is excluded from this assessment in this last consideration as it is not accessible by bike and by users with movement impediments.

3.10 Research Outcomes for the Case Study Area

3.10.1 Planning and strategy for Frihamnen

Evaluating the current situation through literature research and stakeholder interviews shows, that there is a knowledge gap in terms of soundscape implementation as well as an unclear situation about responsibilities within the different institutions involved. In order to have soundscape involved in the planning processes, we suggest a planning structure as shown in Figure 3.28. This planning structure involves all stakeholders and institutions that are part of the planning, which also includes the public.

Firstly, Frihamnen and its surrounding areas need to be identified in order to understand issues. In this case, both a soundscape and walkability analysis is conducted as described in the previous sections of this chapter. From the analysis, further objectives are defined specifically for this area. In the next step, these objectives are analysed and issues are identified that may hinder these objectives. With this, changes of the design are proposed in order to work towards the identified goals. Ultimately, the changes need to be assessed and the whole procedure needs to be evaluated. Should there be more issues or changes be registered, the proposed designs need to be adapted to new outcomes. This whole process is thus rather iterative and entails many dialogues with the involved stakeholders and institutions to ultimately come to a sustainable solution that fits all needs.

SOUNDSCAPE PLANNING IN FRIHAMNEN

INVOLDED INSTITUTIONS

PLANNING AUTHORITY | ARCHITECTS | URBAN PLANNERS | SOUNDSCAPE EXPERTS | PUBLIC

IDENTIFY FRIHAMNEN AND ITS SURROUNDING AREAS

SOUNDSCAPE ANALYSIS

- noise from traffic in dB(A)
- noise from construction
- soundscape in public spaces
- potential quality of soundscape in the area

WALKABILITY ANALYSIS

- identifying paths and barriers
- identifying potential landmarks
- identifying potential nodes and crowded areas

WALKABLE SOUNDSCAPE OBJECTIVES

REDUCED NOISE (SPL < 55 dB(A)) | ENJOYABLE SOUNDSCAPE | EASY PEDESTRIAN ACCESS TO ALL AREAS | AVOIDING SEGREGATION | ENSURE A GOOD QUALITY OF LIFE

ANALYSIS OF ISSUES THAT HINDER OBJECTIVES

PROPOSING DESIGN CHANGES

- masking of noisy areas with more pleasant sound (water fountain)
- inolving natural materials which mask the noise
- changing of the construction order to make the area enjoyable during building phase for the first living inhabitants
- playing with sound as a tool to attract people (soundwalks)

- evaluating the existing connections and proposing changes to make them more accessible (bridge connection to Backaplan)
- identify the major pedestrian paths and put extra effort to make them accessible and enjoyable (utilising soundwalks and playful city environments)

ASSESSING THE RESULT OF THE CHANGES

EVALUATING THE PROCEDURE AND ADAPTING TO CHANGES

Figure 3.28: Proposal of a planning structure to involve soundscape and walkability in Frihamnen (adapted from Rehan (2016)).

3.10.2 Lynch mapping applied to proposal

A research method originally tested by Lynch (Lynch, 1960) was used to assess the movement of pedestrians and the level walkability of the streets at the first stage of the development. As mentioned, the RiverCity development will be a long-term process and Frihamnen will be developed from its core outwards. As in the first phase a city park will be completed, it is likely that the public will show a strong interest in accessing this area. The analytic work has shown that, we believe that the area will be mainly reached via public transportation, following a short walk to the park 3.29. Assuming that the ground floor of the buildings will be populated with businesses, pedestrians will also be attracted to other streets. However, we believe the main interest in reaching the area will be the public space as Gothenburg already offers shopping districts on both sides of the river.

Figure 3.29: Expected walkability after first stage of the development (left) and proposal of walkability compared Uright) (adapted from Lynch (1960)).*author's work*

Figure 3.30 shows how pedestrian traffic could be increased with the addition of two pedestrian connections to link both river banks (right).
As Jacobs (1961) and Gehl (2010) suggest, streets need to lead somewhere people have reason to go to; following this concept walking routes could be drawn in order to connect landmarks and relevant areas in the city to highlight existing assets. A pedestrian linkage over the river can also strengthen the engagement with the water, which remains one of the main concerns highlighted by the public consultations in the River City project.
The weak connection between Backa and Frihamnen is also highlighted in an official report by SpaceScape (2014) for the city of Gothenburg where the creation of pedestrian arteries is advised. Figure 3.31 shows how the pedestrian linkages we identified as problematic match the findings illustrated by SpaceScape.

A later report by Älstaden Utvecking and the city of Gothenburg (Älvstaden, 2017) shows new considerations towards connecting Lundby and Backa to the city centre via Frihamnen. This version was published after our meeting with the planning department and after the analysis and considerations we are illustrating in this thesis. It is visible that while linkages C and D are still considered for future

Figure 3.30: Proposal of walkability map (adapted from Lynch (1960)).*author's work*

implementations, linkages B is no longer a point of intervention according to the document 3.32. Although this new version connects to Backa and Lundy in a much clearer way, we believe that the linkage B remains problematic.

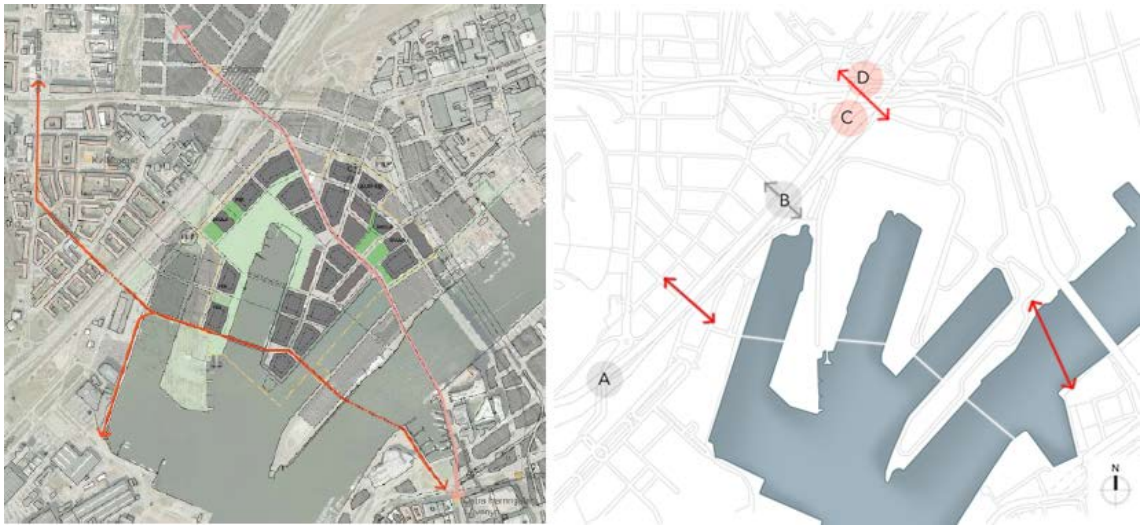

Figure 3.32: Recommendations on pedestrian paths from report by Älvstaden (2017) (left) and our analysis(right) in comparison *author's work*

3.10.3 Design Proposal

In this chapter, the design proposals and recommendations for the area of Frihamnen are presented; the following recommendation are based on the findings from the literature review and best practices for walkability and soundscape and analysis of the case study. The chapter aims to show the application of the design principles that were identified previously.

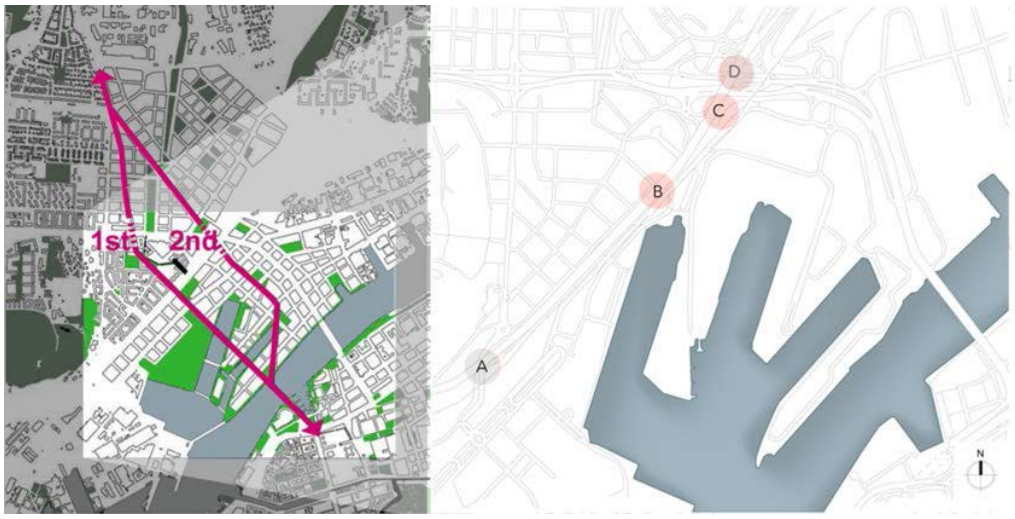

Figure 3.31: Suggested pedestrian linkages between Backaplan and Frihamnen (SpaceScape, 2014) (left) and the previously identified pedestrian connection B, C and D (right).*author's work*

3.10.3.1 Criteria for Walkability and Cycling

In the focus of this chapter is explaining how to discourage social and spatial segregation via promoting pedestrian movement in the area taken as a case study. From literature review, the identified walkability criteria that apply to the case of this thesis are the following:

Temporary pedestrian connections:

The long-term development in Frihamnen will worsen the already weak pedestrian networks leading to the site. It is advised to invest in temporary pedestrian bridges and interventions that will ease the flow of non-motorised traffic to the area. Masking the construction works via visually pleasing fencing and applying way-finding strategies will improve the environmental qualities of the site. Construction sites are usually closed off to the general public with temporary fencing also known as construction hoarding. In some cases they present aesthetic character, in others they try to blend in the surroundings. The latter case is valid in residential or conservation areas for instance. Best practices and Hosanna (2013) show how these implementations can also offer sound pressure levels mitigation effects, if adequately purposed. Temporary plant systems and soil filled barriers such as vegetative wall compositions, can fit the purpose. In general, many noise-mitigation methods also influence the visual environment; to what extent visual environment decreases noise perception is debatable, but it is beneficial to consider all the design elements in a comprehensive way to maximise the success of implementations. In order to deliver welcoming pedestrian routes and maintaining a constant pedestrian movement throughout the construction phase, it is therefore advised to implement strategies that aim to combine solutions for walkability and soundscape.

Way-finding strategies and Thematic routes:

The connection between the newly developed area of Frihamnen and the rest of the city can be supported by developing a route network that connects strategic points of interest in the city. Building on the existing infrastructure, the newly defined routes can be suitable for pedestrian and cyclist. Findings suggest that cycling is already an established alternative mode of transportation in the city; in 2015 the city of Gothenburg ranked among the 122 most bike-friendly cities in the world according to Copenaghenize (http://www.copenhagenize.com) , a Danish design consultancy specialised in bicycle urbanism. Moreover, in the same year the City of Gothenburg Urban Transport Administration launched an important pilot project in partnership with local partners, introducing electric bikes to the city. The potential for these strategies to thrive is evident also considering initiatives such as Cykelköket - from Swedish "a bicycle kitchen" - which up-cycles old models and helps cyclist in repairing broken bicycles.

Many attractive points of interest that can support such route network, such as the numerous parks and green areas, are present in the city. In 2021 part of the RiverCity project will be completed with the delivery of 1000 new homes and Jubileumsparken (the Jubilee Park) a new green space for the city. As one of the the aim of RiverCity is to unify the city connecting the north and south bank of the river, Jubileumsparken represents a great opportunity to be the centre of a thematic route connecting some of the most significant green areas of the city. Figure3.33 shows a proposal that could be implemented to link the north and south of the city via Frihamnen and main parks in the city.

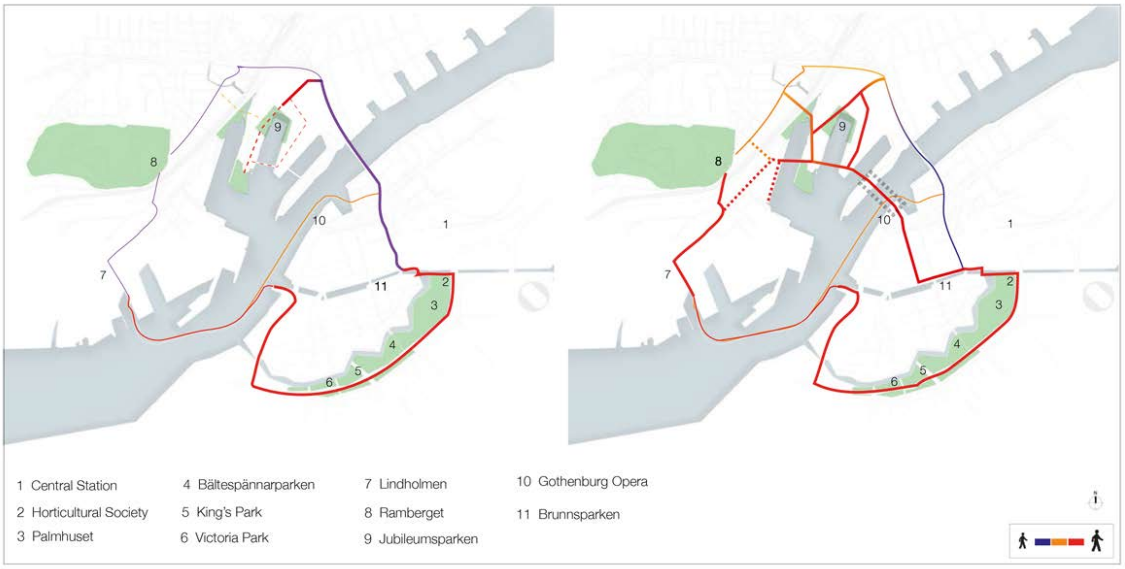

Figure 3.33: Predicted pedestrian routes on completion of the first phase of RiverCity plan (left); predicted improvement with the addition of pedestrian linkage (right) *author's work*

Figure 3.33 considers the first stage of RiverCity plan, and two version of expected pedestrian routes to Frihamnen are shown. The routes represent an example of a path to connect jubileumsparken to existing public green areas in the city of Gothenburg. The city parks identified are Ramberget and Kungsparken as they are in close proximity to Frihamnen. The routes also consider areas of interest such as Lindholmen area and landmarks such as Gothenburg Opera in Jussi Björlin Plats. Colours are used to indicate the amount of pedestrian traffic, where blue represents low levels of traffic (or use of other modes of transportation), while red represents high traffic.

It is visible how pedestrian circulation is interrupted due to lack of walkable routes (left) and how creating a pedestrian linkage between Frihamnen and Jussi Björlin Plats can increase pedestrian circulation and create a more fluid connection between the south and north bank (right).

The implementation of a thematic route can help citizens navigate the city in new ways, provide specialised path for cyclists and pedestrians, ease congestion and become a seasonal attraction to support tourism in the city.

Place-making and targeted events

Urbanisation is an incremental process. As mentioned in *part 3.8.9* placemaking aims to inspire people to collectively reinvent a place in the city and make the heart of their community. This practice has proven to be successful in many cities as many temporary interventions became permanent after strong requests from the inhabitants.

3.10.3.2 Applied Design Principles for walkability and soundscape

Figure 3.34 shows the transition towards Lundby and Backait. As mentioned, the infrastructure creates a strong mental barrier that on one hand limits the presence of pedestrians and non-motorised vehicles, and on the other hand represent an important noise source. From Hosanna (2013), noise reduction interventions by means of ground treatments are advised on the ground along the highway and railways. In red we indicate roughness element configurations and in violet we indicate soft strips and patches

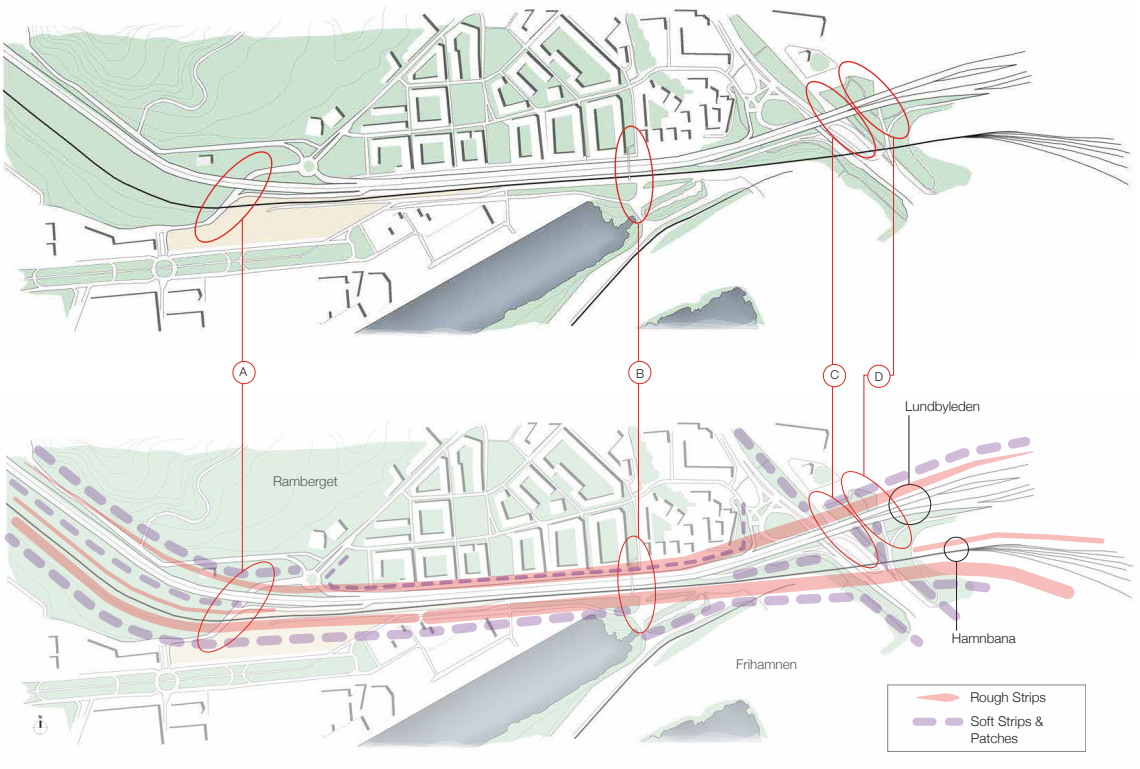

Figure 3.34: Noise reduction by means of ground treatments- *author's work*

As shown in Hosanna (2013), acoustically hard ground doubles the sound pressure of road-traffic noise, compared with no ground, which corresponds to and increase of 6 dBA; this is proven at 1.5 m height and distances of 10 m or more from the noise source. On the other hand, acoustically softer materials or acoustic destructive interface helps mitigate noise more than adding distance.

Pedestrian Connection A

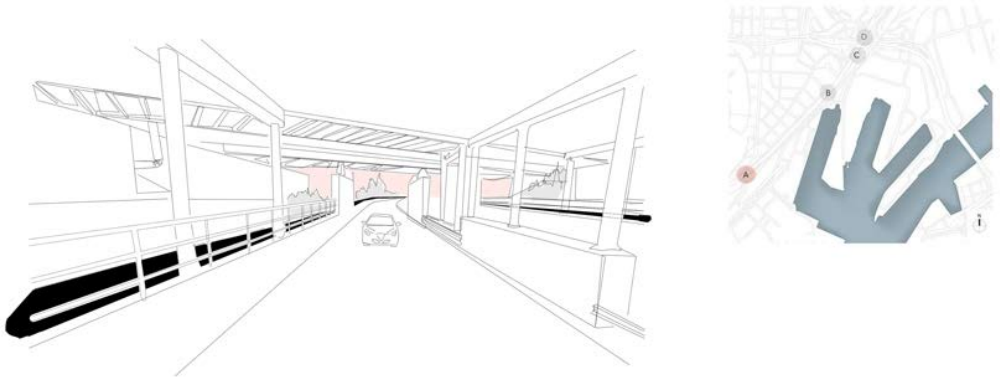

Figure 3.35: Sketch of pedestrian linkage A and its location on site *author's work*

The pedestrian connection in point A consists of the intersection between the railway (hamnbanan) and highway (Lundbyleden) and Karlavagnsgatan, a main road connecting Lindholmen and Lundby. The road, is composed of two two-lane carriages,and a raised hard shoulder for pedestrian and bicycle circulation. The area we are intervening on is the underpass and the raised pedestrian and bicycle lane. The 3.36 shows how design criteria in to point A can be applied.

Figure 3.36: Design principles applied to point A - The current situation (top) and the proposal (bottom) *author's work*

From an initial analysis it is found that the area seems neglected and not very inviting, especially during night hours. This passage represents though an important

connection between Limdholmen and Lundby as it provides access to Ramberget park from the south, and to Lindholmen Science Park and residential area from the north.

Figure 3.36 shows how to improve the acoustic and aesthetic environment in point A via architectural changes. Existing greenery is strengthened and vegetative barriers are added; also, a sound barrier is added between the road and raised the bike lane to improve the sound environment and aesthetics for passers-by. It is also advised the addition of lighting to increase the sense of safety during night hours and wall treatments for wayfinding purposes (fig:3.38) Carmona et al. (2010).

Figure 3.37: Design principles applied to point A - detailed section *author's work*

Figure 3.37 shows how the section in point A can be improved acoustically through the addition of elements that will reduce noise propagation. Porous asphalt and buried resonators are combined as shown to reduce noise by 2-3 dB(A) (Hosanna, 2013). It is also advised to add roughness-based noise reduction strips for the reasons explained in *section 3.8*.

Figure 3.38: Design principles applied to point A: lighting and way-finding *author's work*

Improved street lighting and way-finding strategies not only improve the visual-aesthetic character of a place; a new appearance and visible investment by the local authority can change the way the place is perceived, which is shown in figure 3.38. Learning from Gehl (2010) it is advised to include citizens into the decision-making when regenerating existing areas in the city. *Inhabitants are the experts* is in fact one of the key concepts taught in place-making by the same author and Whyte (1980).

Pedestrian Connection B

Figure 3.39: Sketch of the pedestrian bridge and spatial qualities at point B *author's work*

Point B is located on Lundby Hamngata and coonects to Frihamnen via Kvillepiren. This former industrial area is at the north of the old port and presents a pedestrian linkage to Lundby via a pedestrian bridge overpassing Lundyleden (fig: 3.39). The area is identified for its development potentials and existing pedestrian connection. The site analysis reveals that the area is neglected and underused, and spatial barriers are found due to the presence of a pedestrian bridge lacking accessible ramps.

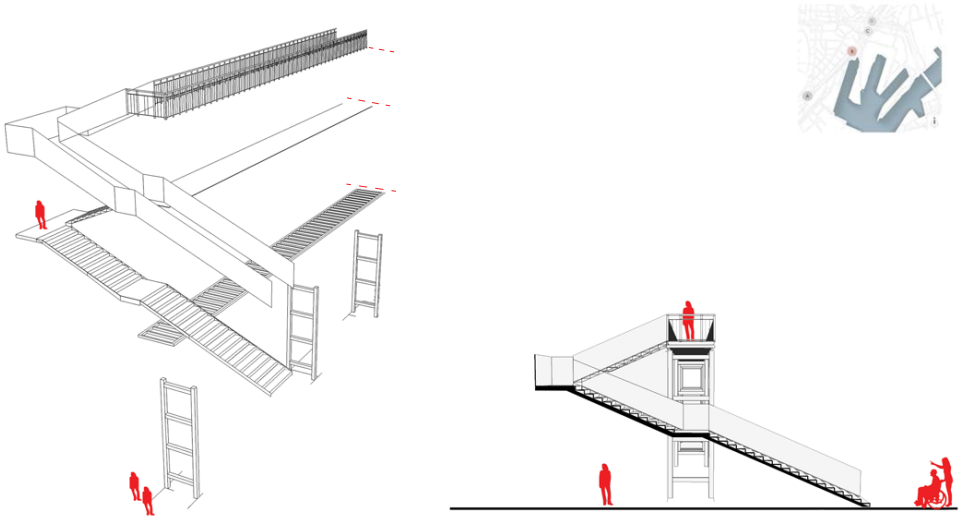

Figure 3.40: Analysis of pedestrian bridge at point B - section and axonometric *author's work*

The proposed plan for point B aims to create a multipurpose outdoor space that can be accessible by any user and used throughout the year. The newly developed park aims to expand the green space in Frihamnen towards Lundy and to promote

better quality of life and well-being in the area. Figure 3.41 shows a diagram of the suggested intervention that can be explained in the following points:

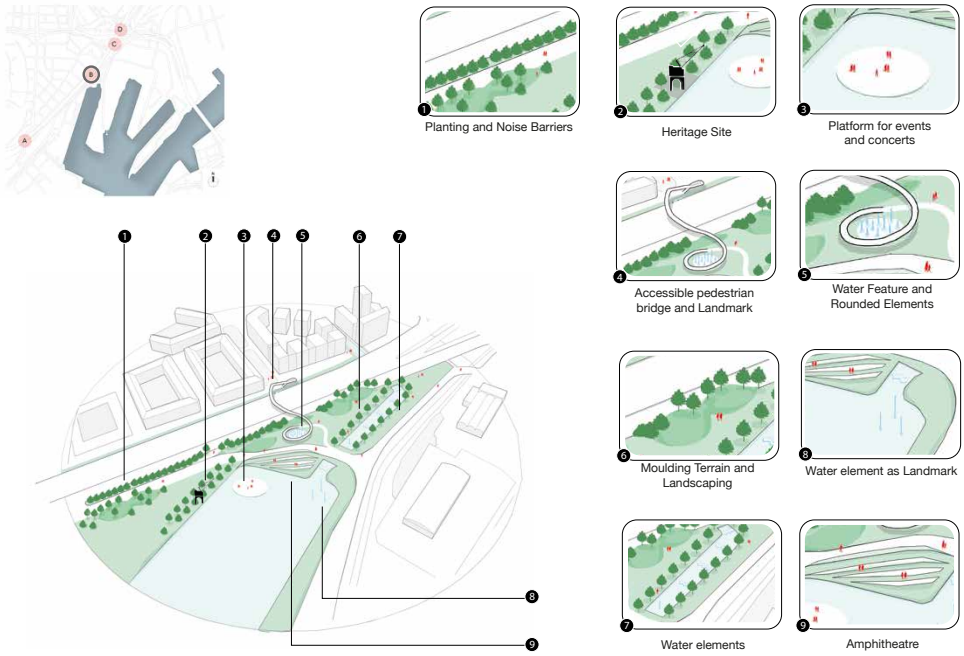

Figure 3.41: Placemaking strategies and the creation of a park on point B *author's work*

1. Planting and Noise Barrier

As seen in Hosanna (2013) planting improves the sound environment by screening off traffic noise. From the same source we know that leafy areas and soft grounds demonstrated to have attenuating effects on sound; wide leafs registered the best performance decreasing noise by 9-13 bB(A) for a 1.5m high receiver 50 m from the source. In the experiment run executed in Hosanna (2013), 1.5 dB(A) was contributed by crops (such as winter wheat). It is advised to add vegetative barriers to the site for its acoustic and aesthetic effects.

2. Heritage Site

The site of Frihamnen presents relevant historical remains of the time when the area was an active port in the city. In this specific part of the ex port is still possible to see one of the old cranes used to load and unload goods from ships onto train wagons. While the port of Gothenburg dates back to 1610, Frihamnen was inaugurated in 1922 following the will to expand the city to the north of the river. The docks were eventually closed to conventional traffic in 1989, as it happened in Lindholmen (Port of Gothenburg, 2017) The cranes remain nowadays as a representation of the past that adds great deal of character to the area and that be can retrofitted and re-purposed.

3. Platform for Events and Concerts

Events, shows and seasonal activities will change the way the public perceives the place. Adding a programme to the place will attract people to the area and increase its popularity.

4. Accessible Pedestrian Bridge and Landmark

The research and site analysis revealed that the pedestrian bridge on site is not accessible to wheelchair users as it does not provide ramps. The exclusive presence of only stairs is not ideal for bike users. Findings confirm that the green has restricted access from Lundby and the circulation is limited as the bridge represents a barrier and excludes specific groups of users. In order to design a more inviting and equitable space it is advised to add accessible ramps and to widen the width of the passage to ensure the safety of pedestrians and bikers. Moreover, the bridge does not implement any sound strategy.

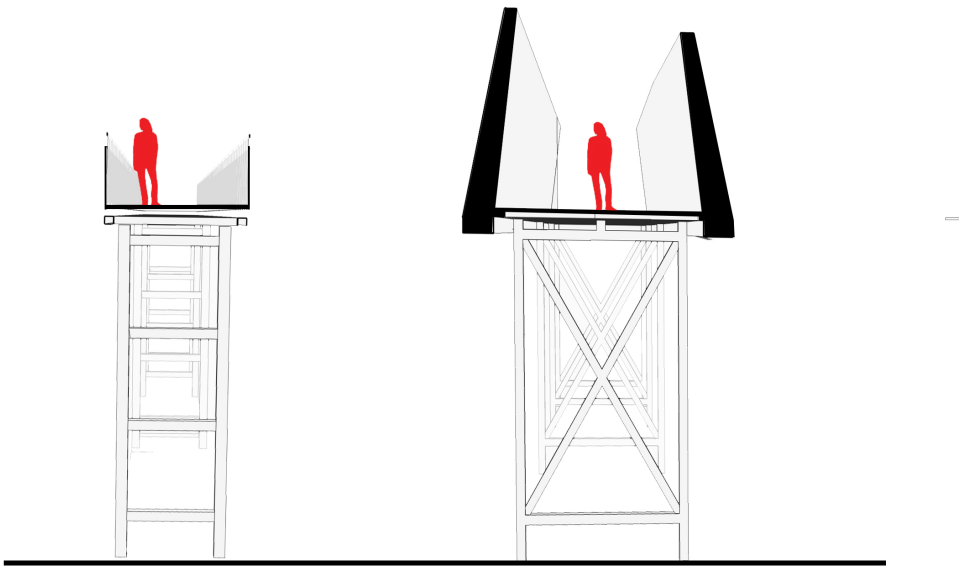

Figure 3.42: Pedestrian bridge linkage B - existent and proposed *author's work*

As learned from Luchsingel bridge mentioned in the best practices in this thesis, timber cladding performs well in environments where traffic generated noise is elevated. Figure 3.42 shows how applying similar architectural principles to the one seen in Luchsingel allows to deliver a positive soundscape experience and shelter passers-by from the traffic noise. The section shows a improved steel structure and added timber cladding to improve safety and block noise. A wider width for better

circulation is also shown in fig:**??**. Combining soundscape and walkability strategies the bridge can also become a landmark for the area, improving the perception of the place.

5. Water Feature and Rounded Elements

Water features are water elements such as fountains, or water installations in urban design. Moving water masks traffic-generated noise and creates a relaxing environment as previously seen with fountain by Tinguely in Basel (CH). Rounded elements are also shown to improve sound perception as curved surface interferes in the propagation of sound. The combination of the two strategies is aimed to mask traffic noise and to deliver a pleasant sound experience.

6. Moulding Terrain and Landscaping

As mentioned in the design principles, moulding the terrain has a positive impact on sound pressure levels. It is advised to create irregularity and differences of heights in the landscape; this will add character to the area delivering a more interesting experience, and also better the soundscape through attenuating traffic noise.

7, 8 Water Elements as Landmarks

As seen in best practices, water is shown to be an attractive and engaging element in urban design. As Jet d'Eau in Geneva (CH), water installations can become important landmarks for a city, and add character and identity to a place. Water fountains can also be part of way-finding strategies that add to the soundscape experience.

9. Amphitheatre

Recalling the objective of RiverCity project, it is advised to strengthen the relation with the water. This is done by creating steps-like structures towards the sea that can accommodate passers-by or spectators in the case of organised events. The preexisting spatial qualities of the shore and the presence of the water provide favourable conditions for this kind of intervention. While point 9 closely relates to point 3 (platform for events and concerts), it is also a versatile solution as proven by preexisting best practices of urban design (Granary square in London, UK).

Pedestrian Connections C and D

The pedestrian connection in point C and D consists of recessed bike lanes closed to the intersection between the elevated railway (hamnbanan) and highway (Lundbyleden), and Branting-Motet E621 on the ground, a wide city road that connects the centre of Gothenburg to the north passing via Frihamnen. The intersection is very complex and sees the transit of light and heavy vehicles as well as two tram-lines. Protected bike lanes are present on site, which connect the south bank of the river to Backa. Although a non-motorised lane is available, the site is not pedestrian friendly since it presents high levels of noise due to its high trafficked roads.

The proposal (fig: 3.43;3.44) wants to improve the existing infrastructure. Planting and noise vegetative barriers are added to the existing green banks dividing the road from the bicycle lane. For the scale of the intersection it is also advised to implement way-finding strategies. Wall treatments and ground pigmentation will improve legibility for pedestrians and bike users. At the same time the area will change its aesthetic qualities improving the overall feeling of the space. The pedestrian connection in point D exists in close proximity of point C. Figure 3.44 shows a similar application seen in D, additionally it is advised to add roughness element configurations and variation in ground covering along the main road and within 5m of the sound source to minimise sound propagation (Hosanna, 2013).

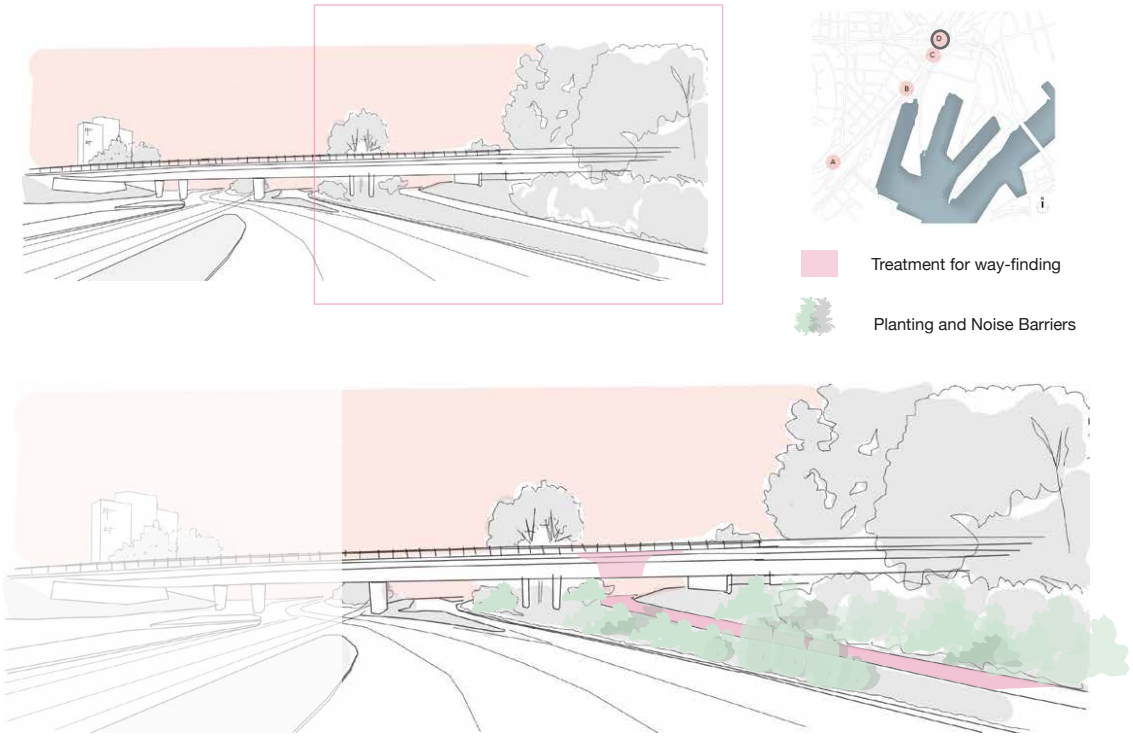

Figure 3.43: Design principles applied to point D - The proposal and the current situation *author's work*

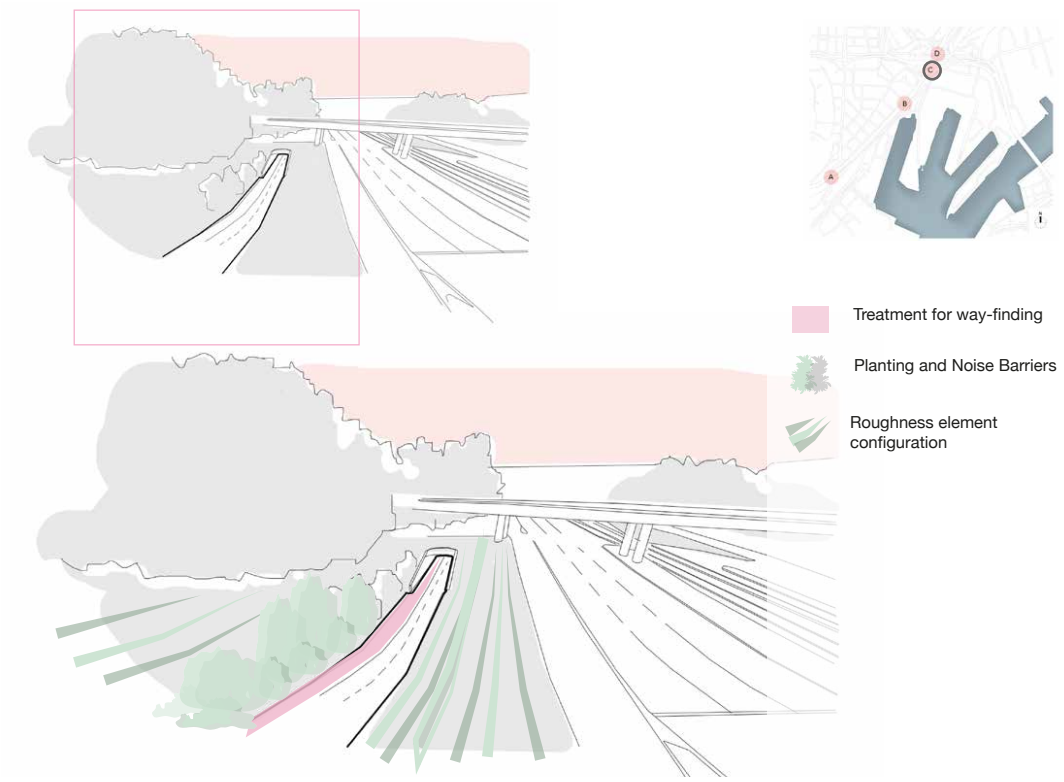

Figure 3.44: Pedestrian passage at point C and applied design principles *author's work*

4

Discussion

In this chapter the process and the findings are discussed as well as ideas for future improvement are presented.

4.1 The Challenge Lab Phase 1

The first phase of the Challenge Lab process took a major role in the beginning of the thesis writing. The first weeks were used to find synergies between the students and to identify needs in the region of Västra Götaland. This ultimately led to the definition of the research question presented in this thesis. It is hereby important to mention that this process took a lot of time and energy of the main part of the thesis, phase 2, which resulted in a problematic time frame in order to get as much stakeholder involvement for the thesis as wished. However, phase 1 enabled to visualise a real issue in sustainability transitions in the region with a topic focused on an interdisciplinary approach towards solving it.

4.2 The Interview Process

In order to get knowledge and opinions from the stakeholders involved, interviews were conducted. The interview process was semi-structured in order to be less restrictive with the interviewees. However, this structure led to somewhat unsatisfying answers, since the interviewees could not prepare into depth for specific topics that were asked. On the the other hand, this allowed to get more stakeholders to be interviewed about this topic on a wider spectrum, getting an overview of the situation as a result. Keeping the questions on a general level allowed more response from the interviewee, since it has been noticed that by being too precise in the questions, the interviewees will directly discard the process by stating they do not know enough about this particular topic.

Ultimately, the quantity of the conducted interviews is not very impressive, but it was managed to get stakeholders from all major planning authorities and research facilities (e.g. Johanneberg Science Park) in the region involved, so the quality of the results should give a clear picture about the situation and is satisfying.

4.3 The Best Practices

The research presents the analysis of existing examples of successful soundscape and walkability strategies that we group as best practises. The research showed how walkability and soundscape are often addressed as disjoint subjects rather than in relation to each other. As shown in Estevez Mauriz et al. (2016) and Hosanna (2013), urban environments need to be considered as a whole, although cities are complex scenarios where multiple stakeholders are involved in the decision making.

4.4 The Analysis of the Case Study

The case study is analysed applying a Lynch methodology adapted to our research objectives. The identification of nodes, barriers, edges and landmarks follow the definition given by Lynch (1960). Good connection and bad connection and district, are specific identification criteria added to fit our scope, and do not follow Lynch definitions.

In our analysis and research we consulted official documents published by the planning department and other public istitution of the city of Gothenburg, that are part of our literature review.
Coming back to the hypotheses presented in the beginning of the thesis, it is visible that:

- Soundscape is often mistaken for noise pollution

  The interviews conducted in this thesis revealed that this is a problem which is also supported by previous research by Estevez Mauriz et al. (2016). Since soundscape deals with a bigger picture than just the negative aspects of the sound environment, the problem is often misunderstood and focus in these issues lies on reducing the sound pressure level, which is a question of cost. However, the benefit of a good soundscape or the utilisation of soundscape in planning processes, since the audible environment is part of a public space or building, more attention must be given to it. Interviewees identified this situation as a *knowledge gap*. This issue can be improved by reworking the planning structure and implementing a more interdisciplinary approach as presented in this thesis, although it is possible that the issue is more complex. Additional research is advised.

- Sound pressure level can cause health deficits, therefore it is linked to well-being;

  According to World Health Organisation (2016), a sound pressure level exceeding 50 dB(A) is already considered as threatening a healthy life and is additionally supported by Ozkurt, Hamamci, and Sari (2015) and Basner et al. (2014). Research by Miljöförvaltningen (2013) shows that the City of Gothenburg al-

ready exceeds in these levels many areas. Having intense densification plans such as in the city of Gothenburg, which evidently underestimate the impact of the sound pressure level is therefore threatening the well-being of the inhabitants of the city. Best Practices demonstrate the existence of ways on how to reduce the pressure on the population and gain a healthy soundscape, such as the use of waterfronts to mask unhealthy traffic noise and substitute it with positively perceived sound from water. In order to plan for a sustainable future in the city, these issues need to be addressed accordingly in the planning processes.

- Soundscape has an impact on walkability, as it influences pedestrian circulation;

  According to Maculewicz, Erkut, and Serafin (2016), walking pace can be different depending on soundscape. Research shows therefore, that soundscape can have an impact on pedestrian behaviour and how different areas are perceived. Having an enjoyable soundscape leads thus to pedestrians spending more time in the area while an unenjoyable soundscape can lead to pedestrians avoiding specific areas. The influence on walkability is therefore evident and should be thoroughly and addressed in planning processes.

- Walkability and Soundscape are understood by the stakeholders involved, who have clear plans to address the two:

  As mentioned, the interview process led to somewhat unsatisfying answers as interviewees could not prepare into depth for specific topics that were asked. The topic chosen in this thesis seemed very specific and not of competence of many interviewees, who appear to be interested in more research. In spite of reported gaps in terms of specific knowledge by the institutions involved, it is clear that the topic involves great complexity and that the solution requires the collaboration of many stakeholders.

4.5 Future Outline

Due to the short time frame of the thesis and the identified complexity of the topic, further research of the topic of walkable soundscape is recommended, especially in future development plans for public space in the City of Gothenburg. In order to gain a sustainable city life, addressing these issues is of importance and should be implemented earlier in planning processes. An adequate approach needs to be identified specifically, since it can vary according to specific countries or municipalities. Future research of the topic addressed in this thesis can deal with planning processes generally within the region or a deeper focus on either on of the two parts, soundscape or walkability. However, it is of high importance to keep the different aspects in mind, since urban planning processes are complex and need to be executed with careful consideration of all involved parties and stakeholders.

5
Conclusion

This thesis was carried out as research for design. The work that is presented in this thesis is based on qualitative and quantitative data collected from interviews, literature review and antecedent interventions that were named best practices. The findings from this initial research created a framework that was used to analyse a case study in the city of Gothenburg. In the final part of this thesis strategies for the implementation of an urban sound planning and walkability strategy in Frihamnen and its surrounding areas are suggested.

The research process in this thesis revealed a lack of understanding and implementation of principles related to soundscape in the planning processes in the City of Gothenburg. This ultimately has an effect on the well-being of the citizens of the future city and need to be addressed accordingly.

A connection between walkability and soundscape was identified and addressed in design proposals which aim to be used as a framework in future planning processes and when densifying the city.

The Challenge Lab procedure, that was the framework for this thesis, enabled a different identification of current processes in the area of Västra Götaland. The interdisciplinary approach of the thesis gave different insights into the issue addressed, which can be seen as beneficial for future collaborations.

It is advised to conduct more research in the field of urban densification and its consequences on health. Further research towards interdisciplinary collaborations in urban planning is also recommended to find solutions for better quality of life in cities, and that is also addressing the UN Sustainability Goals and well-being as key aspects.

Bibliography

Ali, Sayed Abas, and Akihiro Tamura. 2003. *Analysis of road traffic noise level and control in Greater Cairo, Egypt.*

Älvstaden. 2017. *Hållbarhetsprogrammet för Frihamnen.*

Andersson, Claes, Anton Törnberg, and Petter Törnberg. 2014. "Societal systems - Complex or worse?" *Futures* 63:145–157.

Argyris, Chris. 1977. "Double loop learning in organizations". *Harvard Business Review* 55 (5): 115–125. http://www.westernsnowandice.com/09-Presos/DoubleLoop.pdf.

Bahalı, Sercan, and Nurgün Tamer-Bayazıt. 2017. "Soundscape research on the Gezi Park – Tunel Square route". *Applied Acoustics* 116:260–270. ISSN: 0003682X. doi:10.1016/j.apacoust.2016.10.002.

Basner, Mathias, et al. 2014. "Auditory and non-auditory effects of noise on health". *The Lancet* 383 (9925): 1325–1332. ISSN: 01406736. doi:10.1016/s0140-6736(13)61613-x.

Bergek, Anna, et al. 2008. "Analyzing the functional dynamics of technological innovation systems : A scheme of analysis Analyzing the Functional Dynamics of Technological Innovation Systems : A Scheme of Analysis **". *Research Policy* 37 (37): 407–429.

Bohl, C. 2002. *Place Making - Developing Town Centres, Main Streets, and Urban Villages* 1.

Carmona, M., et al. 2010. *Public Places Urban Spaces* 1.

Chew, You Ren, and Bing Sheng Wu. 2016. "A soundscape approach to analyze traffic noise in the city of Taipei, Taiwan". *Computers, Environment and Urban Systems* 59:78–85. ISSN: 01989715. doi:10.1016/j.compenvurbsys.2016.05.002.

Costa, Conceição. 2014. *Media objects and pre-teens' expressions of identities.*

Cruz, Ivonne, Andri Stahel, and Manfred Max-Neef. 2009. "Towards a systemic development approach: Building on the Human-Scale Development paradigm". *Ecological Economics* 68 (7): 2021–2030.

Deichmann, Jessica L., et al. 2017. "Soundscape analysis and acoustic monitoring document impacts of natural gas exploration on biodiversity in a tropical forest". *Ecological Indicators* 74:39–48. ISSN: 1470160X. doi:10.1016/j.ecolind.2016.11.002.

Dreborg, Karl H. 1996. "Essence of backcasting". *Futures* 28 (9): 813–828.

Dumyahn, Sarah L., and Bryan C. Pijanowski. 2011. "Soundscape conservation". *Landscape Ecology* 26 (9): 1327–1344. ISSN: 0921-2973 1572-9761. doi:10.1007/s10980-011-9635-x.

Estevez Mauriz, Laura, et al. 2016. “Urban Sound Planning: the SONORUS project”. *Chalmers University of Technology*.

Flood, Robert L. 1998. “"Fifth Discipline": Review and Discussion”. *Systemic Practice and Action Research* (New York) 11 (3): 259.

Fong, J. 2014. “Making operative concepts from Murray Schafers soundscapes typology: A qualitative and comparative analysis of noise pollution in Bangkok, Thailand and Los Angeles, California”. *Urban Studies* 53 (1): 173–192. ISSN: 0042-0980 1360-063X. doi:10.1177/0042098014562333.

Geels, F. W. 2005. “Processes and patterns in transitions and system innovations: Refining the co-evolutionary multi-level perspective”. *Technological Forecasting and Social Change* 72 (6 SPEC. ISS.): 681–696. ISSN: 00401625. doi:10.1016/j.techfore.2004.08.014.

Gehl, J. 2010. *Cities for People* 1.

Hållbar Stad. 2017. *Frihamnen Picture*.

Holmberg, J, and K -H Robert. 2000. “Backcasting - a framework for strategic planning”. *International Journal of Sustainable Development & World Ecology* 7 (4): 291–308.

Holmberg, John. 2000. “2 pages on principles for sustainability”.

– . 1998. “Backcasting: A Natural Step in Operationalising Sustainable Development”. *Greener Management International* 23:30–51.

– . 2014. “Transformative learning and leadership for a sustainable future: Challenge Lab at Chalmers University of Technology”. In *Intergenerational learning and transformative leadership for sustainable futures*, 68–78. Wageningen Academic Publishers.

Holmberg, John, K. H. Robert, and K. E. Eriksson. 1996. “Socio-ecological principles for sustainability”. In *Getting Down to Earth: Practical Applications of Ecological Economics*, 494.

Holmberg, John, and Karl-Henrik Robèrt. 2000. “Backcasting from non-overlapping sustainability principles–a framework for strategic planning”. *International Journal of Sustainable Development and World Ecology* 7 (4): 291–308. http://www.ima.bth.se/data/tmslm/refs/Backcasting%7B%5C_%7D0013.pdf.

Hosanna. 2013. *Novel Solutions for Quieter and Greener Cities* 1.

Hutabarat Lo, R. 2009. “Walkability: what is it?”

Irvine, Katherine N., et al. 2009. “Green space, soundscape and urban sustainability: an interdisciplinary, empirical study”. *Local Environment* 14 (2): 155–172. ISSN: 1354-9839 1469-6711. doi:10.1080/13549830802522061.

Isaacs, William. 1999. “Dialogic leadership”. *The systems thinker* 10 (1): 1–5.

Isaacs, William N. 1993. “Taking flight: Dialogue, collective thinking, and organizational learning”. *Organizational Dynamics* 22 (2): 24–39.

Jacobs, J. 1961. *The Death and Life of Great American Cities* 1.

Kamal, Mona, and Reem Abd El-Rahman. 2015. *Evaluation of Noise Levels affecting Schools in Cairo - Egypt*.

Krambeck, H. 1999. “The Global Walkability Index”.

Lawson, Bryan. 2006. *How designers think: the design process demystified*. Routledge.

Liu, Fangfang, and Jian Kang. 2016. "A grounded theory approach to the subjective understanding of urban soundscape in Sheffield". *Cities* 50:28–39. ISSN: 02642751. doi:10.1016/j.cities.2015.08.002.

Lynch, K. 1960. 1.

Maag, T., T. Kocan, and A. Bosshard. 2017. 1.

Maculewicz, Justyna, Cumhur Erkut, and Stefania Serafin. 2016. "How can soundscapes affect the preferred walking pace?" *Applied Acoustics* 114:230–239. ISSN: 0003682X. doi:10.1016/j.apacoust.2016.07.031.

Mags, A., B. Davies, and Bruce. 2009. "Soundscape: an urban planning proccess map".

Maristany, Arturo, Manuel Recuero López, and Cesar Asensio Rivera. 2016. "Soundscape quality analysis by fuzzy logic: A field study in Cordoba, Argentina". *Applied Acoustics* 111:106–115. ISSN: 0003682X. doi:10.1016/j.apacoust.2016.04.013.

Meadows, D. 1997. *Places to intervene in a system.*

Miljöförvaltningen, Göteborg Stad. 2013. "Bullernivå stadsdel: centrum".

Minton, Anna. 2009. *Ground control:Fear and happiness in the twenty-first-century city.*

National Park Service. 2016. *Yosemite National Park Soundscape.*

Oldenburg, R. 1990. *The Great Good Place: Cafes, Coffee Shops, Bookstores, Bars, Hair Salons, and Other Hangouts at the Heart of a Community* 1.

Ozkurt, Nesimi, Samet Feyyaz Hamamci, and Deniz Sari. 2015. "Estimation of airport noise impacts on public health. A case study of İzmir Adnan Menderes Airport". *Transportation Research Part D: Transport and Environment* 36:152–159. ISSN: 13619209. doi:10.1016/j.trd.2015.02.002.

Patelli, Paolo. 2016. "A field is to play. Enacting mental images of the soundscape". *Emotion, Space and Society.* ISSN: 17554586. doi:10.1016/j.emospa.2016.11.002.

Paunovic, K., G. Belojevic, and B. Jakovljevic. 2014. "Noise annoyance is related to the presence of urban public transport". *Sci Total Environ* 481:479–87. ISSN: 1879-1026 (Electronic) 0048-9697 (Linking). doi:10.1016/j.scitotenv.2014.02.092.

Puyana Romero, Virginia, et al. 2016. "Modelling the soundscape quality of urban waterfronts by artificial neural networks". *Applied Acoustics* 111:121–128. ISSN: 0003682X. doi:10.1016/j.apacoust.2016.04.019.

Raimbault, Manon, and Danièle Dubois. 2005. "Urban soundscapes: Experiences and knowledge". *Cities* 22 (5): 339–350. ISSN: 02642751. doi:10.1016/j.cities.2005.05.003.

Raworth, Kate. 2012. "A Safe and Just Space For Humanity: Can we live within the Doughnut?" *Nature* 461:1–26. http://www.oxfam.org/en/grow/policy/safe-and-just-space-humanity.

Rehan, Reeman Mohammed. 2016. "The phonic identity of the city urban soundscape for sustainable spaces".

Robinson, Les. 2009. "A summary of Diffusion of Innovations". *Energy Policy*: 1–10. www.enablingchange.com.au.

Rockstrom, Johan Et Al., et al. 2009. "A safe operating space for humanity". *Nature* 461 (September): 472–475.

Ryan, R M, and E L Deci. 2000. "Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being." *American Psychologist* 55 (1): 68–78.

Sandow, Dennis, and Anne Murray Allen. 2005. "The Nature of Social Collaboration - How Work Really Gets Done". *The Society for Organizational Learning* 6 (2/3): 1–14.

Schafer, R. Murray. 1977. "The Soundscape: the tuning of the world".

Scharmer, C. Otto. 2007. "Theory U: Leading from the future as it emerges". *The Social Technology of Presencing by SoL Press*: 1–13. `https://www.waisman.wisc.edu/naturalsupports/pdfs/summer/Theory.pdf`.

Senge, Peter M., and Goran Carstedt. 2001. "Innovating Our Way to the Next Industrial Revolution". *MIT Sloan Management Review* 42 (2): 24–38.

Senge, Peter, Hal Hamilton, and John Kania. 2015. "The Dawn of System Leadership | Stanford Social Innovation Review". *Stanford Social Innovation Review* Winter.

Shannon, G., et al. 2016. "A synthesis of two decades of research documenting the effects of noise on wildlife". *Biol Rev Camb Philos Soc* 91 (4): 982–1005. ISSN: 1469-185X (Electronic) 0006-3231 (Linking). doi:`10.1111/brv.12207`.

Smith, Adrian, Jan Peter Vo??, and John Grin. 2010. *Innovation studies and sustainability transitions: The allure of the multi-level perspective and its challenges*.

Smith, RT, and PRJ SAGE. 2015. "Management and Business Research Mark Easterby". *SAGE*.

Söderberg, Örjan. 2014. "Design Thinking - A Challenge Lab compendium".

SpaceScape. 2014. *Frihamnen and Backaplan, City structural analysis and design recomendations* 1.

Stadsbyggnadskontoret, Göteborg Stad. 2015. "Översiktlig bullerutredning – Frihamnen etapp 1".

Stewart, Greg L, Stephen H Courtright, and Charles C Manz. 2011. "Self-Leadership: A Multilevel Review". *Journal of Management* 37 (1): 185–222.

Stewart, J.M. 1993. "Future State Visioning - Powerful Leadership Process". *Long Range Planning* 26 (6): 89–98.

TDM. 2014. "Transpord Demand Management Encyclopedia".

The Cultural Landscape Foundation. 2016. *Paley Park*.

Tom Crompton, September. 2010. *Common Cause: The Case for Working with our Cultural Values. WWF-UK*.

Trafikverket. 2016. "Analysmetod och samhällsekonomiska kalkylvärden för transportsektorn: ASEK 6.0: Kostnad för buller".

United Nations. 2015. "World Population Prospects: Key Findings and advance tables".

United Nations General Assembly. 2015. *Transforming our world: The 2030 agenda for sustainable development*. Tech. rep. 1.

Västsvenska Paketet. 2016. "Bulleruppföljning av Västsvenska paketet: Del 4: Nulägesbeskrivning av exponering för vägtrafikbuller i Göteborg och Mölndal, 2014".

Vergragt, Philip J., and Jaco Quist. 2011. "Backcasting for sustainability: Introduction to the special issue". *Technological Forecasting and Social Change* 78 (5): 747–755.

WCED. 1987. *Our Common Future*. Tech. rep. 1.

Whyte, William. 1980. *The Social Life of Small Urban Spaces*.

World Health Organisation. 2016. *Global report on urban health: equitable, healthier cities for sustainable development* 1.

Zhang, Dongxu, et al. 2016. "Soundscape evaluation in Han Chinese Buddhist temples". *Applied Acoustics* 111:188–197. ISSN: 0003682X. doi:10.1016/j.apacoust.2016.04.020.

A

Description about the separation of the work

In this description, the individual work on the thesis of the two students is shown. As this thesis is the result of a joint collaboration between two authors the separation of the work is presented in this section.

Shared contribution: Phase 1; 3.2 Research Objectives; 3.3 Hypothesis; Discussion; Conclusion

Fabio Latino: Walkability related, design principles and architectural interventions for Soundscape and Walkability, that is 3.1.2 Walkable soundscapes / 3.6.2 Walkability; 3.7 Best Practices (walkability related); 3.8 Design Principles; 3.9 Case study analysis (Lynch analysis); 3.10.2 Lynch mapping; 3.10.3 Design Proposal;
Figures: 3.5; 3.9; 3.10 - 3.12 (modified by author); 3.13; 3.19; 3.20 - 3.22; 3.25 - 3.27; 3.29; 3.30; 3.31 (modified by the author); 3.32 - 3.37; 3.38 (modified by the author); 3.39 - 3.44

Pascal Kuta: Soundscape theory, that is 3.1.1 Cost of Noise / 3.6.1 Soundscape; 3.7 Best Practices (Soundscape related); 3.9 (Soundscape mapping), 3.10.1 (Planning and Strategy for Frihamnen));
Figures: Cover (modified by the author); 3.1; 3.6; 3.14; 3.18; 3.23 - 3.24, 3.28.