CHALMERS
UNIVERSITY OF TECHNOLOGY

The development of a sustainable urban district in Sweden: common practice, best practice and Frihamnen.

Challenge lab 2015: Sustainable urban development

Master's Thesis in the Master's Programme Design and Construction Project Management

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Department of Civil and Environmental Engineering
Division of Building Technology
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CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg, Sweden 2015
Master's Thesis 2015:16

MASTER'S THESIS 2015:16

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Cover:
Cover picture depicts the Frihamnen district as part of River City (Älvstaden), courtesy of the City of Gothenburg (Göteborgs Stad) (http://alvstaden.goteborg.se/omradet/frihamnen/)
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ABSTRACT

District development in Sweden both shapes and is shaped by multiple societal, environmental and economic factors. The role and responsibility of district development projects is therefore important and requires great attention from both The Client and The Suppliers. Multiple researchers point at the need of transitions towards sustainability within the construction industry, as the trends of growing CO_{2aq} concentration, growing construction prices, high percentage of wasteful construction activities and urbanisation require rethinking how cities should be planned and built.

The Master Thesis report aims at analysing Frihamnen district development in Gothenburg, Sweden regarding sustainability goals and implementation processes. Key points of common practice and best practice of sustainable construction in Sweden are used to identify success, challenges and suggestions for Frihamnen district develop.

The Master Thesis is structured in two phases, with phase one defining the research question according to the Challenge Lab framework, and phase two focusing on analysing the findings within Frihamnen. Backcasting is used as the governing methodology for the whole Master Thesis framework, with qualitative interviews and Gap analysis as main methodologies for the empirical research. The conclusion of the thesis raises the need of developing clear, measurable sustainability criteria in Frihamnen as well as agreeing on implementation processes that guarantee sustainable district development.

Key words: Frihamnen, sustainable construction, district development, criteria of sustainability, sustainability methodologies, Gap analysis.

Hållbar stadsutveckling inom Sverige: allmän praxis, best praxis och Frihamnen.
Challenge Lab 2015: Hållbar stadsutveckling

Examensarbete inom masterprogrammet Organisiering och ledning inom bygg- och fastighetssektorn

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SAMMANFATTNING

Stadsutvecklingen inom Sverige både formar och formas utav flera samhälleliga, miljömässiga och ekonomiska faktorer. Detta medför till att roll och ansvarstagande inom distrikts utvecklingsprojekt har en betydande del samt kräver stor uppmärksamhet från både klienten och leverantörerna. Flera forskare pekar på behovet av övergångar mot hållbart byggande inom byggbranschen. Detta på grund av trenden med växande CO_{2aq} koncentrationen, växande byggpriser, den hög andel av oekonomiska byggverksamheter samt urbaniseringen. Härmed krävs det ett nytänkande kring hur städer ska planeras och konstrueras.

Examensarbetet syftar till att analysera stadsutvecklingen inom Frihamnen i Göteborg stad, Sverige, samt hållbarhetsmålen och implementeringsprocesser för projektet. Huvudpunkterna inom allmän praxis samt best praxis för hållbart byggande i Sverige används inom examensarbete med syfte att identifiera framgång, utmaningar och förslag till utvecklingen av Frihamnen distrikt.

Examensarbetet är uppdelat i två delar, varav del ett definierar frågeställningen enligt ramverket för Challenge Lab och del två fokuserar på att analysera resultaten inom Frihamnen. Backcasting används som styrande metod inom båda delarna tillsammans med kvalitativa intervjuer samt metoden Gap-analys för den empirisk forskning inom del två. Slutsatsen i avhandlingen lyfter upp behovet av att utveckla tydliga och mätbara hållbarhetskriterier i Frihamnen projektet samt enas om implementeringsprocesser som garanterar hållbar stadsutveckling.

Nyckelord: Frihamnen, hållbart byggande, stadsutveckling, hållbarhets kriterier, metodologi för hållbar utveckling, Gap-analys

Contents

Preface

In this study, interviews were performed with Älvstranden Utveckling AB, Gothenburg City Planning Council and six companies from The Consortium – Company 1, Company 2, Company 3 , Company 4, Company 5 and Company 6. The work is a part of The Challenge Lab 2015 as Phase Two. Phase Two was carried out at the Department of Civil and Environmental Engineering, Sustainable Building, Chalmers University of Technology, Sweden.

Phase One was carried out by the Master Thesis authors together with eleven other Master Programme students. John Holmberg as the supervisor and David Andersson as the project manager and coordinator supervised and assisted with this phase. Phase Two has been carried out with Professor Holger Wallbaum as the supervisor. We would also like to thank Älvstranden Utveckling AB, Gothenburg City Planning Council and The Consortium for their co-operation and involvement.

Finally, it should be noted that the Master Thesis could not have been complete without the support from our families.

Gothenburg August 2015

Tania Jadaan

Konstantin Mina

Notations

ACAP – Absorptive Capabilities Package
AEC – Architects, Engineers & Contractors
BAM – Building Assessment Methodologies
BAU - Business As Usual
BREEAM – Building Research Establishment Environmental Assessment Method
C-Lab – Challenge Lab
CEE – Cost of Environment Errors
CLD – Causal Loop Diagrams
ESPA – European Parking Award
FSV – Future State Visioning
GFA – Gross Floor Area
LCA – Lifecycle Assessment
LCC – Lifecycle Costing
LEED – Leadership in Energy and Environmental Design
QDA – Qualitative Data Analysis
SDT – Self Determination Theory
USGBC – U.S. Green Building Council

1 Introduction

The classic definition for sustainable development is:

"… Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts:

- The concept of 'needs', in particular, the essential needs of the world's poor, to which overriding priority should be given; and
- The idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs."
  (The United Nations committee, 1987)

On the one hand, the definition illustrates the importance of both long-term multi-generational strategies and short-term immediate solutions. This includes multiple perspectives, not only the most known ones - environmental, societal and economical - but also technological and well-being perspectives.

On the other hand, *Chalmers for a sustainable future* is the vision of both short-term and long-term technical solutions as well as strategic objectives merged together. In order for the vision to be achieved efficient collaboration with the society, industries, businesses and universities must be made. However, the areas within Chalmers will face crucial challenges in order to transition to a sustainable society. Collaborations can be reached through interdisciplinary education, research and innovation (Chalmers University of Technology, 2013). Put differently, to reach the vision of having a sustainable future by strengthening the overall scientific research but also including entrepreneurship, students and innovation. In order to reach the vision students, researchers and entrepreneurs are set up to meet to create ideas and encourage initiative, which results in cooperation with great opportunities. This environment creates a rich soil for many collaboration projects that include the perspective of Chalmers vision - one of which is The Challenge Lab.

On the society level, The City of Gothenburg, together with the Västra Götalands region, is working on numerous common strategies that would make Gothenburg a beacon for sustainability by the year of 2050. Among a multitude of project programmes in the cities strategic plans, "Gothenburg 2021" (the 400-year anniversary celebration), is one of the key projects. "Gothenburg 2021" is looking to develop, among others, social sustainability, new housing and urban planning (Göteborg & Co, 2014).

1.1 What is Challenge Lab

Challenge Lab (C-Lab) is a neutral arena where a group of master students, in the transition of becoming change agents, are focusing on sustainability challenges and excluding market necessities as well as technical prospects. Challenge Lab deems that the students acting as change agents will contribute to new focus on challenge driven innovation as well as transformative solutions in society.

The C-Lab is looking to connect the three main institutions contributing to the complex societal challenges, which are academia, public sector and private sector (Figure 1). They are also identified as the Triple Helix, where each institution is

overlapping the other with the intention of emerging the crossbreed organisations at the interfaces (Figure 2).

Figure 1 Challenge Lab- Change Agents (based on Holmberg, 2014).

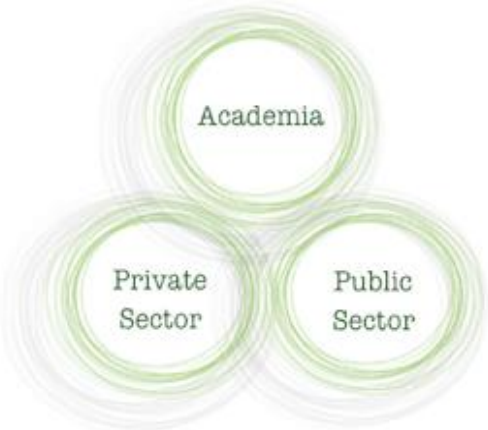

Figure 2 Triple Helix Players, based on Holmberg (2014).

Multiple scholars have noted the importance of interconnections between these sectors. The common impartial according to Etzkowitz and Leydesdorff (2000) is to realize the need for innovative environmental solutions as well as transformative by strategic alliance among the institutions but also within different levels of technology, academic research groups, operating areas and governmental workshops.

The incorporation of academia within the Triple Helix has contributed to the attentiveness of the identification of what academia is. The knowledge triangle mentioned by Maassen and Stensaker (2011) stresses that academia includes three corner stones which are research, education and innovation. The knowledge triangle has created new challenges for universities in the sense of adapting to the three corner stones in a comprehensible way. The mission of Challenge Lab is to implement the knowledge triangle in order to strengthen the educational dimension within the Area

of Advance by including the five regional knowledge clusters, see Figure 3, in order to create a natural hub for the players within the triple helix (Holmberg, 2014).

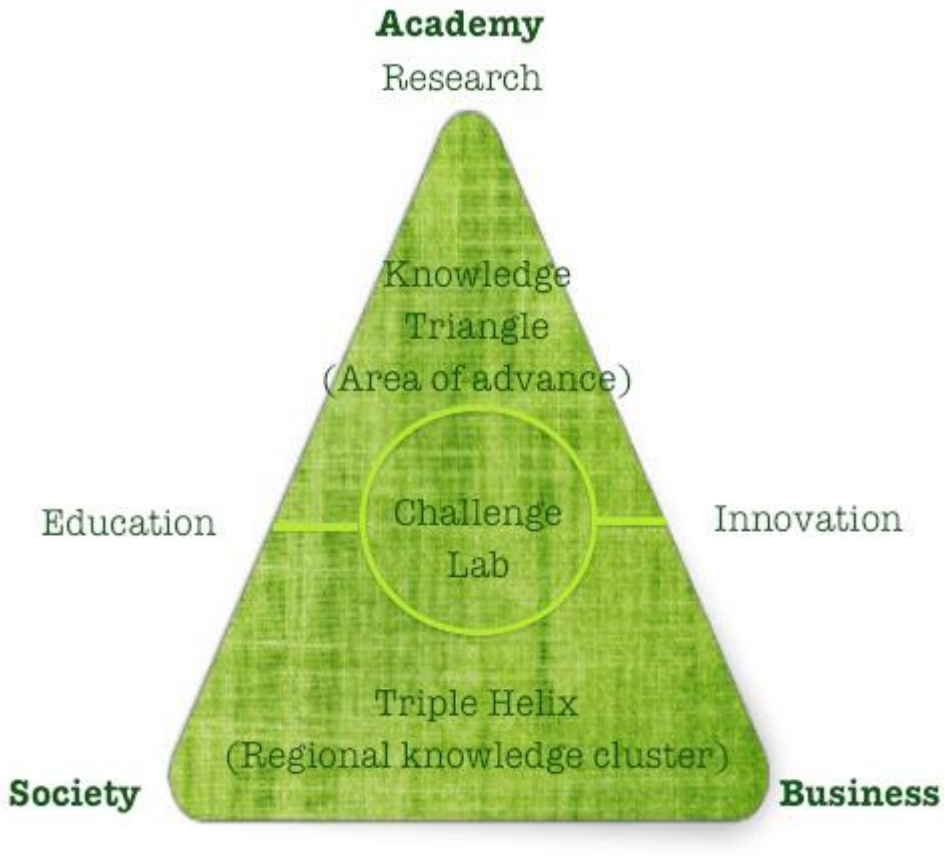

Figure 3 The Challenge Lab mission, (based on Holmberg, 2014).

Finally, not only is Challenge Lab a new and innovative form of academia work but also a challenge-driven research innovation towards a sustainable future. Sustainability is a complex definition in itself globally whereas the core challenge is to understand the complexity of the system as well as how to interfere once it is comprehended. This is where the Challenge Lab methodology arose.

1.2 Aim and Objectives

The aim of Challenge Lab is to understand the ability of how an interdisciplinary group can cooperate with different actors with the purpose of creating a sustainable future without diminishing future generations from natural resources. Furthermore, C-Lab aims to compound different actors with the purpose of creating innovative solutions within the complex system and acts as a "neutral arena" where different actors gather for a combined dialogue regarding sustainability.

The objectives of C-Lab are to understand and implement the Challenge Lab's methodology of providing a neutral hub for the actors within the triple helix and lastly create a research question on how to contribute to the transition towards a sustainable urban development within Gothenburg City.

1.3 Overall Structure

The structure of the Challenge Lab Master Thesis consists of three major parts, which are subdivided into smaller segments according to the requirements and goals associated with these parts. The three major parts are:

1) Leadership for Sustainability Transitions - a Challenge Lab preparatory course;
2) Phase One of the Challenge Lab;
3) Phase Two of the Challenge Lab.

The overall deliverable of Phase One and Phase Two is the Master Thesis report, which includes academic research, practicality, sustainability equality in terms of awareness and action.

1.3.1 Leadership for Sustainability Transitions - a Challenge Lab preparatory course

"Leadership for Sustainability transitions" is a university course specifically designed to provide theoretical background and practical experience for students to be prepared for the Challenge Lab Master Thesis. The course is set around the same theoretical approaches that C-lab implements, but on a smaller scale, for example campus development scale compared to urban development. The main theories are backcasting (Holmberg and Robèrt, 2000), self-leadership (Ryan & Deci, 2006), systems thinking (Haraldsson, 2004), stakeholder dialogues (Isaacs, 1999), design thinking (Söderberg, 2014), outside-in and inside-out perspectives.

The course includes lectures, presentations, group assignments, individual assignments as well as stakeholder dialogues, whereas the lectures create awareness on why participation in sustainability transitions is in need of being acknowledged. The acknowledgement arose when the trends within the current system are identified and understood. Furthermore, stakeholder dialogues are valuable environment for getting to know what is going on in current projects, identifying visions and analysing the challenges for sustainability transitions aimed at reaching these visions.

1.3.2 Phase One of the Challenge Lab

The first phase of the C-lab focuses on the main topic - Sustainable Urban Development. During the first phase teams are formed, common goals are set, deliverables and planning procedures are discussed, information exchange channels are set up and personal areas of interest are shared.

The main purpose of Phase One is to disregard formed opinions and ask more questions, in order to get a clearer overall picture of the current situation within Urban Development. On the individual level, self-leadership seminars are held to identify the values, strengths and focus topics of each participant in the C-lab. The areas of interest are presented through round-table meetings and shared among each other.

The end of Phase One the overall picture of areas of interest is drawn. Each participant of the C-lab illustrates their interests out of the list, which allows visualisation of their "energies". Finally, the process of narrowing down to interests

for separate Master Theses starts. At this point lies the beginning of Phase Two of the C-lab.

1.3.3 Phase Two of the Challenge Lab

During the Phase Two of the Challenge Lab, smaller teams work individually to formulate the areas of interests, research questions, find supervisors and work on the Master thesis report. Even though the research questions are related to the team member's Master programme, collaboration between different projects is promoted.

Next, the literature review starts, followed by analysis of Urban Development projects, qualitative & quantitative studies, interviews and surveys of the stakeholders and other empirical data collection procedures. Further, the collected information is to be analysed and compared with an idea, a model, or used for making a prototype or a design. Finally, a discussion is performed to include the whole steps within the C-lab and conclusions are formulated to answer the research questions.

2 Phase One

2.1 Backcasting

The backcasting methodology allows to create a desirable long-term vision on sustainable future and to find possible ways to realise the vision (Holmberg & Robert, 2000). Some scholars argue further that backcasting is an approach that in itself can include many methodologies, depending on actors involved, the normative future envisioned, the case analysed and strategies to reach the vision (Dreborg, 1996). Nevertheless, Dreborg (1996) agrees that backcasting should focus on a desired state and achievements, rather than the real state and how to increase/decrease its development. It is an approach and/or a methodology for a complex and complicated desired future.

Backcasting consists of four parts, which starts with the future development that is wanted, continues through the present situation and finishes with creating multiple solutions, realised through a stepwise transition strategy. Figure 4 illustrates the application of backcasting methodology, developed by John Holmberg in 2014. This means that the start is with principles and finding the meaning for the actors involved. Future state visioning (FSV) is an approach, which directly involves the environmental limits and stakeholders participating in the transition (Stewart, 1993). Both of these approaches start from a future desired state, followed by application of the restrictions of the current state. Solutions for changing the present situation are identified and based on the actors' competences as well as what base is decided to be necessary.

The tools for backcasting are rich in content and context and can complement extrinsic and intrinsic foci. Such complements can be found by combining, for example, fundamental human needs (Max-Neef, 1992) with personal values & strengths, causal loop diagrams with double loop learning and other combinations of tools (Holmberg & Robert, 2000).

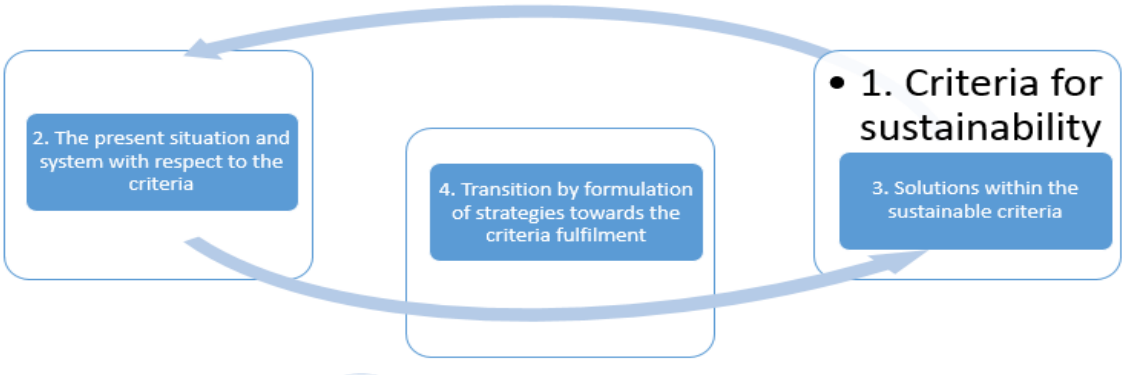

Figure 4 *Example of using Backcasting method for sustainable transitions (Holmberg & Robert, 2000).*

Backcasting requires an entrepreneurial approach more than an ordinary managerial approach because it stimulates innovation, the dare to challenge the existing system, the creation of change agents (MacKay, L., Scheerer, A. & Takada, T,. 2005). Management is not necessarily about the changes, but rather focusing in steering the

organisation towards goals, growth as well as proper handling of the existing system. Backcasting is suitable for complicated and complex systems with great problems, which are very difficult to deal with and require different stakeholder involvements. Participatory backcasting brings in multiple stakeholders into the process, while expert backcasting is used for outsourcing consultancy (Vergragt, 2011; Robinson et al, 2011).

2.2 Outside-in perspective

The outside in perspective is useful for understanding the pattern of things happening in the world, as well as the fusion and transition of innovation systems. The perception of people being stuck in an existing system is strong; thereby it is important to determine the most important transition goals for a whole society, academia and organisation when following the outside-in perspective.

2.2.1 Principles for sustainable development

Sustainable development deals with meeting the needs of the present generation without compromising the needs of future generations. The frameworks of sustainable development are designed to assist in developing the society into a future state that follows the Compass of sustainability criteria as well as introduces additional boundaries, derived from the trends extrapolation.

Holmberg et. al. (1996) describe the four principles of how society should behave in the socio-ecological system to follow the sustainable development. These principles are about limiting extraction of substances from the lithosphere to the ecosphere, limiting accumulation of unnatural substances in the ecosphere, limiting the handling of the ecosphere that causes degradation and efficient use of technology for satisfying human needs (Holmberg et. al., 1996).

The doughnut model is one of many sustainability frameworks aimed at reducing the negative environmental impacts without compromising humanities well-being (see Figure 5). The model is shaped like a doughnut, where well-being and society boundaries forming the inner limits and environmental boundaries - the outer limits. The inside of the “doughnut” is the society formed through sustainable development, where the natural limits of the planet (land, water, air) are in balance with the societal demands and the economy is the instrument of management (Raworth, 2012).

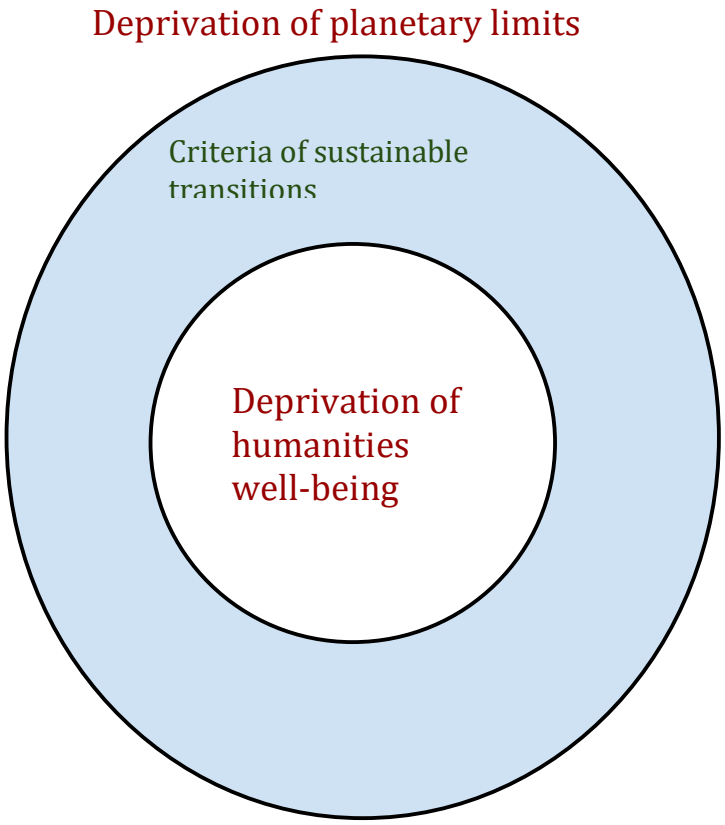

Figure 5 *The "doughnut" sustainable development framework (based on Raworth, 2012).*

The specific boundaries and directions of necessary change addressed by Raworth (2012) within the doughnut model are:

- Environmental boundaries, reduction of: climate change, freshwater use, nitrogenous and phosphorus emissions, ocean acidification, atmospheric aerosol and other chemical pollutant concentration, ozone depletion, biodiversity loss and land use change.
- Human well-being boundaries: refocusing water, energy and food from excess in rich social groups to lack of poorest social groups; equally accessible health and education facilities, support in gender, job, voice and social equality, economic (non-crisis) resilience.

Some of the mentioned boundaries have already been overstepped, while other developments are approaching the limits. Biodiversity loss, nitrogen concentrations, CO_2 concentrations and climate changes exceed the carrying capacity of the planet, with ozone depletion, land use change, ocean acidification and freshwater use approaching this capacity. Despite the excess stress on the external boundaries, internal boundaries are also challenged, with significant percentage of world population living on poor sanitation, healthcare and energy levels as well as gender, social and income inequalities (Röckström, 2009).

The United Nations council has created the Sustainable Development goals based on these growing stresses on the world boundaries. The goals address all of the environmental and human well-being boundaries and propose counter actions to the

negative trends. In addition, the goals include global partnership for Sustainable Development, peaceful and impartial societies, and inclusive, safe, resilient and sustainable cities (UNWorkingGroup, 2014).

2.2.2 The Compass

Despite the discussion of the importance of existing trends that influence nature, society, economy and well-being, backcasting urges to define the vision of a desirable future without taking the current situation in the beginning. The compass is the tool for mapping the sustainability goals. It is recommended to start with guiding principles instead of solutions when applying backcasting. According to the compass model (Robert et.al. 1997), the dimensions of sustainability are Nature, Well-being, Society and Economy (see Figure 6*)*.

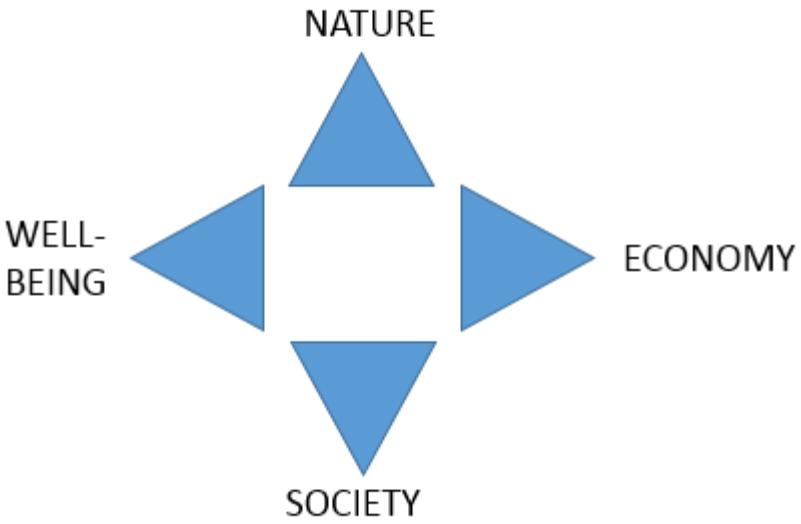

Figure 6. The Compass for the criteria of sustainability (based on Robert et.al, 1997).

The Nature dimension is for the criteria of sustainability concerning the ecosystem, the concentrations of particles from resource transformations and impact on natural habitats. Well-being is the capacity of fulfilling needs, desires and wishes of an individual person. Economy tackles the efficiency and effectiveness of use of resources. Society is the product of interaction of well-beings of each person together within certain framework (Robert et.al., 1997).

The starting point should be the most interesting criteria as well as the factors for those criteria. Next, the most influenced criteria should be developed. It is important to try to create the compass as simple as possible - but not simplistic (Robert et.al., 1997).

The common frame for drawing the structure is formed by the criteria of sustainability, which are agreed on between stakeholders. This framework creation can bring stakeholders with opposite opinions to cooperate better and agree on what is important instead of staying in the “silos” of professional competence (Robert et.al., 1997).

2.2.3 The Funnel

Backcasting methodology is the opposite of Business As Usual (BAU) and to forecasting. Both of the latter with different accuracy and precision either estimate what will happen or what could happen, while backcasting takes the uncertainty or specifies, what should happen (Holmberg & Robert, 2000).

Business As Usual and forecasting are often used as mind-sets based on experience, which assume the situation to develop in accordance to experienced changes in history. These methods are suitable to use in the funnel analysis as trend identification and projection, however, the more complex the system the more complicated the methodology is for increasing the probability of the projection following actual development (Dreborg, 1996).

The funnel is a double challenge visualisation of the depletion of resources and the growth of demand, which are the two main global trends. Growth of resources includes population, economy and material-energy intensity whereas decrease of resources includes decrease in non-renewable resources, assimilation and land area restrictions. The model is illustrated in Figure 7. The blue lines represent the current trends, the yellow lines - the bottleneck, at which the system faces huge challenges to continue existing, and the green curves - transition to a more sustainable society. The curve does not widen the bottleneck infinitely, as there is a potential of need to develop another system in the future (Robert, 1997; Holmberg, 1998).

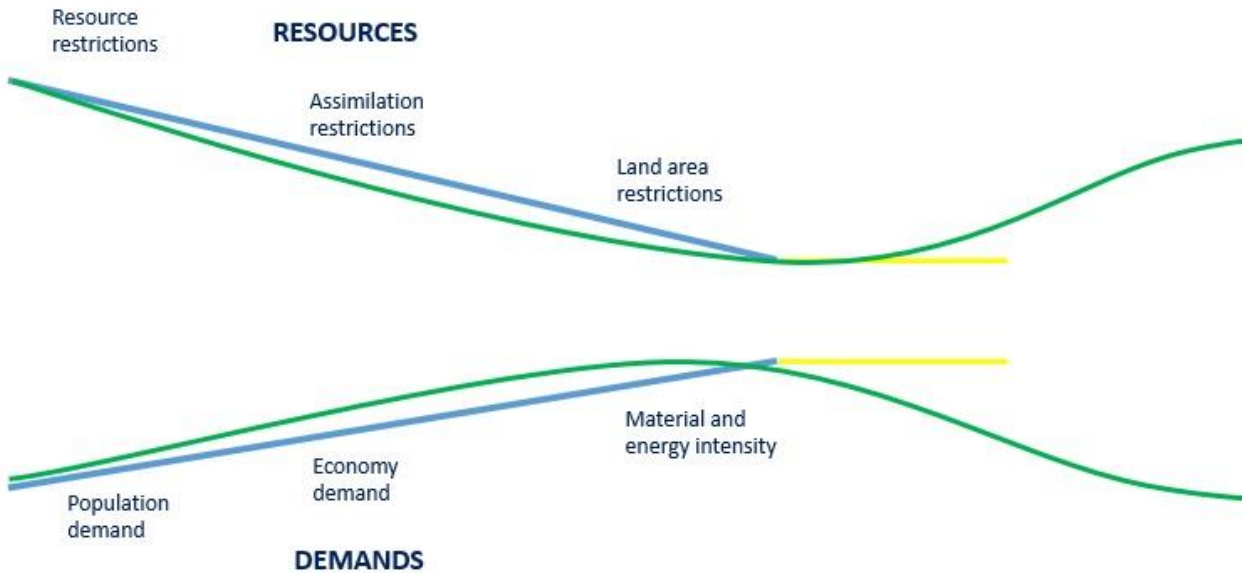

Figure 7 The funnel (based on Holmberg, 1998).

The resource demand side of the funnel has been developing in two major ways. From the beginning part of humanities development it can be said that the intensity and efficiency of material use, as well as the material growth, were on relatively low levels when correlating them with the planets boundaries. However, with technological development, the intensity of material use grew and the positive flux for material growth is still noticeable. This transition has mainly happened during the transition from the agricultural age to the industrial age, when traditional materials started to become consumed in big quantities for mass production, and the main

power source for any work changed from natural sunlight to fossil fuels (Holmberg, 1998).

The consequences of these trends were forecasted by Meadows et al. (1972), which were based on the existing technology of the 70's and history of that moment in time. Several conclusions were made to illustrate what the world would be heading towards if the situation does not change. The foreseen cause-effects where:

1) Increase in population, resource extraction and consumption and increase of population could lead to a sudden decline in population and material growth;
2) If basic material needs would be supplied to the population and employment allowed realisation of each person's potential, an equilibrium could be reached;
3) The sooner the transition starts towards the second cause-effect, the bigger the chances to avoid the first cause-effect model.

In "Limits To Growth" by Meadows et al. (1972), the growing and partially exponential demand is prescribed to increasing population and developing economies. Among the depleting resource side the research mentions decrease of food per capita, arable land, water and non-renewable natural resources. Even though the predictions over time were proven not as tremendous and many unpredicted historical, technological and social developments occurred, the trend is still noticeable and dangerous.

A more quantifiable illustration was developed through definition of approximate formulae for the environmental impact. The impact in nature I is based on four factors: population p, needed utility per capita U, lifestyle i and mass per monetary unit m. The total impact of environment can be approximated by formula: $\boldsymbol{I = i * m + U * p}$. It shows the impact of material on the environment plus activity of the society in economical terms, in essence how much money we spend on an activity (Holmberg and Karlsson, 1999).

2.2.4 Systems thinking

Systemic thinking (Flood, 1998) can facilitate understanding the complexity of sustainability transitions without breaking it into parts, in addition by synergizing personal mastery, mental models, shared vision and team learning. Team learning can allow the stakeholders to reach the achievements of desired goals by directing the energies towards synergetic knowledge development. Systems thinking is visible through applications of Causal loop Diagrams, Multi-level perspectives and system interventions (Flood, 1998).

Causal loop diagrams are important to get to the root of the problem in the current situation instead of treating the symptoms (Häraldsson, 2004). A systemic approach builds a picture of sequence of events in the current regime. Feedback may or may not be present in the loop. The loop could behave in two ways: reinforcing each of the following events that creates a progressive, often vicious circle, or balancing, where there is feedback and the events are opposing one another. The structure of causality might be set up in a way that changes occur in the same direction or change into different directions (Häraldsson, 2004).

Causal loop diagrams (CLD) are perfect models for perceiving the gap between the current and desired state. The simpler the CLD diagram, the easier it becomes to "feel" the gap. When connected to the Compass of Criteria for Sustainability, the most interesting, influenced and relevant factors are identified. In addition, leverage points can be identified and acupuncture needles designed in order to know which event (or events) should be influenced.
The identification of leverage points is not simple. To start with, a discussion should be performed through careful consideration on the nine factors (Meadows, 1997):

"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-organization.
2. The goals of the system.
1. The mind-set or paradigm out of which the goals, rules, feedback structure arise."

These points are not a recipe by themselves for identification of leverage points, but rather to stimulate discussions in the relative fields and to enhance. Numbers can be seen as means on the list, rather than ends, taken with respect to short or long delays in loop feedbacks. Proper design and build can be done for the new system, whereas for the old it is smarter to analyse the bottlenecks rather than redesign and rebuild it immediately. The feedback loop in strength and reaction time can be relative to the impact it is designed to correct. The reinforcing loops can be weakened rather than balancing loops being strengthened for having a well-functioning system. Information flows can empower the users to better understand what their decisions and actions bring into the system as well as to have a more trustworthy picture of the CLD. Rules can be designed not just to satisfy the ones making the rules, but to actually control the balance within the systems, with respect to multiple actors. Self-organisation through respect to personal values and diversities of other's values can be balanced with the rules of the system. System goals can be influenced to change with a clear, relatable point of view on the existing problems within a system. The same can happen with shifting paradigms for entire social systems. Finally, it can be that not a single paradigm is right within a system, and there is no single solution to solve the problem. Rather it can be possible to constantly develop the system to either solve problems or constantly change visions due to new discoveries (Meadows, 1997).

The delay in the system is always present to a degree, which causes oscillations. This is especially noticeable for balancing loops, when many cycles should pass before a resilient state of balance is reached. It takes time to identify the interaction between different factors and a common mistake is to make the model too difficult or too simple. One of the examples of application of the CLD, later translated into computer programs simulation, is the World Model for investigating the limits of development of humanity (Häraldsson, 2004).

Multi-level perspective is another way of simplifying the understanding of the complexity in thinking around systems. The purpose of this perspective is to understand how societal requirements transition between different socio-technical levels and systems through technological innovations. According to Geels (2004), the

transitions into applying technological innovations for a sustainable society face obstacles due to sectorial "lock-ins". Different social groups produce or reproduce sociotechnical systems according to incremental innovations. The micro-levels (niches) are often the incubators for radical innovations, change agents, learning processes and social relations that are relatively isolated from external environment influence. The macro-level (landscape) is the environment that due to the multitude of socio-technological aspects from multiple disciplines, the huge number of actors and high quantities of innovations from the niches are very limited in the way of which innovations are selected to form the landscape. However, it is the regime level that locks out the innovations coming from the niches due to the actors' aligning themselves to BAU and market demands within landscapes (Geels, 2004).

For innovations to reach the regime and the landscape levels, several steps have to be followed. The first step is to generate an idea based on what is missing in the regimes. The second step is to form a dedicated community of designers and users for learning and developing the ideas into models and prototypes. The third step is to diffuse the final product in the regimes according to contemporary and quasi-stable developments in existing socio-technical systems, with respect to what is lacking and where the demand for something new is necessary. Finally, during the fourth step, the innovation gradually replaces the old regime, after the lock-ins due to old investments and procedures are secured (Geels, 2004).

2.3 Inside-Out perspective

Inside-out perspective allows individuals to enhance the trust among each other, identify their own strengths, vision and values.

2.3.1 Background

The Inside-out approach includes methods, tools and knowledge to understand as well as to cope self-values, self-leadership and dialogue tools (Holmberg, 2014). In one hand, self-values include identifying own values, goals and strengths as well as building teams with active listening and openness and self-leadership includes inspiring leadership skills with the purpose of having a sustainable development approach. On the other hand, dialogue tools includes identification of co-creation and interaction tools in order to get "beneath the interface" with the purpose to recognize true driving forces (Holmberg, 2014).

2.3.1.1 Leadership skills

Personnel within an organisation are either engaged and proactive or reserved and passive dependently on the social conditions due to the limitation and availability of developing as well as functioning within the organisation. Researchers have realized correlation between self-determination and social conditions when individuals facilitate healthy psychological development and self-motivation. However, it is in the hands of the leadership abilities to create an atmosphere with constructive social conditions in order to engage the personnel within the organisation (Ryan and Deci, 2000).

Ryan and Deci (2000) developed the self-determination theory (SDT) in order to enhance human personality and motivation by developing humans' internal resources

for interactive self-regulation as well as personality development through engagement of organismic meta-theory and traditional empirical methods. The basis of humans' personality integration and self-motivation relies on their inborn psychological needs as well as characteristic growth. In one hand, the authors have identified three empirical process needs that are fundamental in order to facilitate optimum function of inborn tendencies for integration, which are personal well-being and positive social development, see Figure 8. On the other hand, the authors acknowledged coherence between environmental factors and self-determination, which undermines and hinder self-motivation, personal well-being and social functioning (Ryan and Deci, 2000).

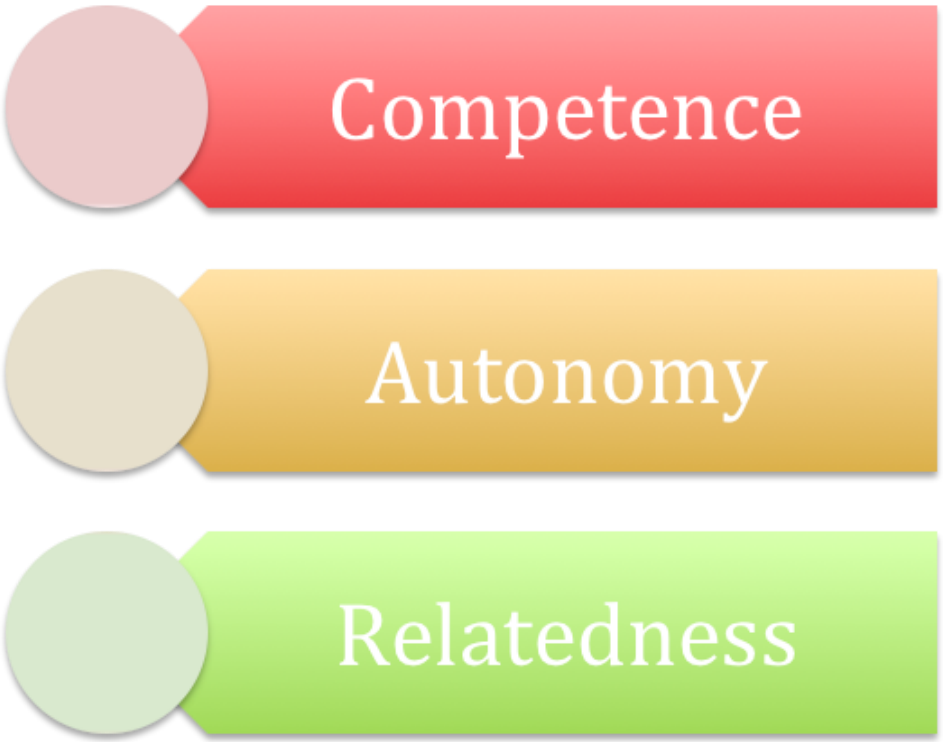

Figure 8 *The three empirical process needs of humans' personality integration and self-motivation (based on Ryan and Deci, 2000).*

According to Deci and Ryan (1985), it is necessary to understand the different types of extrinsic motivations in order to identify the depth of human motivation and engagement. Moreover, the authors' stresses that having environmentally caused intentions the human motivated behaviour is more or less controlled by the extrinsic rewards, which resulted in a differentiation between self-determination behaviour and control-determination behaviour (Deci and Ryan, 1985). The result is the identification of four levels of depth considering engagement and extrinsic motivation see Figure 9:

1. ***External regulation*** – behaviour that is the least self-determined among the four different levels. Based on consequences and incentives, whereas the behaviour is made in order to receive a reward. Also referring to the aspects of intention and activation of energy, with respect to the query of "if-so" (Brown, 2007, Ryan and Deci, 2000, Holmberg, 2014).

2. ***Introjected regulation*** – behaviour that is made with a small degree of motivation with the purpose of increasing self-esteem or to avoid guilt, with respect to the query of "I should" (Brown, 2007, Ryan and Deci, 2000, Holmberg, 2014).

3. ***Identified regulation*** –behaviour that is based on personal valued outcomes or sense of meaning, whereas people feel competent, autonomous and related resulting in the query of "I want to". This may be reached by adapting core learning, shared vision and goal, sense of choice and freedom (Brown, 2007, Holmberg, 2014, Ryan and Deci, 2000, Senge et al., 2001).

4. ***Integrated regulation*** – behaviour that refers to self-determination with the query of "I am", whereas values and goals are important personally and reached when they are brought into congruence with the regulations as well as one's needs and values (Brown, 2007, Ryan and Deci, 2000, Holmberg, 2014).

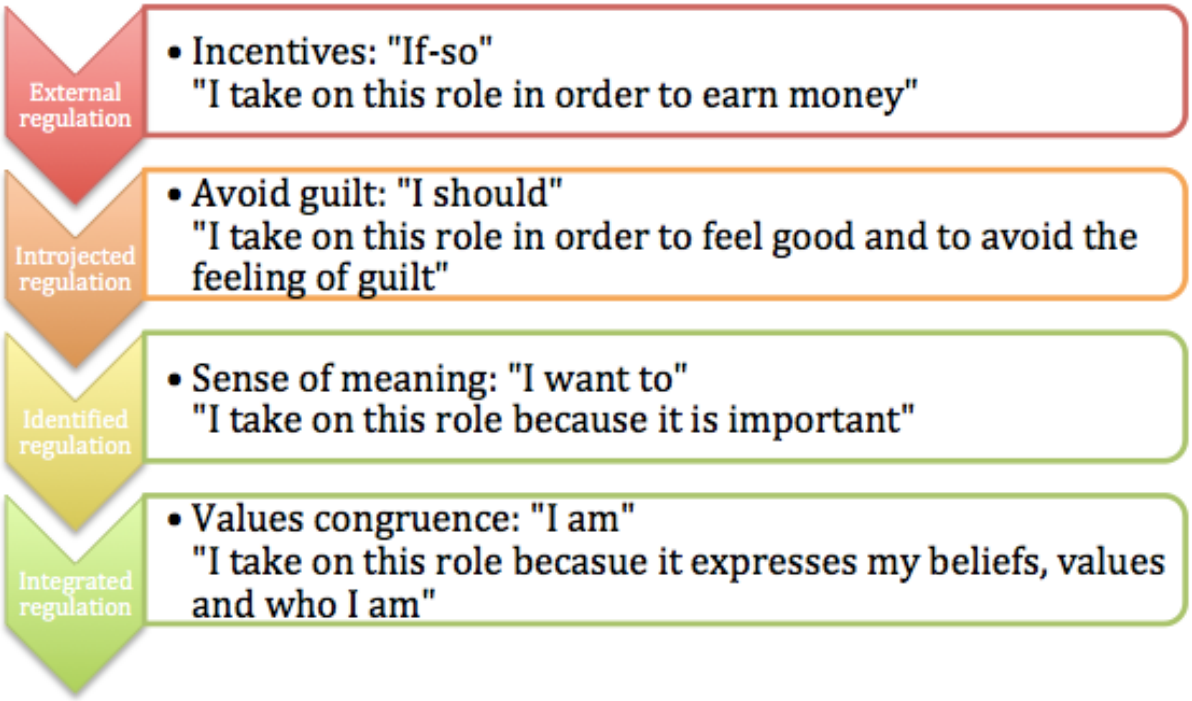

Figure 9 *Four levels and depth of self-motivation and engagement based on Self-determination theory (based on Ryan and Deci, 2000).*

The ability of motivation being a central issue of self-determination and its consequences sets a higher value on being adapted by managers, leaders, teachers etc. People adapting self-motivation and are self-authored have more excitement, confidence and interest resulting in enhanced persistence, creativity and performance as well as self-esteem and well-being (Ryan and Deci, 2000).

There is a joint coherence between the four levels of motivation by Ryan and Deci (2000) and the inside-out perspective. Self-motivation will result in successful leadership as well as quality. However, it is worth mentioning that different leaders

completing the same task will result in different outcomes due to their inner vision and values in which each operates (Holmberg, 2014, Ryan and Deci, 2000).

The concept of future state visioning would allow creating a description of the future instead of being mentally trapped into the current state. The key concepts of FSV are acknowledge the present state as well as the future state of your shareholders, identify key factors regarding the future environment, creating a resolution to "how can we overcome certain barriers" with the comparison of the current state with the future, developing a vision of aim and finally creating a strategic plan or action with respect to the values and vision. As a result, FSV is a framework that creates a methodology in order to manage change and enhance influential management processes. The development of a vision will not only develop a strategic plan but also develop an understanding that will lead to commitment and encouragement to reach the vision (Stewart, 1993).

Peter Senge's fifth discipline method, mentioned by Flood (1998), is a tool in order to develop core learning capabilities such as developing reflective conversation, fostering aspiration and understanding complexity. The fifth disciplines are systematic thinking, personal mastery, mental models, shared vision and team learning (Flood, 1998).

Personal mastery is the framework of developing and going past one's skills and competence by continuously learning to adapt the present and acknowledging important factors of one's everyday life (Cathon, 2000). Mental models are the management of improving the internal interpretation of others. This by treating an individual differently due to one's interpretation and believes of that person. A shared vision is a vision shared between individuals, which thereby create a bond and connection resulting in courage, risk taking as well as creating a focus and energy for learning. Team learning is the outcome of personal mastery and shared vision with the process of the development and alignment of a team's desired outcome. Nevertheless there are three critical areas, which are acknowledging the need of thinking insightfully about issues, take coordinated acts and having a clear communication from start to finish. The fifth discipline, systematic thinking, is the essential discipline combining all other disciplines together. In order for systematic thinking to realize its potential the need of shared vision, personal mastery, team learning and mental models is essential (Cathon, 2000, Flood, 1998). Then again, Vergragt and Quist (2011) also identifies systemic communication as an essential discipline in order to identify challenges ahead and to achieve the desired future by developing a methodology, policies, toolkit and approach especially towards the transition of sustainability.

What makes the fifth disciplines essential is due to the character of each one, where shared visions equal commitment, personal mastery teaches the effects of internal motivation, team learning shares skills among team members and mental models identifies the current state and what is needed for the future. In order to develop these disciplines and create a learning organisation the leadership skills and management is primary. As a conclusion, growing from "I" to "us" mentality is the key of systems thinking within the learning organisation (Cathon, 2000, Flood, 1998).

As mentioned within the abilities of sustainable transitions, Senge et al. (2001) declared certain leadership skills needed in order to nurture new leadership networks. Meaning leadership skills such as building a shared vision, strategic conversation, systems thinking, sensing, reshaping focus that maintain status quo etc. Such

leadership skills will allow long-term success within organizations through the adoption of new energy resources and implementation of new business models (Senge et al., 2001).

The methodology of the openness and trust spiral, defined by Wendelheim (1997), identifies the importance of how openness and trust goes hand in hand in order to collaborate successfully with complex tasks, see Figure 10. The level of trust and openness is divided into three different levels of difficulty, which are operational (low difficulty), tactical (average difficulty) and strategic (complex difficulty) (Wendelheim, 1997).

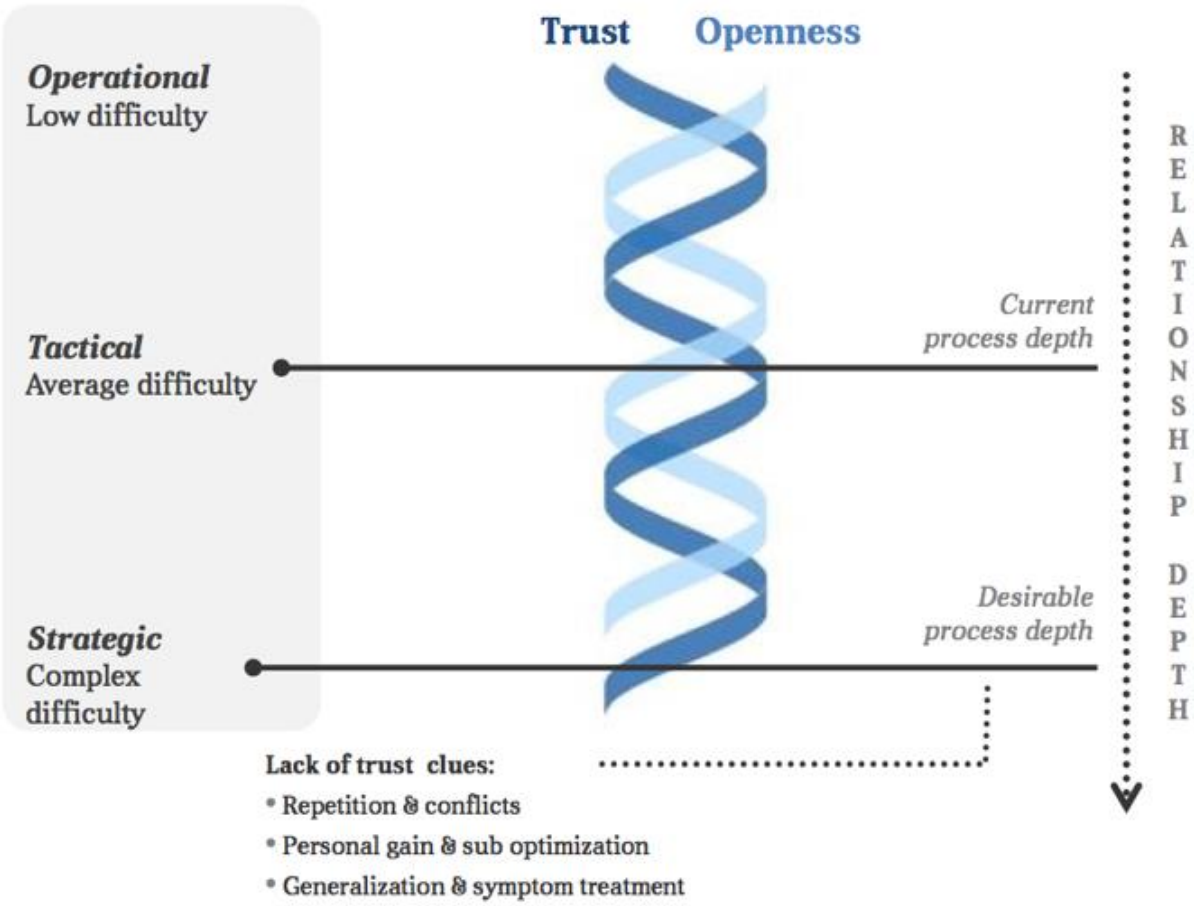

Figure 10 The Openness and Trust Spiral (Wendelheim, 1997).

As an example the tool "balancing your strengths" presented by von Martens (2015-01-21) is a tool that identifies ones strengths and qualities. The strengths and qualities identified will not only influence self- knowledge but also collaboration in teams. The first step in "balancing your strengths" is to take a single strength in order to exaggerate it to get an overdone strength. In other words, how others perceive the strength when it is exaggerated? The second step is thereby to identify a positive opposite of the exaggerated strength, also called the complementary strength. Within the third step, the complementary strength is exaggerated into a challenge. Lastly the original strength from step one becomes the positive opposite of the challenge in the third step, see Figure 11. As a result, the new strength complements the initial one,

which also leads to eluding a high focus on a single strength (von Martens, 2015-01-21).

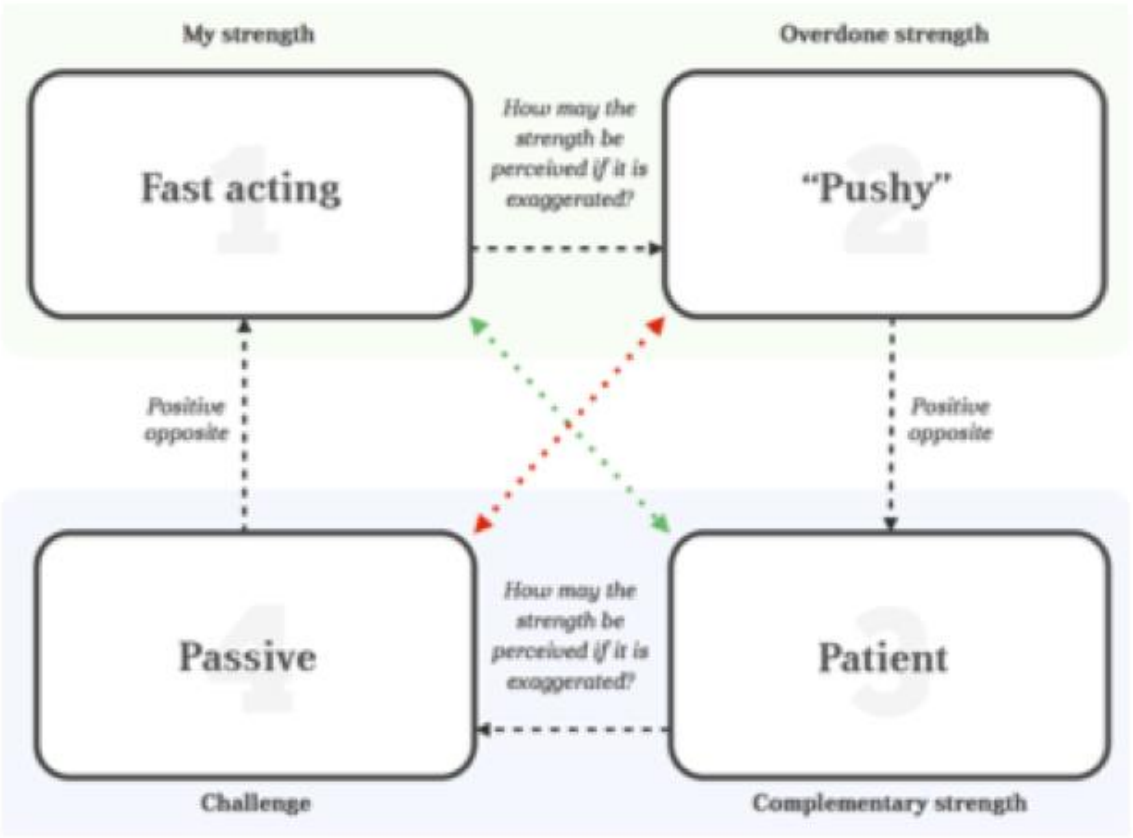

Figure 11 Balancing your strengths (von Martens, 2015-01-21).

2.3.1.2 Dialogue

Organisational relationships that are trusting and innovative with governmental initiatives tend to be more successful. The key indicators in order to achieve success are the art of thinking together (dialogue) and trusting one another. Combining good dialogue, reading strategic documents and understanding the political goals, scientific development and business strategies will result in what the future of sustainable transitions is in need of as well as what existing barriers there are (Holmberg, 2014, Isaacs, 1993).

However, Isaacs (1993) stresses that dialogue is the essential discipline due to its ability of fostering communication and collective thinking, which on the other hand is in need of improving certain disadvantages. An improvement may be learning how to collect intelligence and knowledge of individuals when solving problems within complex systems. This task is not easy due to its complexity that often leads to teams breaking down in regards to existing conflictual issues. Another improvement may be erasing the breakdown of the current effort of encouraging collective thinking. Especially since there is a clear pattern that individuals support the current dysfunctional situation of an organisation even though continuous learning is acknowledged (Isaacs, 1993).

One of the communication tools mentioned by Isaacs (2008) is conversation, meaning a dialogue between two individuals taking turns in speaking. According to Isaacs (2008) when participating and listening to a conversation one is deliberating the

information shared depending on what parts one like and dislike. In other words, the individual is selecting and processing the information, which thereby results in an action to suspend or defend one's own opinion, see Figure 12. On one hand, the party suspending one's own opinion creates a conversation where both parties take part without interrupting or resisting one another. On the other hand, the party defending one's own opinion creates a debate and discussion where both parties are eager to defend one's own opinion (Isaacs, 2008).

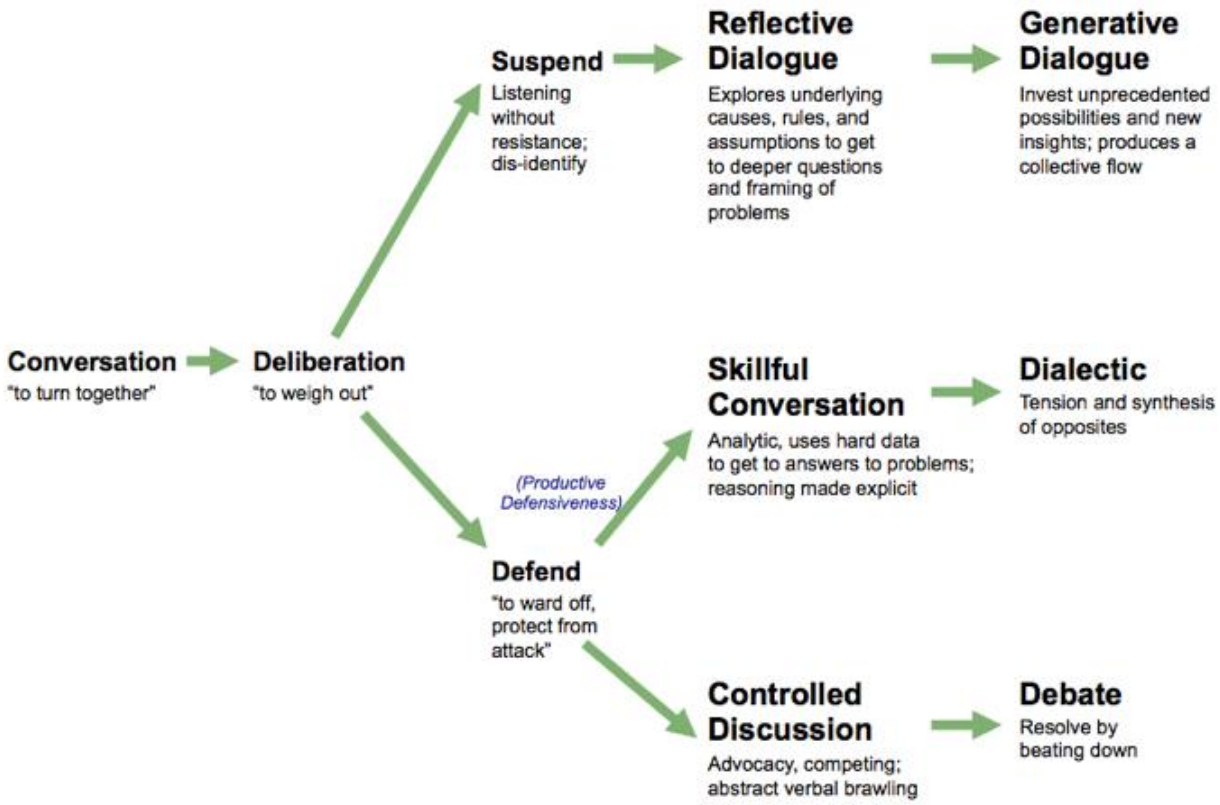

Figure 12 Dialogue structure (Isaacs, 2008).

However, Sande (2015-02-27) stresses that the basic principles of action within dialogues are voicing, suspending, listening and respecting. When voicing one is speaking what is on their mind, listening without interrupting and respecting the others opinion, see Figure 13.

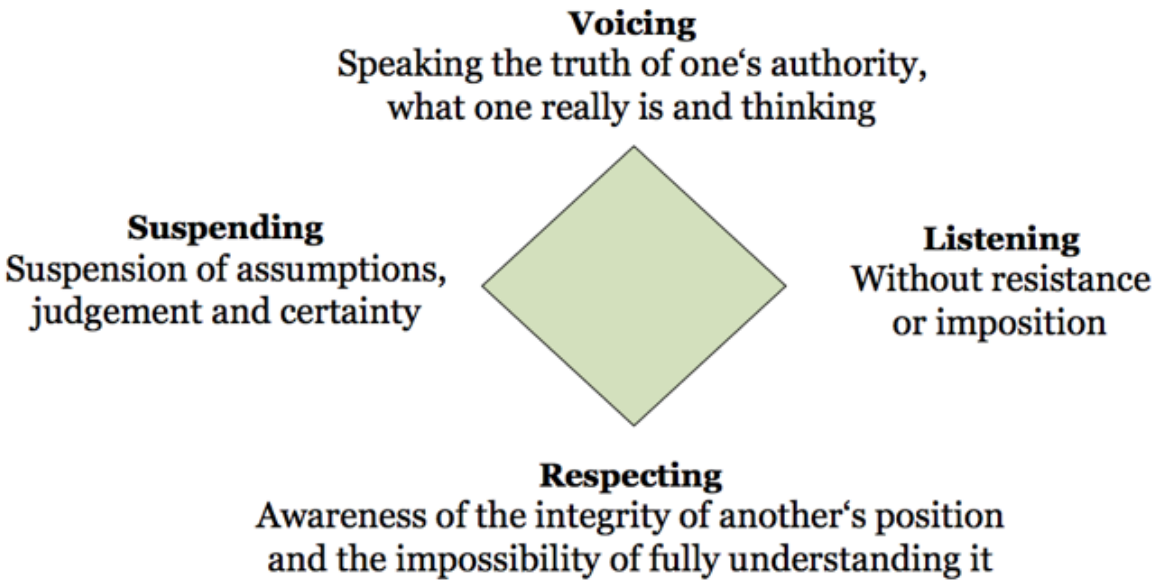

Figure 13 The basic principles of dialogues (Sande, 2015-02-27).

In addition, based on the action a person takes during a conversation Isaacs (1999) have identified four qualities taken by dialogic leaders within the dour-player model, which are move, follow, oppose and bystand. The mover offers direction to their initiated idea, the follower supports and helps clarify what was said as well as complete the task. However, the oppose challenges and questions the task as well as its potential while the bystand acknowledges what is happening and thereby provides perspective of the situation. In order for a conversation to stimulate learning the four-player model identifies the relationship needed between inquiry and advocacy. Meaning, in order to inquire one must move satisfactory and oppose satisfactory as well as follow and bystand. An advocate that opposes but fails to move as well as an inquiry that follows but fails to bystand will most probably result in being less effective; see Figure 14 (Isaacs, 1999).

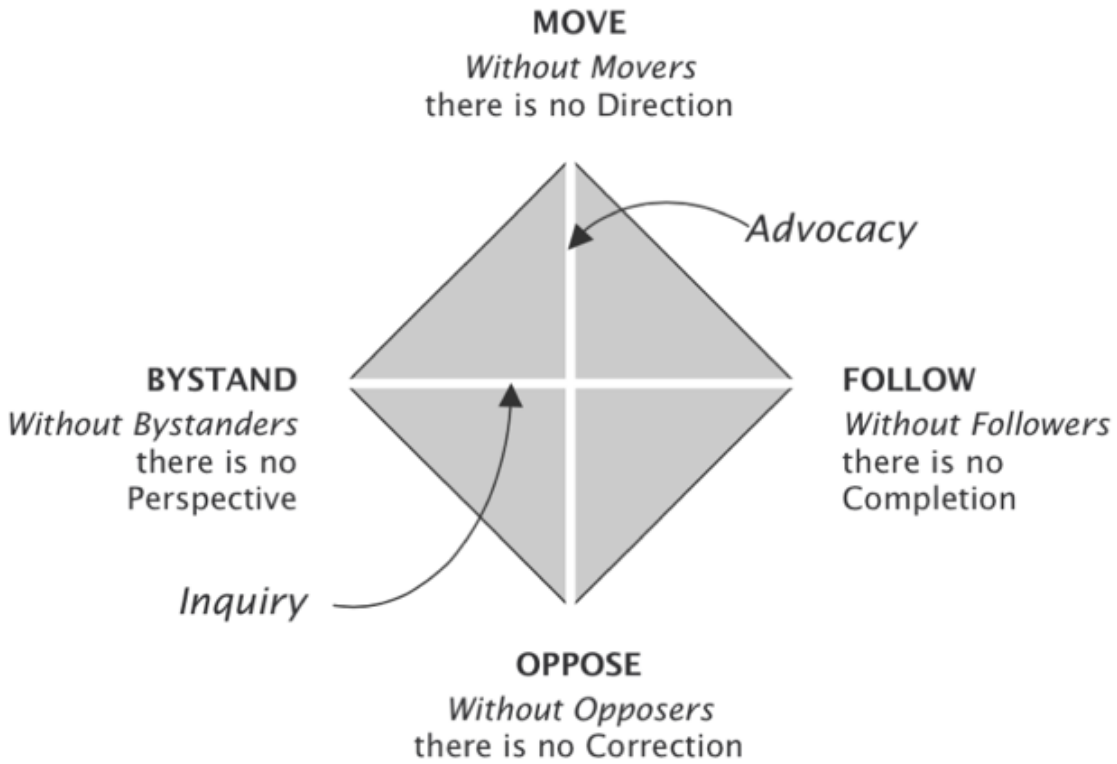

Figure 14 Dialogic leaders within The Four-player Model (Isaacs, 2005).

A tool in order to design for dialogue is the Preeras 5R model, which is divided into 5 steps. As an example within the first step *(1) room* it is important to gather the stakeholders and face each other's, within the second step *(2) relations* it is wise to create collective knowledge and area of focus and within the third step *(3) roles* to acknowledge the role intended to be played. Moreover, within the fourth step *(4) routines* it is wise to explore the questions and take the time in order to be efficient and within the fifth step *(5) results* it is wise to "go rounds" several times in order to include all stakeholders to create participation, see Figure 15 (Sande, 2015-02-27).

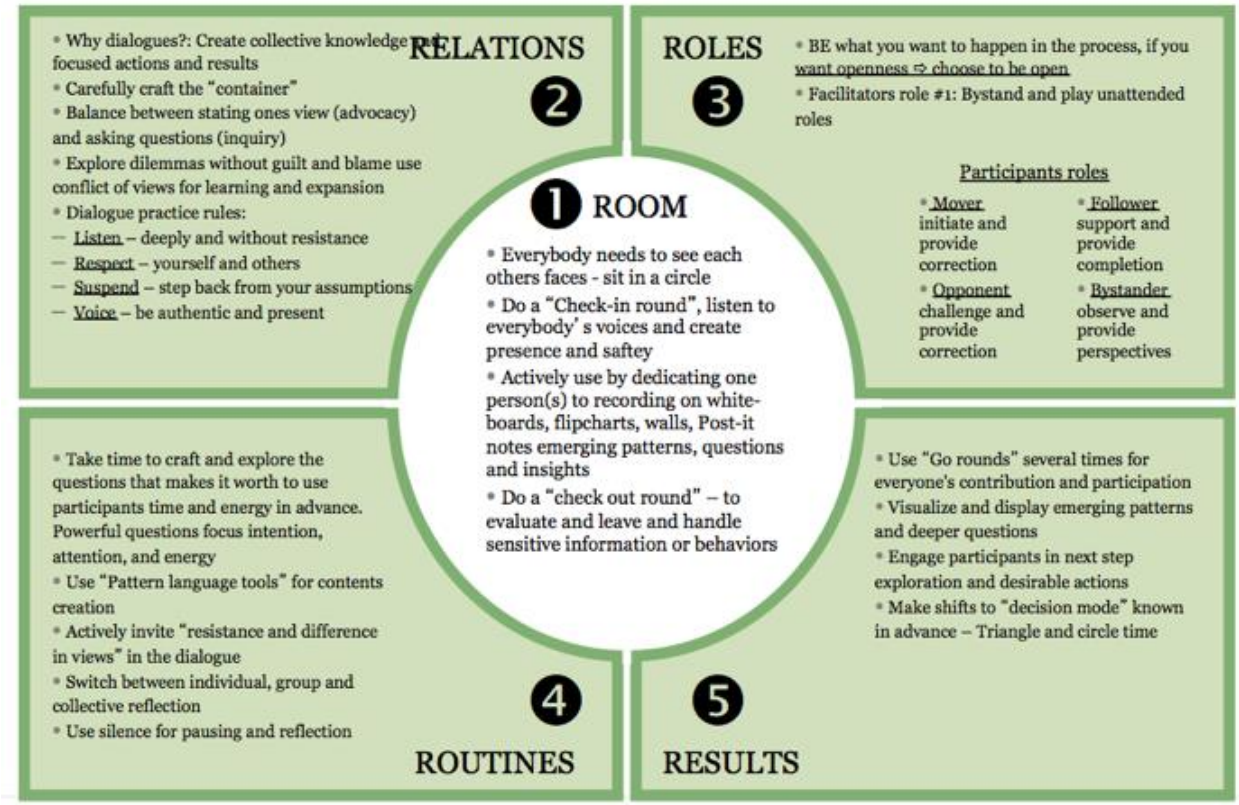

Figure 15 Preeras 5R model (Sande, 2015-02-17).

According to Argyris (1977), the process of organisational learning is a process that either corrects or detects failure. On the one hand, the processes of where an organisation is enable to move forward in order to achieve its objectives and policies are the process of single-loop learning. On the other hand, the processes of where an organisation is not only detecting a failure but also questioning the objectives, policies and goals is the process of double-loop learning; see Figure 16 (Argyris, 1977).

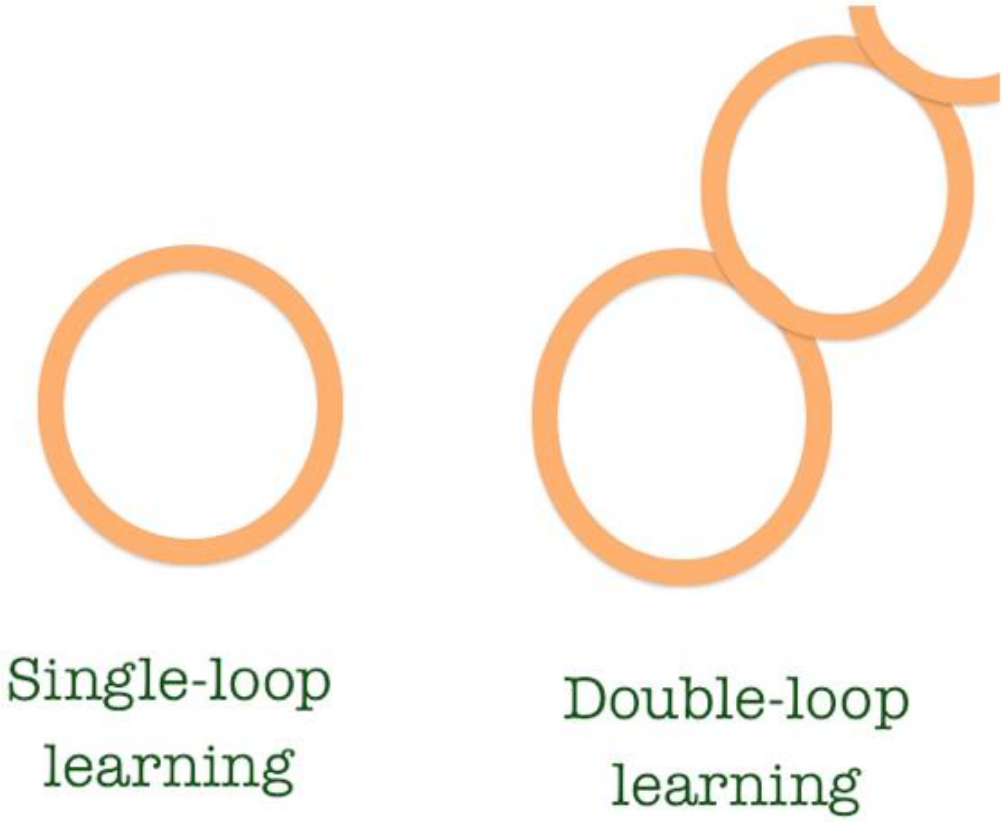

Figure 16 Single- and Double-loop learning (based on Argyris, 1977).

Another dialogue tool is the value adding of collaboration among stakeholders within the social systems. Currently, organisations are differentiating between formal as well as informal systems, which often result in constant tension among the self-organising employee networks and the management hierarchies. Sandow and Allen (2005) stress that the tension among the parties hinders organisational performance and suggests that organisation should focus on differentiating value-creating social systems where the business value is created through different stakeholders such as customers, employees and vendors. In addition, lack of collaboration creates social separation where stakeholders tend to have fear, mistrust resulting in repeating action and redundant costs. Collaboration among different stakeholders will generate trust and understandings as well as participation, which on the contrary generate creativity and innovation and finally excitement that result in closing the loop, see Figure 17 (Sandow and Allen, 2005).

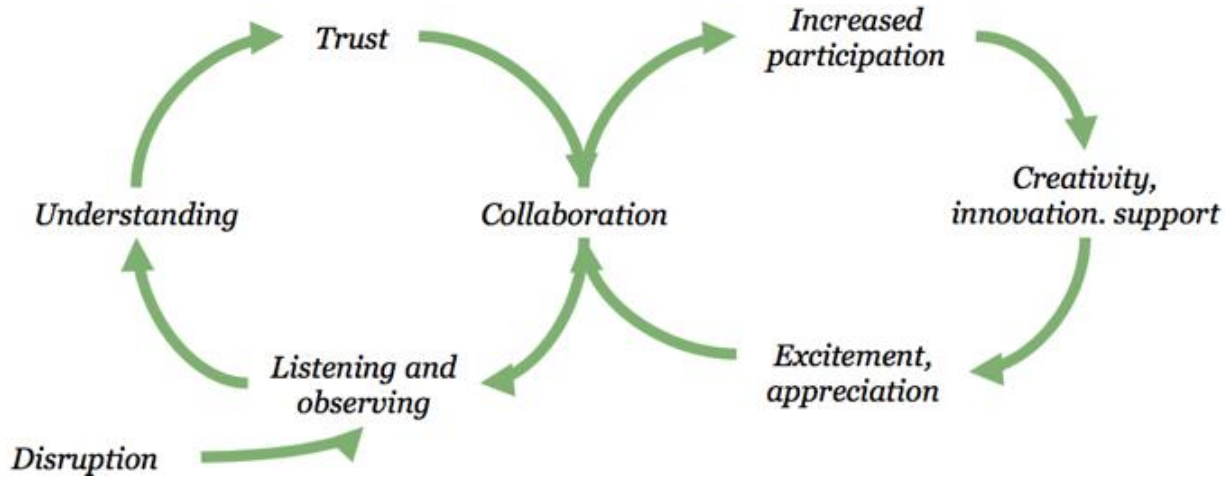

Figure 17 *Double-loop reinforcement through collaboration (Sandow and Allen, 2005).*

In addition, the absence of trust leads to social separation when misunderstanding occurs among stakeholders. As a result, the decrease in understanding and listening fallouts in redundancy, cost increase and resource decrease, which leads to lack of investment availability, see Figure 18. The disadvantage of insufficient investment is the development of other organisational competition as well as creation of fear and separation among the employees, which thereby closes the loop (Sandow and Allen, 2005).

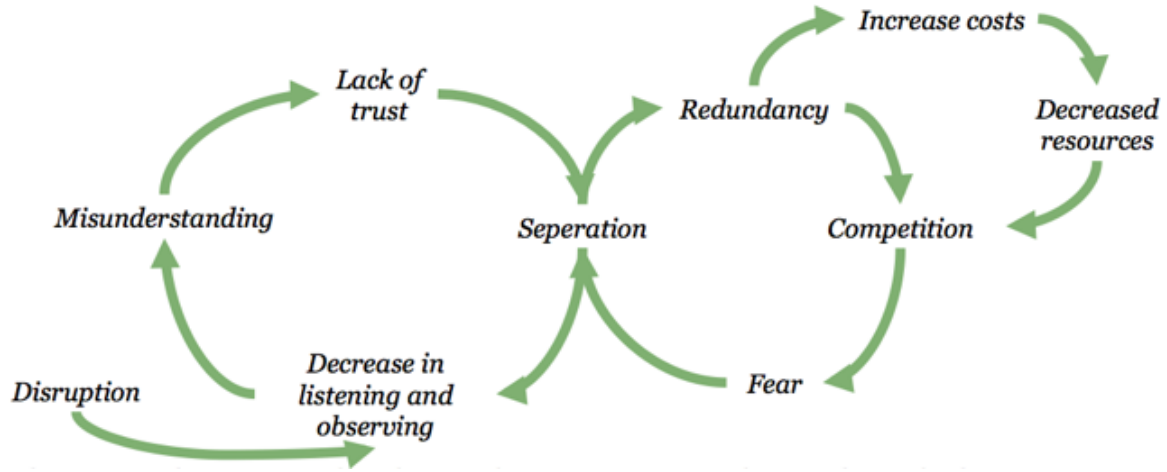

Figure 18 *Redundancy created by organisational separation (Sandow and Allen, 2005).*

2.4 Design Thinking

An experimental, prototype-building environment should be created in such a way that does not pose any restrictions on the idea formulation and concept creation. According to Söderberg (2014), design thinking is a good way of thinking when designing a solution from scratch, with integration of needs and following the requirements, defining the ideas and functions, subsequently visualizing and prototyping the solutions applicable to the future state envisioned. Brown and Katz (2011) stress that design thinking is rather interdisciplinary than solely important to

designers and was arisen due to not only cultural change but also the ability of applying one's skills. In addition, the skills addressed are issues that matter in regards to the improvement of individual well-being.

One important aspect of design thinking is learning-by-doing due to the indefinite process on how it must be done. The key step is to start with pre studies, collecting documents as well as creating matrixes before forming the initial concept/idea and testing the prototype/model or simulation. The design thinking process includes these steps: challenge, system, needs, requirement, function, idea, concept, visualization and prototyping. Thereby, the steps are divided into three categories, which are pre study, develop and verification, see Figure 19.

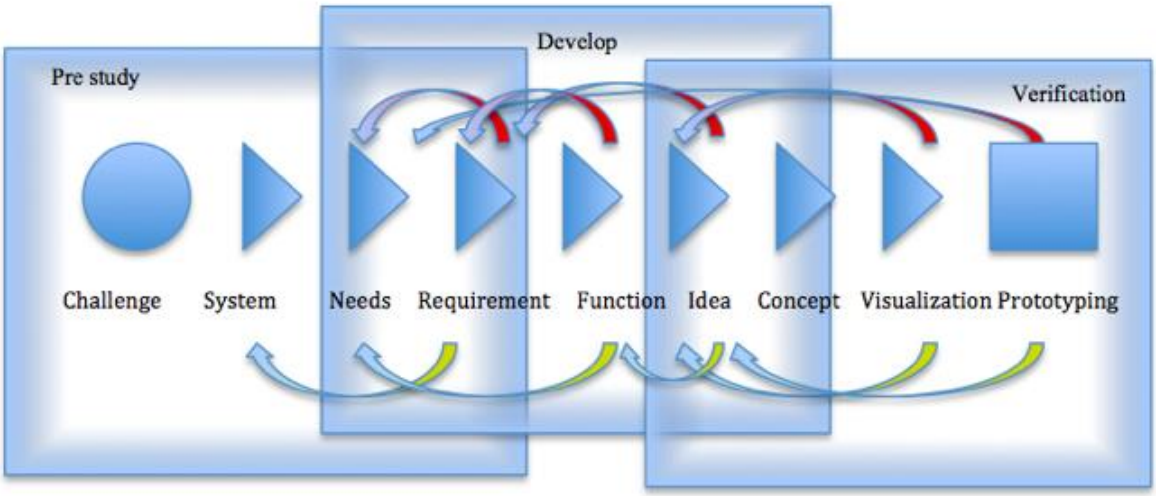

Figure 19 Design thinking process (Söderberg, 2014).

The knowledge of oneself as well as the knowledge acquired for the assignment of design thinking together with the joined forces of others is necessary within the Pre-study phase (Söderberg, 2014). This phase is highly important when identifying the challenge, system, needs and requirement. However, the development phase requires a lot of discussions, retakes as well as brainstorming. More importantly to ask the correct questions as well as to be open minded.

Nevertheless, the phase of verification is thereby developed into the form of drawings, videos, text, scenarios, matrixes etc., with the purpose of creating a discussion with for an example the stakeholders or client. Once the final step, prototyping, is achieved, it is important to identify what the verification is in order to recognize the new needs. Thereby, the process is restarted (Söderberg, 2014).

The ecosystem as well as the sustainable development is highly dependable by not only climate change effects, hot spots within the system but also trends (Smit and Pilifosova, 2003). The complex challenge of sustainable development is adapted within the methodology of multilevel design by Joore (2010). The system is divided into four levels, which are societal system, socio-technical system, product service system and product technology system, see Figure 20.

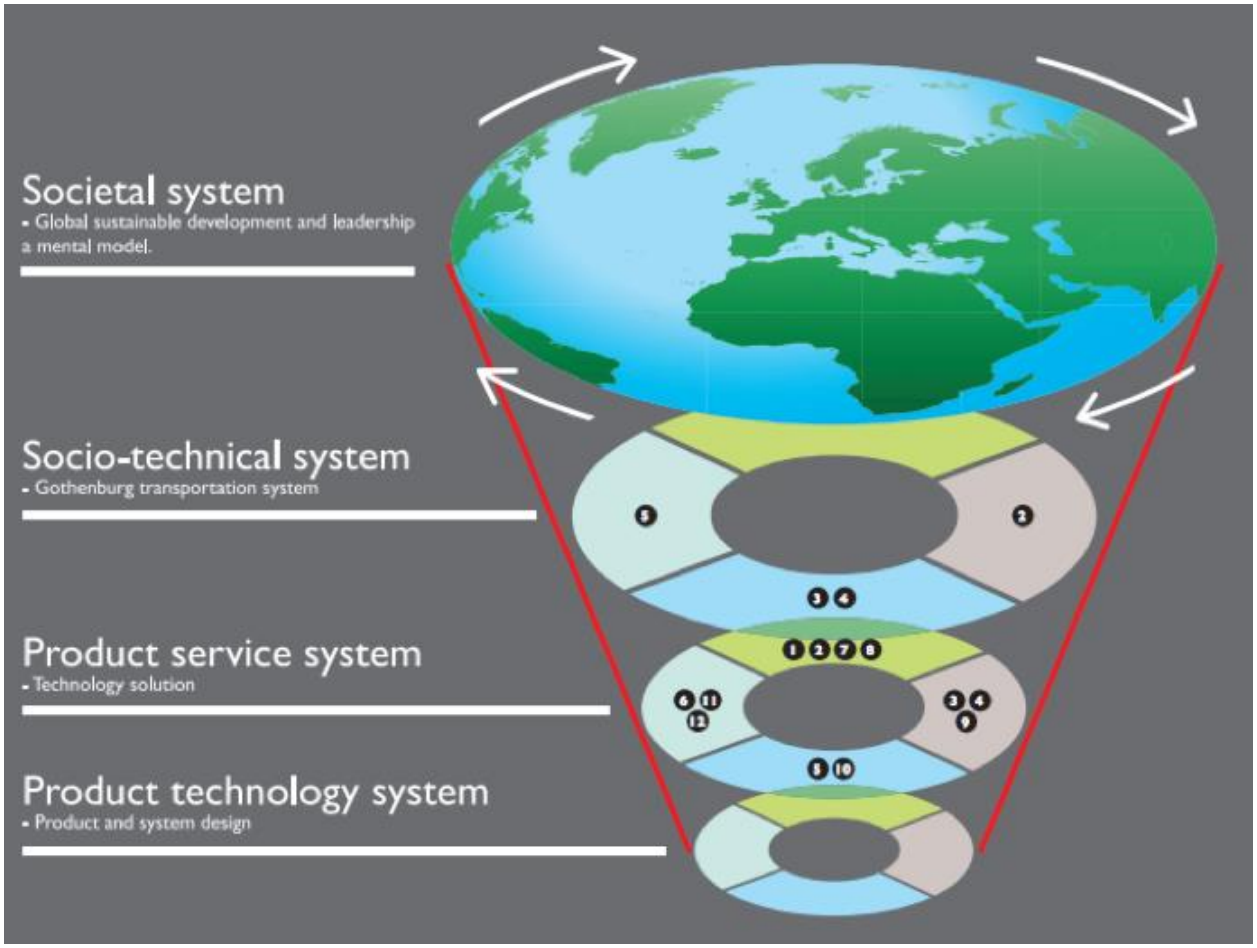

Figure 20 Multilevel design methodology (Joore, 2010).

Adapting the backcasting methodology together with the four levels within the system results in the explanation of:

- Societal system: The developing of a sustainable process that identifies societal changes desired as well as the desired global future vision.
- Socio-technical system: The development of a normative vision of the desired future by adapting the design process in order to identify the needs within the system, such as stakeholders, environment, users and services.
- Product service system: The development of new product-service system, identifying the requirements as well as understanding the specific stakeholders' outline. In other words, a part of the innovation agenda within the product technology system.
- Product technology system: Assumed as a part of the innovation agenda as well whereas the product technology system focuses on semiotics, manufacturing and target groups. The result is the development of a new product or technology.

2.5 Results for Phase One

In this section, a short summary of what was done during Phase One of the Challenge Lab Master Thesis will be presented. Inside-out perspectives were the basis for the activities, as they allowed developing personal interests together with objective knowledge, stimulating dialogue between stakeholders, initiating sharing of knowledge and double-loop learning between the Challenge Lab Master students. In addition, the Challenge Lab Master students have changed roles during meeting conduct by suspending beliefs, voicing own opinions, listening to opinions of each other & respecting them.

2.5.1 Criteria of Sustainability and The Vision

The criteria of sustainability were developed during this phase by applying several tools. The backcasting, step one, allowed the isolation of the criteria from the current trends and socio-economic systems. The compass was used as the mapping tool to allocate the criteria according to the dimensions of sustainability: Nature, Well-being, Society and Economy. Future state visioning was also used to formulate future ideas that may include, but are not limited, by the current situation. A shared vision was formulated, connecting the visions of multiple people & perspectives. The shared vision allowed to switch from the "I" to "us" and to formulate the criteria and the vision that satisfies multiple opinions and that the participants would agree to follow. As an inspiration for our own criteria, the principles of sustainable development were taken into consideration. However, the goal was not to go into deprivation of the planet and human well-being, but to unify the criteria formulate criteria for sustainable transitions.

Table 1 summarises the criteria and the vision, developed during Phase One. Some basis for developing the criteria & the vision was taken from existing research, through reviewing the Universal Declaration of Human Rights (The General Assembly of the United Nations, 1948) and the research performed by the Challenge lab from the year 2014.

Table 1 *Criteria & vision for sustainability development (based on* Robert et.al., 1997).

Well-being	**Nature**
● Everyone has basic needs fulfilled such as food, water, health, energy, shelter, and safety. ● Human life includes affection, understanding, morality, participation, leisure, empowerment, creation, identity, and knowledge. ● Each person has an equal right to the most extensive basic freedom compatible with a similar freedom for others. This includes freedom of	● Not to increase the concentration of substances from the lithosphere in the ecosphere. ● Not to increase concentration of human made substances in the ecosphere. ● Not systematically deteriorate the resource base; such as fresh water, fertile land, and biodiversity through manipulation, mismanagement, or over-exploitation.

<table>
<tr><td>opinion and assembly, expression, conscience, and choice - without deliberately harming others.

● Social and economic inequalities are not justified unless they are to the greatest benefit to the least-advantaged members of society.</td><td></td></tr>
<tr><td>Society

● Societal institutions are built on transparency, accountability, and mutual trust. They enable the well-being of the individuals in society.

● The societal system is an instrument for individuals to live together within the other criteria.</td><td>Economy

● The economic system enables us to meet the other criteria efficiently and effectively. The other dimensions (society, well-being, nature) and not the other way around should influence the economic system.

● The economic system is resilient in a way that it functions as a buffer against destructive disturbances, such as environmental catastrophes or economic mismanagement.

● Enable further use of resources and avoid dissipative use of materials.

● The economic system has an inherent mechanism of maintaining and serving societal infrastructure and institutions that permits human well-being to be met over time.</td></tr>
<tr><td colspan="2">VISION

A sustainable future where we (~10 billion people) are able to meet our own needs within the planetary boundaries without compromising the ability of our future generations to meet theirs”</td></tr>
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2.5.2 Existing Trends

In order to understand the present situation concerning sustainable urban development, it is necessary to analyse the forecasts of development associated with it. The funnel tool is used to identify the dependencies of resource supply and changes in demand, in addition to trends assessing environmental conditions.

2.5.2.1 Carbon dioxide

The increasing trend of carbon dioxide emissions in Sweden were clearly noticeable between 1993 and 2005 where it increased by 1.4 % (more specifically 0.8 million tons. It is worth mentioning that the limit of 4 % increase of carbon dioxide emissions according to the Kyoto Protocol was still met (Stockholm Environment Institute, 2009).

In Sweden there are six main drivers affecting the emissions trends within the industries. As shown in Figure 21, the consumption level is the highest trend driver (Stockholm EnvironmentInstitute, 2009).

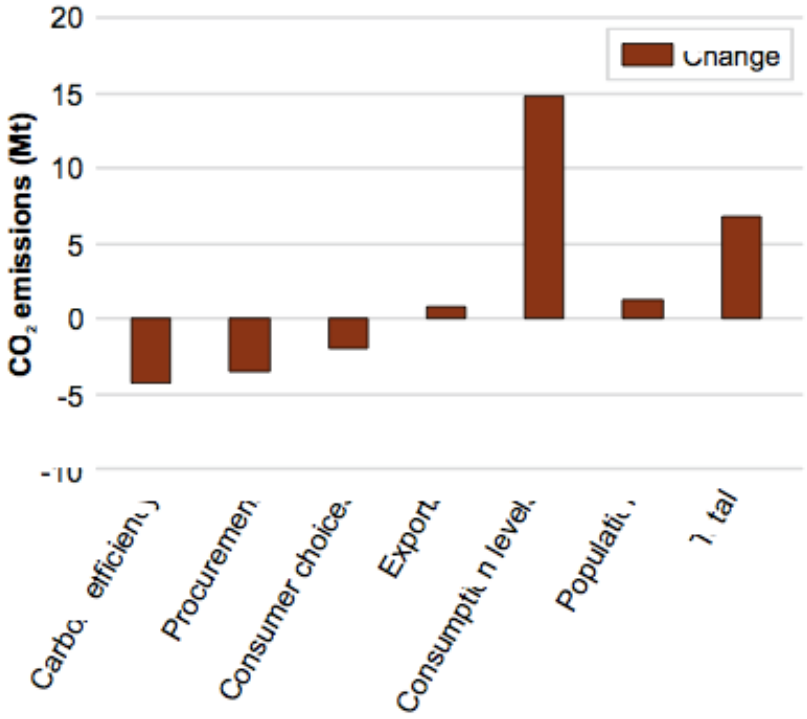


Figure 21 *The drivers of carbon dioxide in Sweden (StockholmEnvironmentInstitute, 2009).*

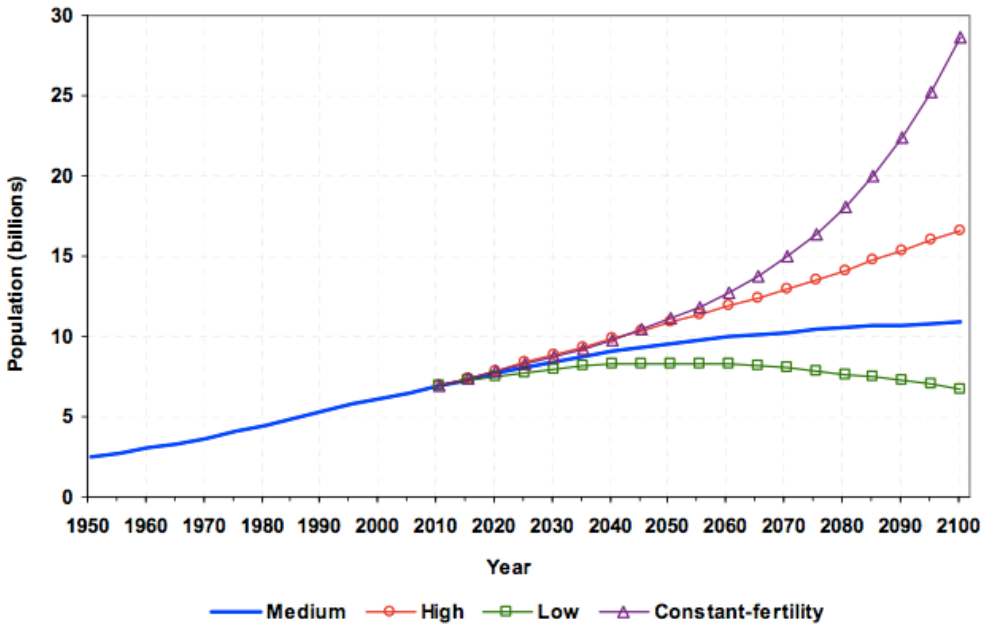
However, the Swedish population decreased the use of carbon dioxide, 2 Mt to be exact, by choosing greener products. Nevertheless, the consumption trend increased the carbon dioxide level per capita resulting in an increase of 15Mt CO_2 emissions between year 1993 and 2003 (Stockholm Environment Institute, 2009).

The Swedish culture of consumption, where households are responsible for 76% and the government for 14% CO_2 emissions, is one of the industrialised countries following this trend. The energy demand from households includes private transportation, heating and electrical utilisations, but also the indirect energy demand such as the energy from manufacturing the consumers' services and goods (Stockholm Environment Institute, 2009).

2.5.2.2 Population

According to United Nations, the world population of 7.2 billion was reached by mid-2013. The world population, which is continuously growing, is estimated to reach 8.1 billion by 2025, 9.6 billion by 2050 and 10.9 billion by 2100, see Figure 22. In

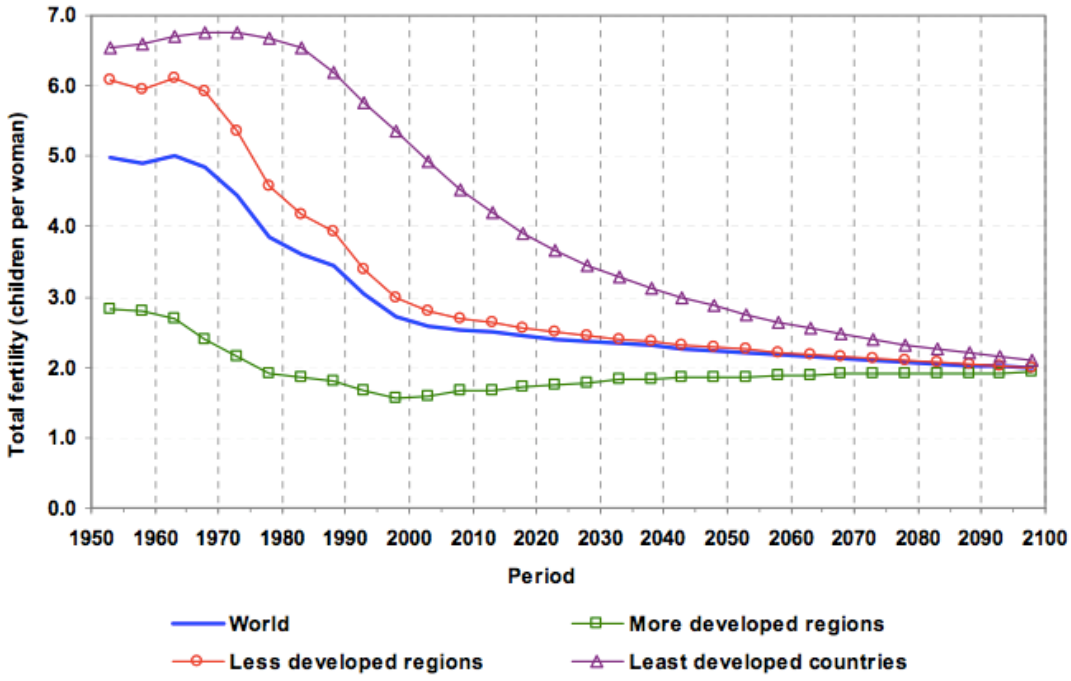
addition, the estimates are based on the medium-fertility due to the trend of decreased fertility during the twentieth century. On average, it is estimated that the number of children per woman is lower than two (UnitedNations, 2013).



Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat (2013). *World Population Prospects: The 2012 Revision.* New York: United Nations.

Figure 22 Estimated world population (UnitedNations, 2013).

Furthermore, on average the high-fertility estimates 2.5 children per woman and the low-fertility estimates 1.5 children per woman. As a conclusion future fertility will have an important influence of the population growth the next decades, see Figure 23.



Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat (2013). *World Population Prospects: The 2012 Revision.* New York: United Nations.

Figure 23 *Fertility estimates of the world's and developed countries (according to the medium-fertility rate) (UnitedNations, 2013).*

Additionally, the world population of older people (older than 60 years old) is continuously growing at 1.0 % yearly until 2050 and 0.11 % yearly between 2050 and 2100 (United Nations, 2013). More specifically, the population of older people is increasing rapidly within less developed regions where it is expected to increase from 0.554 billion in 2013 to 1.6 billion in 2050. Currently, 34 % of the world's older people live in the developed countries, resulting in 66 % within less developed countries (United Nations, 2013).

The level of mortality have rapidly decreased during the twentieth century, resulting in a gained longevity of the world's population to have increased to 69 years in 2005-2010, 76 years in 2045-2050 from 47 years between 1950-1955, see Figure 24 (United Nations, 2013).

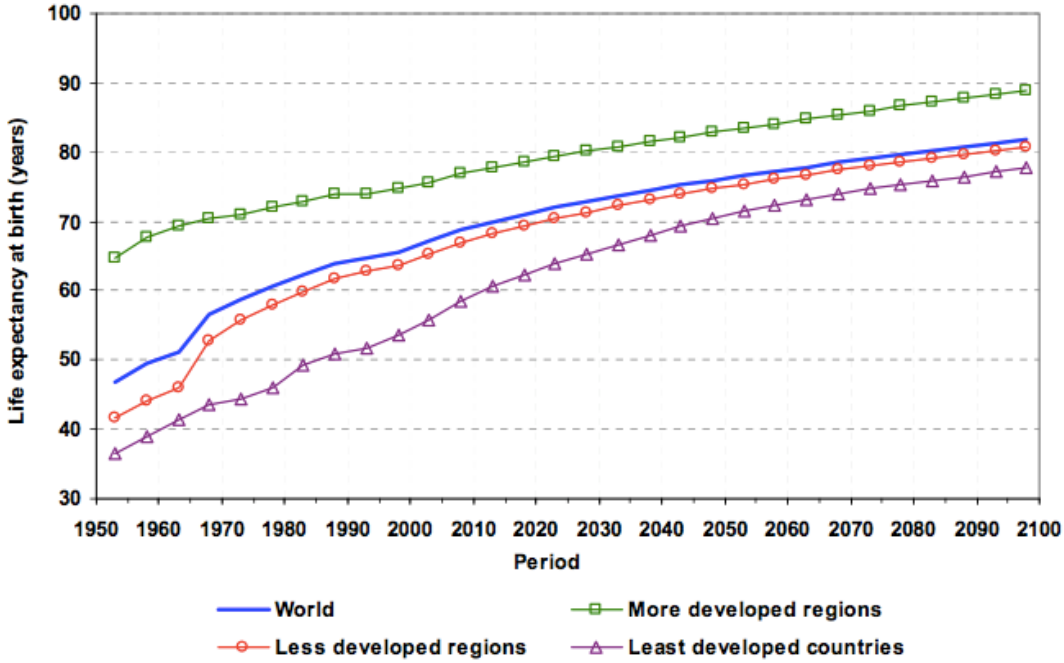
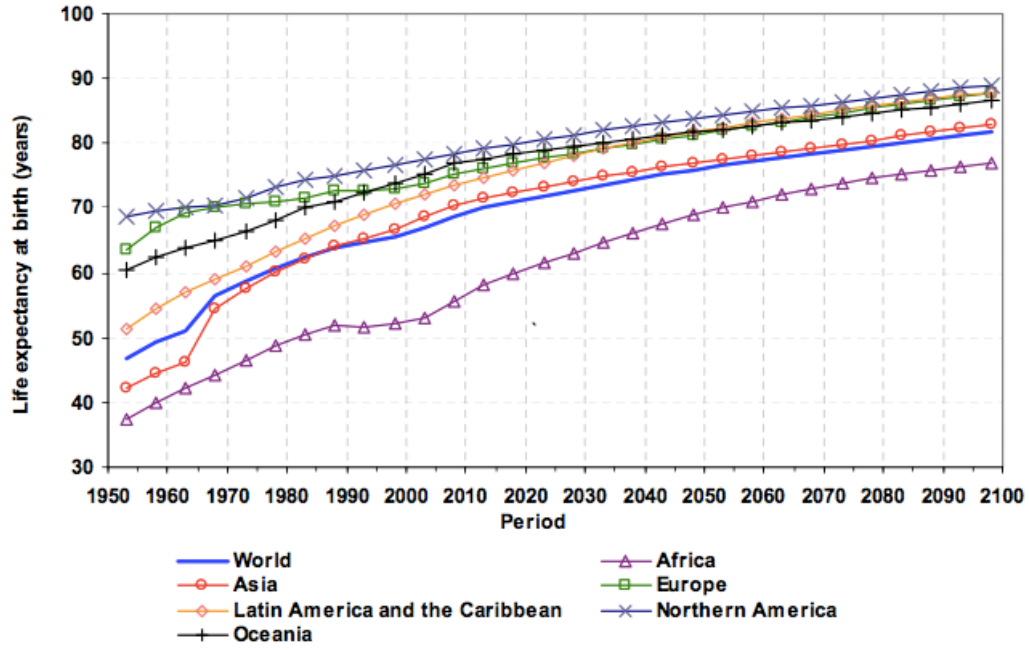


Figure 24 *Life estimates of the world's population and developing countries (UnitedNations, 2013).*

In one hand, the trend where the world fertility and mortality is declining is resulting in a decreased growth rate of the world population while, on the other hand, the quantity of the world population is increasing (UnitedNations, 2013). As shown in Figure 25, the population is growing the fastest in Africa compared to Northern America, Europe and Oceania, which will have a slightly growth of population. However, the biggest part of the world population lays in Asia.



Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat (2013). *World Population Prospects: The 2012 Revision*. New York: United Nations.

Figure 25 *Life estimates of the world's population and major areas (United Nations, 2013).*

Half of the world population, 3.3 billion, is looking to be settled within urban areas resulting in a historical time within the twentieth century where a trend of urbanisation is created (Obaid, 2007). The trend is expected to reach approximately 5 billion inhabitants by 2030. However, many of the developing urban areas are looking into becoming poor dependent on the conclusions that are and will be made in organising for this development. The trend will result in 50 % urban population growth just in Asia and Africa between 2000-2030. It is estimated that 80 % of the world population will be settled within cities by 2030 (Obaid, 2007).

The urban development trend is also notable within Sweden, more specifically Gothenburg city where an additional 150 000 people are estimated to be settled within the city by 2035 (passing the mark of 600 000 inhabitants). In order for the city to create wellbeing ones the development is made it is necessary to create more offices, new constructions, public transport, services etc. Nevertheless, without compromising the needs of the future generations. Thereby, it is important to create a sustainable urban development (Göteborgs Stad, February 2014).

The percentage of people living in urban areas during the nineteenth century was not higher than 7 %, in Sweden. However, the percentage have drastically increased and reached 85 % by year 2010. There is a remarkable increase within the urban areas, where during the last decade approximately 550 000 people settled within urban areas, see Figure 26. The remarkable increase is further notable in Stockholm, Malmö, Västerås and Uppsala between 2005 and 2010 (Statistics Sweden, June 16 2010).

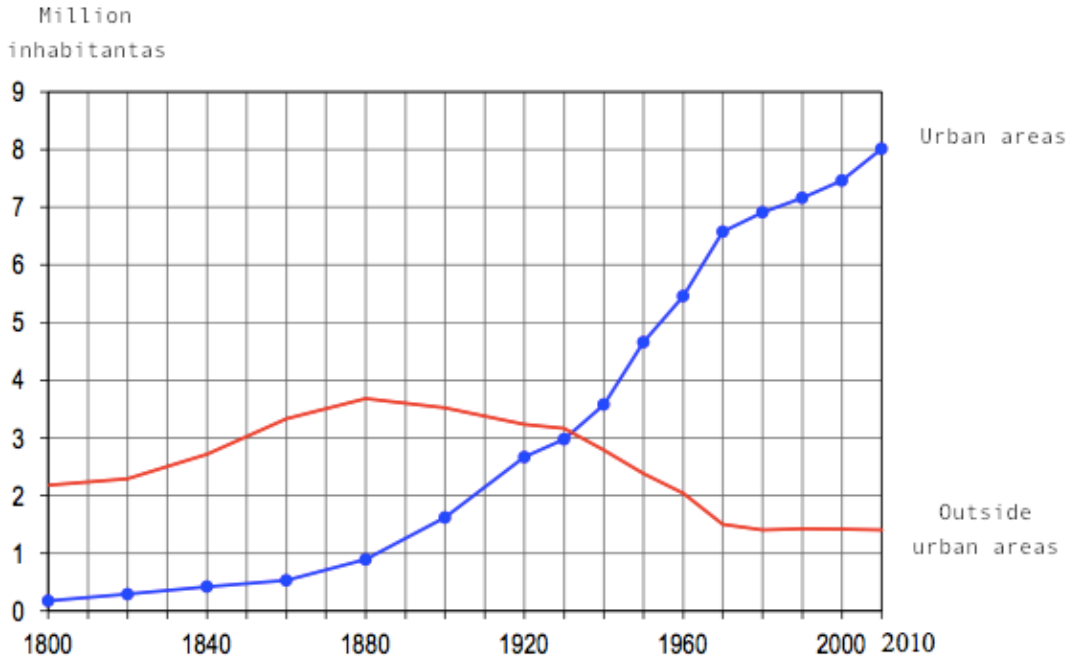


Figure 26 *Population within and outside of urban areas (Sweden) (Statistics Sweden, June 16 2010).*

2.5.2.3 Economy

The trend of new construction has set off significantly during the last two years, 2013-2014 and is not looking to decrease the upcoming years. The number of undertaken residents during 2014 increased to 40 000, which is vaguely exceeding the average

level of undertaken residents during the boom years 2006-2007 (Sveriges Byggindustrier, February 25 2015). It is an increase of 9000 extra undertaken residents compared to previous year, see Table 2 below.

According to the report "Byggkonjukturen", the upcoming year is looking into a decrease due to the financial funding limitations of new construction. The limitation is highly dependent on the demand of residential and rental units as well as single-family houses. The demand side of household are highly dependent on the financial assets growth after reducing debts, construction costs, mortgage rates, land taxation and capital gains taxation (SverigesByggindustrier, February 25 2015).

In on hand, the forecast of 2015 will is looking into a small increase within undertaken residents. The estimated number is 42 000 undertaken residents compared to previous year of 40 000 (SverigesByggindustrier, February 25 2015). On the other hand, the forecast of 2016 is looking into a decrease within new construction of residential buildings and almost an unchanged quantity of 38 500 within new construction of single-family houses, see Table 2.

Table 2 The quantity of undertaken residents 2001-2014, estimation 2015-2016 (based on Sveriges Byggindustrier, February 25, 2015).

Year	Apartment block	Single-family house	Total
2001	12.4	7.1	19.5
2002	11.7	7.4	19.1
2003	12.8	9.3	22.1
2004	16.9	10.6	27.5
2005	19.6	12.4	32.0
2006	31.8	13.8	45.6
2007	14.2	13.7	27.9
2008	11.3	10.2	21.5
2009	9.4	8.4	17.8
2010	18.1	9.4	27.5
2011	18.4	8.3	26.7
2012	15.8	5.5	21.3
2013	23.8	6.6	30.4
2014	31.2	8.7	39.9*
2015	32.0	10.0	42.0
2016	29.0	9.5	38.5

The investment trend within new construction will continue to grow during 2015 and thereafter level out around an equivalent level in 2016. The investments within residential buildings are approximately double the amount of investments within houses. The increased redevelopment investments, which are highly dependent to household income, general economic activity as well as financial strength, reached an additional 10 % in 2014 (Sveriges Byggindustrier, February 25 2015).

The increase of Swedish housing prices is connected with the increased demand for mortgage loans. In addition, the trend of urbanisation together with population growth influences the price increases as well, see Figure 27 (RiksbankStudies, April 2014).

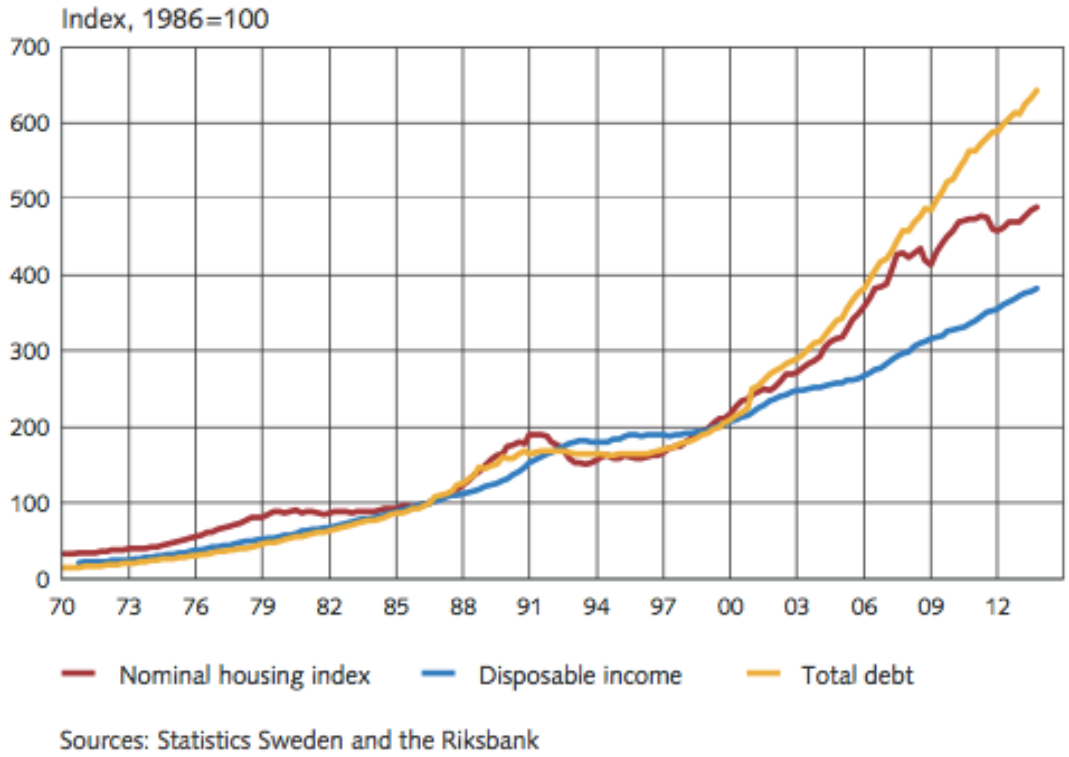


Figure 27 *Swedish statistics of housing prices, income and debt (RiksbankStudies, April 2014).*

As a result, increased prices means increased loans leading to an increased level of debts. However, there are many other indicators increasing the prices and it is not only dependent on the demand of new households. The increased debt in Sweden may also have an influence of the increased number of tenant-owned apartments compared to single-family houses, see Figure 28 (Riksbank Studies, April 2014).

Figure 28 *Swedish statistics of tenant-owned apartments and Single-family houses (RiksbankStudies, April 2014).*

2.5.3 Areas of Research for challenges and solutions of Sustainable Urban Development

In order to understand the necessity of change in urban development towards sustainable development, following the criteria for sustainable development, a workshop was held with the Challenge Lab participants in order to identify the principle areas of change. Those areas are Built Environment, Open Innovation & Collaborative Projects, Participation in City Planning, Energy, Water & Circular Economy. For each of the areas, two questions were answered regarding the necessity of change: the "Why" question, describing the importance of the area & reasons for unsustainable development trends within it, and the "How" question, recognising possible acupuncture points and leverages for change. In this section, the results for the Built environment area are presented (Table 3), whereas results from all of the areas of research are mentioned in Appendix 1.

Table 3 Area of Research for challenges and solutions – Built Environment

Built Environment		
WHY	HOW	Example projects
Big part of life passes inside houses	Design to solve segregation	Frihamnen
Segregation is a problem in city planning	Combine Zero Energy & Carbon Neutral buildings	HSB Living Lab
1 Billion people live in slumps	Multiple perspectives	City Lab
50% of resources used and 50% of waste generated by the construction industry	Design criteria based on sustainability	
Urbanization	Earn in the process	
Where does sustainability come in municipal planning and how?		

2.5.4 Path to the research – a critical retrospective

Based on the results from Phase One, a first research aim was formulated. The basis of the first research aim was to identify the criteria for sustainable housing through analysing research of scholars in the field, to identify the criteria from several selected Building Assessment methodologies, and to compare the two perspectives via a model, while applying them for a case study project – Frihamnen.

However, when conducting the first research, several major obstacles were faced. First of all, the overall model of sustainability criteria was difficult to create because each of the Building assessment methodologies had many different criteria within them. The model was restructured in a way that similar criteria from different assessment tools did not duplicate each other, but the selection of such was difficult to perform objectively. Criteria categories of each of the assessment methodologies were removed in order to only focus on the criteria themselves, but each of the methodologies contains dozens of criteria. To analyse all of them was way over the time scope of a master thesis.

Furthermore, in our pursuit to identify the demanded and supplied criteria, the approach was too broad. It turned out that many of the criteria were on different boundary levels, some belonging to separate buildings, some belonging to whole districts, and some not depending on the construction industry at all. This created a confusing result that not all criteria are suitable for this question. In addition, the BAM's have had a big number of researchers behind their development, and even if something missing were identified, it would most probably be a small fix to already existing major research initiatives

To sum up, the main focus had to be switched from a broad one to a more specific one. That is why Frihamnen was chosen to be the main focus of the new research aim.

2.6 Discussion of Phase 1

The result shows that it is important to interconnect stakeholders from different sectors, such as the private sector, municipalities, researchers and users. In addition,

innovative environment as well as strategies towards transformation unifies multiple actors to work together and find new solutions. In order to understand the overall picture there should be a fusion between technology, nature and human well-being. This is where Challenge Lab initiated multiple dialogues helping to create a better understanding of the complexities within different systems/organisations as well as how to interfere once it was comprehended.

The inside-out perspective allowed identification of self-values, strengths and goals. Self-motivation provided the courage to bring up not only existing problems but also values and voicing one's opinion on the system was as important as listening and respecting the opinion of others. However, personal values strongly affected the formulation of criteria and areas of interests. Still, the dialogue was generative resulting in mutual contribution to the criteria. In addition, the role was shifting between advocating and inquiring within dialogues once decisions were taken.

The outside-in perspective helped creating an understanding of existing activities and limitations within the systems/organisations. The perception of people being stuck in an existing system is strong; thereby it is necessary to highlight the importance of transition goals and future state visioning. The discussions during Phase 1 touched upon multiple perspectives and levels of urban development. This leads to the creation of a better understanding of the complexity within existing systems.

During the whole process within Phase One backcasting was the main methodology. Within the first step of backcasting criteria for sustainable urban development were designed including the key dimensions: well-being, nature, economy and society. Well-being and society were found to be closely related to each other as well as difficult to categorise. In addition, economy was estimated as the dimension satisfying the other three dimensions.

80 % of the world population is estimated to be settled within urban areas by 2030, which together with growing population will drive and increase the demand on housing. Increasing demand increases the prices as well as contribution of CO2 emissions.

A proposed solution to counteract the trends is to determine the criteria based on sustainability for the built environment. In addition, it is important to connect to an existing project with involved stakeholders.

One of the previous attempts during formulation of the research topic was focused on creating a general approach, suitable for any district development project. The general approach had proven to be too broad, because not all of the implications, benefiting stakeholders were properly taken into consideration. This was due to an inside-out perspective employed for research aim generation. Thus, an outside-in perspective should always accompany an inside-out perspective when performing research, even if in ones opinion, the research topic is perfectly formulated. Continuous dialogue and double-loop learning must accompany the initiative of formulating a research aim and subsequently performing the research.

Finally, our new research is focused on the sustainability goals of Frihamnen and how they are planned to be implemented both by the city and by the industry. This is necessary because Frihamnen is a living example, where research can bring positive effect. The new research aim is to both to identify the sustainability criteria of Frihamnen and to evaluate, how they are going to be delivered. Evaluation should be done with support from literature regarding common and best sustainable construction

practice in Sweden, as well as from performed semi-structured and unstructured interviews among suppliers and contractors involved.

3 Phase Two

3.1 Introduction

The municipality of Gothenburg City initiated Centrala Älvstaden to develop a vision as well as a strategy for the city's urban development by 2012. The vision developed by Älvstaden states that the city should be open to the world. The strategies of Älvstaden focus on, integrating the Göta river as a link between two banks of the river, to jointly develop the districts situated on the two banks, to raise and equalise their strategic importance and to integrate the ideas of multiple stakeholders in solving the cities challenges. The vision was developed from a bottom up approach, where around 2800 people from Gothenburg's urban districts were interviewed (The Council of Gothenburg City, 11th October 2012, Stadsbyggnadskontoret, 9th September 2014).

Strategically, the urban development of Frihamnen district, a total area of minimum 1.5 million square meters, is of great importance for when the inner city will develop over the river and connect Backaplan, Ringön, Kvillestaden and Lindholmen (Stadsbyggnadskontoret, 9th September 2014, Älvstaden, 2015). The aim is to develop an area that is green and dense by offering a waterfront park (Jubileumspark), accessible public transport and socially mixed residents. By this, they aim to attract families as well as both young and old inhabitants (Council, 11th October 2012, Stadsbyggnadskontoret, 9th September 2014). Additionally, the strategies of Älvstaden are formulated as three goals that contribute to the vision of Älvstaden as followed (Stadsbyggnadskontoret, 9th September 2014):

- Connect the City: *"We will bring the city together across the river to become a physical and social whole."*
- Embrace the water: *"The water will be a permanent feature of urban life and will be an asset for everyone."*
- Reinforce the centre: *"To meet the challenges we are facing, the knowledge and ideas of all actors- big and small- must be used and developed."*

Moreover, Frihamnen should be developed as a framework of multiple projects that in one way or another include the social, economic and environmental aspects. The district is planned by the city to become an example of sustainable urban development (Council, 11th October 2012, Stadsbyggnadskontoret, 9th September 2014).

Frihamnen is seen as a *test arena* where numerous actors are expected to contribute and participate towards the transformation process. The development of the district will occur in multiple stages, where the results and feedback from of a previous stage will influence the development of the following one. The first stage of Frihamnen is proposed to be completed by the 400-year anniversary of Gothenburg City year 2021. The target is to have built 1000 residences, 1000 workplaces as well as parts of the Jubileumspark. The overall target by 2040 is to have built around 9000 residences as well as 15 000 workplaces (Council, 11th October 2012, Stadsbyggnadskontoret, 9th September 2014).

3.1.1 What is the challenge Frihamnen is facing in making their ambition reality

According to the land allocation agreement of Gothenburg city, the involved stakeholders are Älvstranden Utveckling AB and eight procured suppliers. The companies have are agreed on reaching the vision and strategies of Älvstaden in the Frihamnen's district development to make the district a good example of sustainable urban development (STADSBYGGNADSKONTORET. 9th September 2014).

The development of Frihamnen is an ambitious project, however there are no clear definitions on how to reach the vision that will both satisfy the stakeholders and make the district sustainable. It is therefore important to formulate concrete goals, or criteria of sustainability, that will satisfy the vision and strategies of Frihamnen development. The criteria of sustainability should be derived from the point of view of Älvstranden Utveckling AB, as they are the client that will take the final decision in Frihamnen's development. Moreover, it is important to identify how will Älvstranden Utveckling AB and suppliers, which are involved in the detailed planning stage, satisfy these criteria. Finally, solutions and suggestions on how to bring Frihamnen closer to a "sustainable success" should be provided. Suggestions should be derived based on literature on best practice and on research about the attitude towards sustainable development in the Swedish construction sector.

The challenge leads to the following research questions:

3.1.2 Research Questions

RQ1: What is the precise understanding and definition of the sustainability criteria in Frihamnen, derived from Älvstrandens Utveckling AB?

RQ2: What are the concrete actions that Älvstranden Utveckling AB has implemented to make the realization of the criteria really happen?

RQ3: How do the contractors/suppliers have in mind to meet these criteria?

RQ4: Which suggestions can help to implement the sustainability criteria in Frihamnen?

3.1.3 Purpose and limitation

The purpose of the Master Thesis is to identify the intentions of the stakeholders (project developers, suppliers and contractors) to realise the vision, strategies and criteria of sustainability for Frihamnen, and to provide feedback. This will be reached by analysing the proposed processes and tools from the stakeholders as well as their willingness/resistance to deliver the district development that will satisfy the criteria. Due to the limited time, the scope of the Master Thesis will only focus on the case study of Frihamnen.

3.2 Literature review

The literature review starts with the research on how the concepts of "sustainability criteria" and "sustainable development in construction" have developed. Following that, the review focuses on the status of sustainability in construction in Sweden, as well as processes that influence realization of sustainable development. The literature review is concluded with suggested processes for improving the attitude towards sustainable construction and an example of best practice in Sweden – the Norra Djurgårdsstaden project.

3.2.1 The need of criteria for sustainability

Sustainability is a wide concept that can assist the development of scientific sectors in multiple ways. Sustainable development can be focused in the context of a single scientific field, combine the fields in order to solve complex questions, or form a unique multidisciplinary field with defined scientific notions. However, it is difficult to apply the concept by itself to solve real life social, economic and environmental problems. Moreover, the bigger the data collected in research between multiple disciplines becomes, the harder it is to pinpoint the necessary information for a specific question. There is a need to develop frameworks with measurable criteria dealing with separate disciplines that could help organise the knowledge in sustainability (Kajikawa, 2008).

The need for criteria for sustainability comes not just from the academia. In jurisdictions around the world, regulations and projects relate to the political decisions, with sustainability criteria being at best implicit (Gibson et. al. 2013). Certain regional working groups, like the HUR 2050 network in Western Sweden, try to develop the vision and agree goals between multiple stakeholders and define criteria of sustainability (Polk M, 2011). However, these are mandated sustainability initiatives, which still are at risk of being downplayed in favour of long established practices that have proven to work (Gibson et. al. 2013).

Downplay can also be present in the industry. Profit is always the priority for a corporation, and risk assessment can either support the new idea, or oppose it. Competitive advantage from sustainable decisions based on benefits for the environment and the society needs to be proven to the industry. Otherwise, an under developed initiative could become economically unfeasible, force a company to experience losses and cutbacks, and create fear of ever trying to challenge the status quo of Business As Usual again. Therefore, careful selection of effective sustainability criteria from Environmental, Social and Economic perspectives is more important than just having some criteria (Gibson et. al. 2013).

A recognised path for reaching effective criteria consists of setting clear goals, effective communication and discussion of the goals within society, publishing the goals and discussions and following legal procedures in decision-making and implementation. However, multiple challenges lie along this path. Firstly, our understanding of the situation is based on fragments of available information, which complicates definition of applicable criteria for a certain case. Secondly, diversity of perspectives needs to be properly recognised and addressed when approaching experts of different disciplines. Otherwise, miscommunication might lead to complications in implementation stages, resulting in higher costs. Lastly, conflicts are seldom

avoidable without recognising the interests of stakeholders, and the criteria have to be adjusted to be acceptable for everyone (Gibson et. al. 2013).

Overall, the development of sustainability criteria helps to reformulate the fuzzy goals of, for example, "reducing environmental impact" or "increasing social diversity" into precise bullet points. Well-defined sets of criteria support the processes of purpose identification, assessment of purposes and consequences, selection of actions based on what should/should not be done, monitoring, learning, adjusting and integrating. Furthermore, successfully developed criteria can become applicable outside the case study, provided they are incorporated into a sustainability assessment scheme. If there are conflicting criteria in a specific project, trade-off choices have to be made. However, the decision should be made on the most sustainable option for the particular case and context (Gibson et. al. 2013).

3.2.2 Sustainability criteria - from global level to constructions level

In the construction industry, the definition of sustainability differs from the traditional iron triangle of cost, time and quality. Reduction of resource consumption, decreasing the impact on the environment and improving indoor environment were added to the iron triangle (Kibert, 1994). Hill and Bowen (1997) further explained the definition by adding objectives of quality of life, flexibility in building functions, costing aimed at efficient construction as well as regenerative functions of the building to the environment (Hill and Bowen, 1997).

When translating economic, environmental and societal dimensions of sustainability to the construction sector, several key aspects can be found. A new building should improve the economic prosperity of building owners and AEC (Architecture, Engineering and Construction) specialists, but most importantly, to bring value to a community. The benefit should be created in a fair and equal way, with at least preventing long-term damage to the environment – at best, improving the environment (Keeble et. al, 2003).

An important concept associated with sustainable construction is the ISO 14040, or Life Cycle Assessment (LCA). The concept helps to define the purpose, limitations and stakeholders within the project, collect data on input and output levels of material and energy consumption, determine the impact of said levels and formulating recommendations for improvement. Life Cycle Assessment is the cornerstone of such Building Assessment Methodologies (BAMs) as BREEAM, LEED, Miljöbyggnad and many others. These products of LCA work design and assessment of whole buildings as well as construction products (Ortiz et. al. 2009).

BREEAM (Building Research Establishment Environmental Assessment Method) is the collection of global assessment methods for various project stages and actors aimed at designing and evaluating sustainable buildings (The BRE group, 2008). BREEAM launched in 1990, and it focuses on preventing unsustainable building construction by addressing sustainability from the earliest stages of project development. The BREEAM scoring system encompasses design, construction and management of buildings (The BRE group, 2015). The scheme has been developed to be applicable on the international level, in addition to several schemes tailored for UK, Sweden, Germany, The Netherlands, Norway, Spain and Austria. Depending on the stage of project delivery, BREEAM assessment methodology can be useful for the

client, designers, contractors, auditors, funders, property agents, design teams and managers (The BRE group, 2010).

LEED (Leadership in Energy and Environmental Design) is a certification system owned by the U.S. Green Building Council for design, construction and maintenance of sustainable buildings. The goal is to implement the recommendations for buildings that are environmentally safe and profitable on an international level. (U.S. Green Building Council, 2013) Multiple actors from the construction industry can take part in the LEED certification system. Depending on how the project team utilises the criteria from the certification system, different actors become involved and dedicated. The Designers play the role in the buildings integrity, durability, the Developer (the Builder) has to invite the Designers, and the Contractors to cooperate in order to deliver the sustainability goals, the whole project team should assess the risks and mitigation strategies for the risks in the design stage (U.S. Green Building Council, 2013).

Miljöbyggnad is the Swedish building certification system that is based on Swedish construction and governmental regulations. This certification system deals with energy, indoor environment and materials for both new and old buildings (Sweden Green Building Council, 2015). Miljöbyggnad analyses residential buildings, office buildings and districts (Sweden Green Building Council, 2014). Miljöbyggnad provides building owners and consultants with a basis for creating a healthy environment where people can feel safe. Property owners are advised to hire a certified coordinator, who has trained in the Miljöbyggnad certification system and knows how indicators are analysed, reported and assessed (Sweden Green Building Council, 2015).

The purpose of sustainability methodologies is described by Ness et.al. (2007) as:

"…to provide decision-makers with an evaluation of global to local integrated nature–society systems in short and long term perspectives in order to assist them to determine which actions should or should not be taken…" (Ness, et al., 2007).

According to Ding (2008), this purpose corresponds with construction projects and actors in several ways. Firstly, the purpose encompasses the efficiency, optimised energy consumption and potential for repeating use of resources, which satisfies the long-term and short-term perspectives of sustainable development. Secondly, it addresses the gap between the demand and environmental impact in current construction practice against the consideration of the demand for future generations. Thirdly, sustainability methodologies offer multiple logical sequences for process management and educate the awareness of both the importance and the implementation of possibilities among stakeholders for sustainable building processes (Ding, 2008).

The need of directing the construction industry towards sustainability is also recognised by Hishman & Berger (2014). According to the survey taken for the opinions of new construction project clients and AEC specialists, diverse impacts of the project throughout the whole lifecycle should be frequently assessed. However, when it comes to investment decisions, the focus lies in collecting credits from the BAMs. Moreover, the measurements for making investment decisions are connected with initial investment, operation & maintenance costs as well as with building's functional performance. What is interesting, social impact on project stakeholders and the community is least prioritised, and there is less need of preparing environmental analysis and analysing the ways of material recycling. These factors show the

importance following the Building Assessment Methodologies not just for credits, but also for the content, in order to realise the potential of sustainability methodologies (Hisham & Berger, 2014).

Mora (2007) recommended distinguishing from sustainability of construction activity and sustainability of works constructed. The construction materials chosen for the construction process might not be renewable, provided the impact from maintenance and repair of construction products is small enough. Likewise, exclusive construction materials, which provide long durability to the building, can be useful. Modularity of the construction elements increases functionality and simplifies reconstruction works. As a result, these options provide buildings that lasts for a longer lifetime and can be considered as examples of sustainable construction, functionally meeting the needs of our and several – ideally, all – of the future generations (Mora, 2007).

Ding and Langston (2002) developed sustainability criteria for the construction industry that go beyond the environmental impact assessment. The sustainability index is the measure of these criteria, which include the benefit-cost ratio for as the economic value of the building in the construction and operation stages, a weighed score for usefulness of the project to the AEC specialists and users, the annual resource consumption in energy value Gj/m^2, and the risk probability factor for the environmental impact. The sustainability criteria recommend to maximise the first two values (wealth and utility) and to minimise the last two values (resources and impact). The criteria are expanded into sub-criteria, such as land acquisition cost, revenues, building maintenance, manufacturing, employment opportunity, pollution and several others (Ding and Langston (2002), Ding (2008)).

To summarise, the concept of sustainability has developed a long way. Multiple researchers have offered sustainability methodologies, indicator measurements and criteria. Applicability of the research however may differ between countries due to set practices, historical construction developments and geographic locations (Mora, 2007). The following chapters focus on the state of sustainable development and the overall state of construction performance in Sweden.

3.2.3 Competence in sustainable development of construction in Sweden

Firstly, the literature review is performed concerning the Swedish client, which procures suppliers of design, construction and other services for construction project. Secondly, the literature review is performed concerning the Swedish suppliers of services for construction projects.

3.2.3.1 The client

The association for professional construction clients in Sweden Byggherre Forum recognises the construction client as an agent of change in sustainable development of the built environment. The construction client is required to develop the construction project from concept to handover with respect to environmental, social and economic aspects. The R&D programme for Constructing Clients has the goal to integrate technology necessary for satisfying sustainability criteria into the construction sector in a systematic way. The roles of the client are to support the long-term quality of the project, to meet customers' demands and to manage the overall processes in the

construction project with own and external resources. In addition, the construction client is overall responsible for determining the long-term profitability of the project (Swedish Association of Construction Clients, 2006).

In reality, the level of interest from Swedish clients to sustainable construction is not on the highest level. There are minimum incentives for sustainable design services in Sweden during public procurement procedures. Based on the survey conducted by Sporrong and Bröchner (2009), around 38% of respondent municipalities in Sweden include sustainability as a policy component for the procurement of the building's design services. Contrary, environmental policy components were identified in 74% of the municipalities (Sporrong and Bröchner, 2009).

Delivering satisfactory designs that ensure environmental criteria of sustainable development should be rewarded to the procured consultants. This might be the question of time before proper recognition of other sustainability criteria diffuses in the public sector. In addition, it takes time to learn how to properly recognise the criteria for the contract regarding sustainable design. The positive side is that multi criteria and value are prioritised over lowest bid in public procurement projects for design (Sporrong and Bröchner, 2009).

The results from the survey, undertaken by the Swedish Association of Construction Clients, shows that construction clients should play a more active role in promoting sustainable development. In fact, the association prescribes that the client should translate the needs of construction activities to civil engineering and other specialists with regards to the societies view on sustainable construction (Swedish Association of Construction Clients, 2006).

After the needs are set by the client, The Swedish Planning and Building Act requires the detailed planning procedure to adhere the natural, cultural values with aesthetic design, creating good living and environmental conditions with effective management of land and water with respect to surrounding districts (Swedish Planning Agency, 1987). The Environmental Code 1998:808 requires the construction industry to adhere to sustainable development by supporting good human health, natural and cultural environments, biological diversity, good management of physical resources, reuse and recycling of resources (Riksdag, 1998).

Overall, there are both needs and responsibilities for the client to recognise the sustainability goals in a construction project and to communicate them clearly to suppliers.

3.2.3.2 The Supplier

Several trends have been established when performing research on environmental performance of the Swedish construction industry over the last ten years. Influence of stakeholders on environmental and sustainability decisions have diffused among more stakeholders, including knowledge intensive actors and financial beneficiaries. Multiple companies work in accordance with energy management systems, have set up an environmental policy, set up the environmental goals and measured their realisation. However, the benefits for business coming from environmental processes in construction come mostly in forms of "soft rewards" as personal satisfaction, image recognition and corporate image, with minimum influence on short-term profit, productivity or market share. Moreover, there is an increase of challenges coming from perceived high costs, indifferent market for green buildings and lack of

cooperation between clients and suppliers (Gluch, P. ; Gustafsson, M. ; Thuvander, L. 2014).

In order to identify mistakes during construction processes, which cause environmental impacts, a survey was performed among Swedish contractors. The sources of the mistakes were identified to come mostly from poor planning of processes, breakdown of machinery used during construction and inappropriate behaviour of construction workers regarding their tasks. Little influence came from bad weather or other external factors, or lack of knowledge. (Gluch, P. 2010)

The survey of construction companies in Sweden, working with refurbishment projects of buildings, shows a different adherence to sustainability indicators in implementation stage. Both SME's and large contractors have environmental policies, however, large contractors, especially those supported by public companies, have more detailed routines that aim at following up on key performance indicators for sustainability. The sustainability policy routines for site management are concluded to be valuable for all contractors, whether increasing productivity or sustainability (Sezer, A. 2015).

To sum up, most of the suppliers are capable of meeting sustainability goals to certain extents. However, troubleshooting of basic processes must be performed in order not to have mistaken of implementation coming from usual procedures. Moreover, recognition of sustainable performance with both financial and "soft" rewards might increase the attractiveness to competitions and projects of sustainable urban development.

3.2.4 What is the performance of Swedish planning and construction projects?

It is important to review the overall state of Swedish planning and construction performance, as these processes are imbedded in the organisation and influence any project – whether sustainable or not. Mistakes in these processes influence overall performance of the project and the adherence to sustainability goals.

Based on the survey performed among public and private clients in Sweden, the most important success factor perceived by the clients is their power of making decisions in a project. The success is also expected when committed and competent consultants and contractors are working in the project. However, the involvement of communities, trust and learning from mistakes were least recognised to bring success. The results may be interpreted as the clients wish to achieve project success relying only on personal and procured competence. Lack of trust and learning from mistakes often results in not taking risks and avoiding extensive organisational learning (M Frödell, 2008).

From the economic perspective, the costs for clients and end users of construction projects have increased in Sweden in the last ten years. This is believed to be due to increase of prices on materials and labour, as well as increasing market value of property and complex criteria for projects (Lindén, S. and Josephson, P.). Another account of increased costs is wasteful construction activities, which is estimated to be up to 35 % of the overall production cost (Josephson and Saukkoriipi, 2007). In general, over 60% of the production cost for a new residential building comes from construction costs, where 30-40% comes from raw material costs. Despite high

overall construction prices, low profit margin of the construction industry forces companies to save on actual costs whenever possible (Lindén, S. and Josephson, P.; Josephson, K. 2012).

In the construction phase, delivered value per work amount is the key factor for success. Waste is opposite to value, and lean thinking is a concept, growing in popularity, and aiming to reduce the waste generating processes in the construction industry. Several researchers tried to clarify how lean thinking is perceived in the construction industry. Green and May (2005) mention the concept of lean construction as a multitude of diffused concepts, used by the construction companies as it suits them best. The researchers summarize these concepts into three lean models: based on waste elimination, on relationship development towards better collaboration and on rethinking the building sector's structure as a whole. The waste elimination model is model that is most required to the construction industry, as Josephson and Saukkoriip (2007) mention in their report that waste often absorbs 30-35% (sometimes – even 50%) of production costs that the client pays for the construction project. That means only 2/3 of what the client pays for can actually be justified in the processes that undergo in the project environment.

Despite relatively high financial figures coming from wasteful activities, overall high quality management and low risk tolerance are common traits used to describe the Swedish construction industry. The industry has been developing in a relatively self-sufficient way, with continuous training of construction specialists to be able to deliver buildings and civil engineering structures of high quality. External dependence of Swedish construction industry lies mostly on raw materials, while knowledge of their transformation into products is often considered plenty (Brochner, J. Josephson, P. Kadefors, A. 2002).

Although the Swedish construction industry overall is considered to be conservative, contracting companies find ways to support innovation through coupling with Research and Development for improving processes of material extraction, construction product manufacturing and others. Innovation and communication technologies support innovation through developing new quality assurance processes, helping contractors with transportation of goods, measuring and controlling environmental impact of buildings in new ways. The major contractors of Sweden contribute to construction innovation in most fields, however, SME contractors can also contribute to develop performance – it is a question of how easy it is to measure the impact of the innovation. In addition, narrow focus on a single stage of the lifecycle, which is often the business of a sub-contracted company, is wasteful in determining the overall innovation for the industry (Brochner, J. 2010).

Unfortunately, the level of innovation of the construction industry in Sweden, based on the traditional output/input measurement of productivity, show little progress in increasing productivity. On the one hand, the risk aversion, greater care towards the life cycle of a construction project, user comfort and environmental sustainability has made the projects longer in time, so as to deliver these important criteria. On the other hand, technological innovations have been used to make the delivery of projects more efficient and less time consuming. Unfortunately, the traditional productivity measurement does not show a significant increase of productivity, caused by these innovations (Bröchner, J. and Olofsson, T. 2012).

The role of the environmental specialist in a construction project is recognised, however, not fully integrated. The environmental specialists are separated from really

influencing the production processes. In addition, the resources are limited and the same environmental specialist has to manage with multiple projects. Project managers do not recognise the power of the environmental professional and usually address the specialist for advice, to solve particular problems. Moreover, site managers sometimes see environmental managers either as a nuisance, that has no real construction project experience, or as a threat, as they expect negative feedback for their daily decisions at the construction site. Overall, during the project execution stage, the environmental goals are often challenged by budget, delays and unpredicted risks that force to find a compromise (Gluch, P. 2008).

Construction companies increasingly use the tools for reporting environmental practices, however, rarely translate the quantitative data into financial figures due to lack of standardised definitions, lack of demand from investors and difficulty in obtaining reliable data (Gluch, P. 2010). In addition, Swedish construction companies focus on waste management and administrative environmental procedures, while avoiding a holistic approach (Gluch, P. Gustaffson, S. and Thuvander, L. 2009).

Knowledge management is another important concern in the construction industry. Construction processes consist of recurring activities, which need to be codified. However, the knowledge of construction employees is informal and personal, difficult to transfer to a standardised form. Moreover, the relatively high interchange ability of employees in the construction industry means that knowledge from one project might get lost for transfer to another project (Styhre, A & Gluch, P. 2010).

3.2.5 Which processes need to be in place?

Research on the construction project delivery barriers, perceived by Swedish construction clients, shows that the biggest perceived challenges are the adversarial behaviour, short-term focus, and resistance to change within the industry. Improved interaction between the construction client and key stakeholders is seen as a possible solution to partially solve these challenges. In addition, the construction clients can become more effective by implementing a structured, but not too formalised, process-oriented approach starting from the project definition stage (Vennström, A. 2009).

A clear importance of the role of the environmental specialist need to be further established, with developed firm position, integrity, and the power to push the decisions towards green building (Gluch, P. 2008). Clients of the projects can help establish this role, since the survey of environmental performance of the Swedish construction industry shows the client to be the most influential stakeholder in this matter (Gluch, P. ; Gustafsson, M. and Thuvander, L. 2014).

Waste reduction in construction processes is recommended to decrease production costs and increase value (Josephson, K. 2012). A good explanation of how to reduce waste activities and increase value in the construction industry is mentioned by Josephson and Björkman (2011). The report offers the companies to adapt a long-term approach towards the client's value support using the "value pyramid" and elimination of waste in resource consumption simplified by prior waste discovery. Adaption of this mindset should increase profitability of the projects as well as strengthen the bonds between client and supplier in the long-term relationship. In addition, the contractors might find valuable to analyze the logistics of material delivery to site, to specify the demands for the material delivery the supplier, to develop the delivery plan and the process map. Finally, responsibility for logistics at

the site must be clearly stated with the use of, for example, responsibility area documents, quality controls and arrival controls (Josephson, K. 2012, Josephson and Björkman 2011).

Alternative productivity measurements and improvement schemes of construction processes also need to be in place. Bröchner and Olofsson (2012) offer example of these measurements. They estimate user-oriented capacities, discounted future energy use of facilities, future disruption of user activities and risks of these disruptions, comparable user comfort and negative non-market effects (Bröchner, J. and Olofsson, T. 2012).

Josephson and Björkman (2011) have developed 31 recommendations that should increase the productivity of construction processes for a company. These recommendation offer higher standardisation of products and processes during the whole project lifecycle, focus on customer need satisfaction, extensive utilisation of construction mechanisms and machines, transportation of materials on a 24 hour schedule, management decisions focused on long-term benefits, collection of best practice examples from own experience and theirs systematisation and others (Josephson, P. and Björkman, L. 2011**).**

Cost of Environment Errors (CEE) can be used as a decision-supporting tool regarding the economic impact of environmental decisions on a construction company. The tool uses the similar principle of error identification as strategic and quality management, therefore, it can be integrated in a wider perspective. The tool is valuable for the living environment, built environment as well as population of these environments, as it addresses all of these areas from a financial, environmental and goal fulfilment perspective. The procedure of using the tool starts from choosing the relevant environmental policies, that the management must or wishes to follow, next listing the planning, social and other causes of deviations from expected results, grouping the cost class and responsibility for the deviation. Although the tool does not determine the profit from following an environmental policy, it is valuable for identification of mistakes, learning from them and decreasing costs. The biggest limitation is the retrospective approach of the tool, which makes it valuable for the production stage, but not as useful for the planning stage (Gluch, P. 2010).

Platforms are tools that can be used to accumulate, standardise and distribute the knowledge from construction specialists, as well as other stakeholders. These tools are used in a number of Swedish construction companies. They allow codifying technical solutions and practical advice, integrating and guiding construction processes. However, the platforms must be carefully designed and implemented, so as not to be too “fluffy” as an online forum, and not too strict as an audit procedure. Otherwise, the tool will take too much of valuable time from processing the knowledge to be of benefit for a construction company (Styhre, A. & Gluch, P. 2010).

Regarding competitive advantage from sustainable performance, the absorptive capabilities package ACAP can be used. The knowledge-based package supports innovation towards sustainable development in the construction industry by looking at previous experience of implementation of sustainability goals into contractual agreements. ACAP can be used between stakeholders of complex consortium projects in a, for example, consortium setting. The absorptive capacity can be further divided into potential and realized absorptive capacities. Potential is a flexible platform for adapting to changing conditions and integrating external knowledge, for example, following environmental demands and legislation. Realized absorptive potential is the

tool for fusion of new and old knowledge for employees, which supports organizational transformation towards opportunities of benefit from new knowledge, and routines of incorporating the knowledge into operational routines. Examples of realized absorptive potential are environmental audits, monitoring of fulfillment of environmental criteria (Zahra, S.A. and George, G. 2002).

Green ACAP is a refined tool for sustainable performance, developed from extensive survey between multiple Swedish construction companies. It builds on the previous ACAP model with additional insight, that external knowledge from benchmarking and successful experiments is preferable over external knowledge from joint actions and supplier control. Moreover, potential and realized ACAP have been identified to have certain relations within the procedures. For potential ACAP, demand identification routines significantly influence for employee training, measurability of criteria, planning and life cycle assessment. Moreover, the better the processes are running in the potential ACAP, the better the processes will run in realized ACAP. The overall model for Green ACAP, presented in Figure 29, can help management to capitalize on green innovations by following the acquisition, assimilation and transformation processes (Gluch, P. Gustafsson, M. & Thuvander, L 2009).

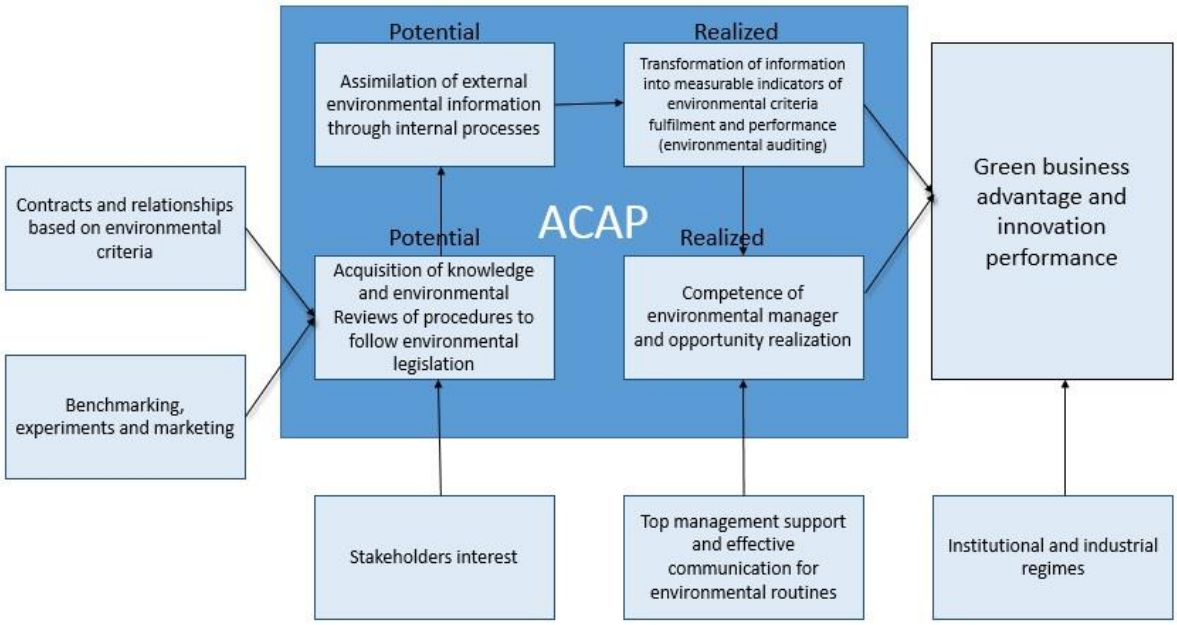


Figure 29 *Green ACAP (*based on Gluch, P. Gustafsson, M. & Thuvander, L 2009).

One example of successful previous experiences for sustainable construction can be taken from the case study of a Swedish public construction client organization, that managed to transform the broad mission of "reducing energy use in buildings by half by 2030" into a set of procedures. An investigation project was set up to meet the political mission. A corporate event called The Energy Day was organized to spread the importance of finding out how to meet this target and to present the management team as leaders in this process. The principle requirement for achievement of these procedures was to influence the key stakeholders and make them committed. The Energy Expert played the main role in reinforcing the energy target, setting up future action plans. This coincided with his personal desires to bring energy-efficiency into

the organization, which also shows the commitment as one of the main driver. Overall, discursive competence, recognition by top management and commitment plays an important role in strategic decisions of the company (Ludvig, K. ; Stenberg, A. ; Gluch, P. 2013).

The Lifecycle Costing (LCC) approach considers investment costs, as well as operating costs for the whole lifecycle of the building. It does not take into account all environmental costs. In addition, LCC aims at measuring the environmental impacts in monetary units; however, not all impacts can be measured with similar reliability. The measurement actually leads to over simplification of the sources of impact. Still, the tool can be used, if the user carefully considers the positive and negative side. (Figure 30) (Gluch, P. and Baumann, H.2004).

PROS	CONS
LCC...	LCC...
... uses a familiar unit, money.	... fails to handle decisions under uncertainty
... gives an indication on which aspects to consider	... fails to handle irreversible decisions
... limits the information flow by simplifying multi-attributed alternatives.	... neglects items without owner, such as the environment
... may entail learning by participating in the calculation process	... over-simplifies environmental problems into a monetary dimension
... has a life cycle perspective	... underrates future environmental costs
	... suffers from poor availability and reliability of data
	... relies on many estimated variables due to the complexity of the building and building process
	... results are biased towards the decision maker's personal values
	... may restrain learning if too mechanically used
	... is beset with conceptual confusion due to many similar LCC-oriented tools and inconsistent life cycles.

Figure 30 Usefulness of Life Cycle Costing (Gluch, P. and Baumann, H.2004).

Another helpful advice for supporting environmental goals is to organise meetings related to these goals. According to the case study of a tunnel project, the most effective processes for communicating environmental goals were the meetings. Since this information is not available openly to key project stakeholders at a given time, the meetings must be targeted to brief the stakeholders on what is most important, and to discuss possible barriers from other project management processes (Gluch, P. 2004).

3.2.6 What are the good practice examples in Sweden?

A living example of Frihamnen project is the project of Norra Djurgårdsstaden in Stockholm City. The city has invested 21 billion kronor in order to develop a sustainable district. A total of 40 contractors provided land allocation commitments with the aim of building 500 residences per year. The area was planned to include

student housing, condominiums as well as rental apartments. The first decision of Norra Djurgårdsstaden was made in year 2010 with the aim to deliver a sustainable district. The first two stages are finalized and contributed with 1 000 apartments within the area (Norra Djurgårdsstaden, 2014).

It is stated that there are four peaks within the project of Norra Djurgårdsstaden, which are the human being, the building, the district as well as the surrounding world. The human being refers to the development of meetings and dialogues in order to create engagement with and between the residents. A numerous of associations within the old as well as the new district of Djurgårdsstaden have been created. The outcome has contributed with the ability of acting as well as being engaged in the development of a secure and welcoming district. The buildings developed will contributed with new reinforced characteristics with a combination of self-generation of energy, energy efficiency as well as a good living environment. This was generated through land allocation proposals. The development of the district contributed with the outcome of methods for the valuation as well as the quantification of the ecosystem. The outcome of these methods is of great importance in the development of knowledge for a better future. The aspects of the surrounding world was generated through an innovative competition on how solar could be integrated into parks and streets. As a result 71 countries with a total of 775 attendants contribute with 70 different entries. However, it is yet to be decided if it will be implemented or not (Norra Djurgårdsstaden, 2014).

The project of Norra Djurgårdsstaden has included the political will, cooperation and training, requirements and monitoring as well as research and development. The purpose is, in order to ensure that new knowledge and new solutions are initiated in the development of the urban district (Norra Djurgårdsstaden, 2014).

The district development of Norra Djurgårdsstaden aims at contributing a functional everyday life where it should be easy to make sustainable choices. Thereby, the development of functional cycling areas, public transportation, walking and close to services and nature is key. In order to each a functional everyday life accommodation meetings have been organized for all newcomers. This contributes with an ability to be engaged and involved by attending the open seminars. Furthermore, the seminars include different themes such as preschool, recovery, energy and urban farming. What is more, citizen network have been created in order to facilitate the accommodation to discuss and pursue important local issues. The topics discussed and pursued during 2014 was waste management, recycling, transport, schools and preschools. Also, the urban development project initiated a Facebook page where the project developers provide information about what is happening within the area as well as responding to comments. The statistics have showed that the engagement and commitment have increased significantly (Norra Djurgårdsstaden, 2014).

There are clear requirements for contractors that have received the land allocation of Stockholm City. The requirements of Stockholm City include the requirement of minimizing the use of resources, increase the usage of renewable energy, prioritize sustainable transportation as well as prepare buildings for climate change in the future. Furthermore, there is a high demand on that the tools used in order to bring high quality should contribute with new knowledge and creativity. As a result, 91% of the contractors reached the sharp energy requirements goal and 75% of the contractors reached the parking requirements for bicycles. The green space should fulfil three different functions- biodiversity, climate change adaption as well as social values. As

a result, 100% of the contractors reached the demand and moreover 82% of the contractors reached the requirements for local generation of solar power (Norra Djurgårdsstaden, 2014).

As for now, the development of Norra Djurgårdsstaden has resulted in an inspiring district, whereas 1500 individuals visited the Norra Djurgårdsstaden. An event day that included food trucks, viewing of Gasverket as well as climate activities, 128 people participated during the past year of 2014 in various skills programs as well as 490 people from 77 different companies participated in one of the six forums for sustainable solutions (Norra Djurgårdsstaden, 2014).

3.3 Method

The master thesis is based on a qualitative approach. Two methodologies are used in order to achieve the objectives of this thesis, which are gap analysis of data and snowball sampling. The data collected are derived from primary sources referring to interviews as well as secondary sources referring to journals, articles, conferences etc.

3.3.1 Qualitative data analysis (QDA)

Qualitative data analysis is used in order to structure and analyse qualitative data, which is often collected through a sequence of interviews that are firstly recorded and thereafter transcribed but also through collecting relevant literature review (Brightman, May 2003).

3.3.1.1 Gap Analysis

Gap analysis is a tool used when analysing what steps an organisation/project needs to take with the aim to transfer it from its current state to the desired future state. The gap analysis includes the steps of:

i) ("What is the current state?") To identify as well as to compare processes, competencies, characteristics and performance levels within the organisation/project.
ii) ("What is the future state?") To identify factors that needs to be implemented within the organisation/project in order to reach the future state.
iii) ("Identifying the gaps") To identify the existing gaps within the organisation/project as well as to acknowledge which practices are in need to be implemented.

Who are the target audiences?

The project liaison will be the primary individual to prepare this written gap analysis, but the entire improvement project team should be engaged in performing the gap analysis.

3.3.1.2 Qualitative interviews

This section describes the details of the interviews as well as their structure when collecting data within Frihamnen, Älvstaden and contractors involved.

Snowball sampling

The methodology of snowball sampling is applied within qualitative research, whereas the data is collected through recommendations among shareholders that know others suitable within the researchers interest (Biernacki and Waldorf, 1981).

The master thesis conducted a total amount of ten interviews, whereas ten actors were interviewed. The initial interviewee derived by Challenge Lab supervisors, which thereafter created a snowball sampling where the interviewee suggested potential interviewees within Frihamnen as well as Älvstaden. The interviewees were contacted due to their position as well as relation to the Frihamnen project.

The overall contacted stakeholders were 14, whereas ten stakeholders were interviewed. The ones not interviewed either did not respond or find the time to be interviewed. All interviewees derived from recommendations, in other words snowball sampling.

Structured and Unstructured Interviews

The unstructured interview includes certain variety of issues or topics, which involves an informal structure of questions. The interview begins with a question from the interviewers, leading the interviewee to respond openly, whereas the interviewers responds with follow-up questions by signalising data that is considered worthy to supplement (Bryman and Bell, 2011). This structure allows the interviewers to observe the interactions as well as behaviours resulting in a guided dialogue (DiCicco-Bloom and Crabtree, 2006). Furthermore, this allows the interviewers to have an open mind regarding comments and thoughts stated by the interviewee in order to identify additional relevant data as well as potential contacts. The unstructured interviews were used when interviewing both Stadsbyggnadskontoret and Älvstrandens Utveckling AB.

The structured interview includes a formal structure of questions. The interview begins with a question from the interviewers, leading the interviewee to respond on a specific issue or topic. This structure allows the interviewers to collect a certain data needed. The structured interviews were used when interviewing the contractors involved within Frihamnen.

3.3.2 Data analysis

The data collected was analysed in the following way:

- *Collection of data*: Recorded through voice recording equipment.

- *Transcription of collected data*: A word document containing questions asked followed-up with the stakeholders' statements and opinions were created.
- *Coding collected data*: The data collected was thereby grouped in accordance to their similarity. However, in order to differentiate the results the results were classified through colour definition together with a short description.
- *Categorizing topics*: The topics were categorized in accordance to the structure of the data collected.

3.4 Interview findings - Frihamnen

A number of ten interviews were performed in order to get a better understanding about the sustainability goals and how they are going to be implemented in the Frihamnen project. The interviews were based on two main perspectives – on the one side from the city of Gothenburg, represented by the municipal company Älvstranden Utveckling AB, which is the main district developer and landowner, and the Gothenburg City Planning Council, and on the other side from the companies, procured by the main district developer.

The Frihamnen district development project as of July 2015 is in the detailed planning phase – the phase, when the municipal developer and the eight companies need to cooperate on part of the whole Frihamnen project. Currently, Frihamnen aims to have 1000 flats, 1000 work places, a school, a hospital and part of the municipal Jubileums Park by the year 2021 (Stadsbyggnadskontoret, 9th September 2014).

Älvstranden Utveckling AB has performed the land allocation competition for companies to enter and compete. Out of 64 companies, eight have been selected for their professional competence, creativity and special skills offered for Frihamnen. The companies together with Älvstranden Utveckling AB have formed The Consortium in order to more effectively plan, communicate and coordinate decisions. (Stadsbyggnadskontoret, 9th September 2014).

The criteria for selection of the companies for The Consortium are related to their ability to support social and environmental sustainability, social mixing of residents, creating diverse competition on the job market and economic stability of the future owners of the property in Frihamnen. The focus lies in creating a dense city district with socially mixed housing (Stadsbyggnadskontoret, 9th September 2014).

Furthermore, the companies selected for Frihamnen are diverse in size, but equal in recognition within The Consortium. One company has 10000 – 20000 employees, three companies have 100-500 employees, two have 10-100 and two have 1 – 10. In addition, the roles, specialisation and what the companies will deliver are also different. The eight companies were also selected during land allocation based on their innovative approaches, experience and solutions in sustainable urban development. In addition, they have promised to provide prising on rental housing that will be affordable for people with different incomes (Stadsbyggnadskontoret, 9th September 2014).

The purpose of the interview is to get answers from both Älvstranden Utveckling AB and other members of The Consortium concerning sustainability goals (or sustainability criteria) and principles of implementation of the goals. It is important to determine, what are the sustainability goals, how are they understood by and by

Älvstranden Utveckling AB and the companies, how will they be realised and guaranteed, concerning different perspectives of the members in The Consortium.

3.4.1 History of Frihamnen

Frihamnen district had had an important role in the Gothenburg city since the day it was built. In 1922, Frihamnen was officially open as the cities first ocean harbour. The port was very important for achieving the goals of the Swedish industry in the international market. A dedicated railway route, around 20 dock cranes, warehouses and other buildings were erected in the new industrial district. However, many of the older buildings were demolished by the 1960s in favour of new residential buildings. Until the 2000s, Frihamnen took the import of the bananas for whole Sweden, counting 200000 tons per year. Nowadays, the harbour district is used for concerts as the pier for cruise ships (Älvstranden, 2014).

Frihamnen district is the part of Norra Älvstranden (Northern Riverside), the area that extends opposite the central Gothenburg on the northern Göta riverbank. Originally an industrial area with around 45000 employed, Norra Älvstranden harboured 3 ship yards, cargo and port facilities until the 1970‘s. The oil crisis and growing global competition forced the Port of Gotheburg to dismantle all the port infrastructure in Norra Älvstranden and to leave the territory abandoned for over 20 years. Depending on the owner at the time, Norra Älvstranden was planned to become an off-shore oil industrial area or a housing area for 20000 residents. However, the financial crisis of the 1990’s put a stop on those plans and the whole area was sold for a fixed price to the City of Gothenburg (NUAB, 2006).

The regeneration of Norra Älvstranden by the City of Gothenburg has brought back life to the area. Around 6000 residents live, 15000 employees work and 9000 students study in the area. Big warehouses were transformed to house SME’s, a new Chalmers campus was open and a joint Chalmers and Gothenburg University IT campus was initiated, the Lindholmen Science Park was inaugurated and large companies like Ericsson found their home. The public transportation in the area developed relatively efficiently with tram and bus lines. The interest of the people was induced to visit the area more often. However, several problems are still unsolved. These problems regard the relative isolation from the rest of the Hisingen Island by railroad and from Central Gothenburg by the river. In addition, the housing prices are considered too high for everyone to afford living in Norra Älvstranden (NUAB, 2006).

In the contrast to the linear management and delivery of the *One Million Homes programme*, the City of Gothenburg decided not to develop the whole area by themselves, rather to invite investors from private companies. Over 11 million kronor were invested in the area from private companies alone. The main processes in place of the Norra Älvstranden regeneration projects include the regeneration scheme, ensuring economic success through education, innovation and businesses within the area, a “non-linear” flexible strategy, adaptability to external forces and strong collaboration for the common goal. In addition, the city, the industry and educational establishments must cooperate, build on strengths, develop healthy relationships and encourage good service quality (NUAB, 2006).

3.4.2 Frihamnen Now

The following two sections illustrate the decisions around Frihamnen's development according to available documents online.

3.4.2.1 Background

Fastighetsnämnden (the real estate committee) is responsible for the development of residential and land policy commissions in Gothenburg city. However, Fastighetsnämnden must adapt the conditions of the city council ones the tasks of preparing and supplying, acquiring as well as leasing or selling land. In addition, Fastighetsnämnden is also responsible for exploitation activities, land activities and residential planning of Gothenburg city(Fastighetsnämnden, 13th June 2014).

The company Älvstranden Utveckling AB owns some of the city's land where their responsibility is to promote long-term urban development around the area of Göta Älv with the actualisation of Älvstaden's vision. Älvstranden Utveckling AB must cooperate with Fastighetsnämnden to coordinate Gothenburg city's land-use as well as development activities in order to equivalent the vision of the company (Fastighetsnämnden, 13th June 2014).

The policy of land zoning defined within the master plan of the city, the city's budget, the development planning strategy, the vision of Älvstaden as well as the regional growth strategy of Gothenburg city are derived from the political level where the strategies and objectives are determined. Ones the designation of land for current projects is approved by Fastighetsnämnden a land use agreement must take place in order to accept the terms and conditions of the land allocation agreement (Fastighetsnämnden, 13th June 2014).

The vision and strategy of Frihamnen is corresponding to the urban development of Gothenburg City. The planning and implementation of new buildings must contribute to a sustainable urban development in terms of environmental, social and economic aspects, as mentioned within the strategy of Frihamnen. The purpose is to create good living condition for all citizens as well as mixing different residents, apartments and offices in order to offer a wide and varied selection of activities where each part of the city is allowed to develop on its qualifications. However, the development and planning of Gothenburg City must consider the child perspective in all projects. The criteria for Gothenburg City's land allocation agreement shall be applied the following way when new developed is made (Fastighetsnämnden, 13th June 2014):

- Residential diversity*: "A fundamental aim is to promote diversity in housing. This means that there should be a wide variation in terms of tenure, types of houses, apartment sizes and price images within the city as a whole but also in different neighbourhoods and areas. This creates the conditions for a mixed composition of population and socially mixed residents."*

  "All housing production must meet the requirements of high availability."

- Social sustainability and commitments: *"The developer´s ability and willingness to social responsibility is of great importance."*

  "As a condition of land allocation the developer must assign special housing for different categories, as well as facilities for children and the elderly."

  "Fastighetsnämnden will also be able to require the developer to lease apartments for households with special needs. This should be done either by the intended new construction or in the developers other existing housing stock."

- Environmental sustainability: *"A sustainable ecological construction should be promoted. This means that new buildings are planned for environmentally friendly implementations, that the operation of buildings are energy and resource efficient, that emissions from buildings has minimal environmental impact and that buildings do not affect the environment negatively and that a good in- and outdoor environment is created. Construction builders should have a long-term quality and environmental profile."*

- Business premises: *"A fundamental aim is to promote a diversity of offices for businesses. The city would like to see a mixed city developed within many areas. Where it is appropriate, therefore, residential and business offices should be integrated into buildings."*

  "The land that is specifically designed for scope of practice should offer anyone wishing to construct buildings that contain activities that suit the current extension field."

- Market competition and diversity: *"Opportunities are created by promoting good competitive conditions and business offices at reasonable costs. A diversity of contractors, both large and small, should have the opportunity to establish themselves and the city shall establish to bring in several stakeholders in the same area."*

- The contractors' stability and economic prospects: *"To participate in the planning and implementation of new construction a good financial stability as well as organisational conditions in order to carry out the construction is required. Consideration should also be given to the builder's interest in long-term continuance of the settlement with the intended tenure."*

- Other criteria: *"When selecting the contractor they shall take account of previous similar projects. How the developer has completed its previous commitments are of great importance. Innovative thinking and commitment to participation in cooperation to create good urban environments as well as good environments for business and its development is also of significant importance."*

- *"As there may be special circumstances in different projects, an assessment is also made of the appropriate contractor based on the different criteria and conditions that may otherwise apply to the current specific project."*

3.4.2.2 Division

Frihamnen is planned to be constructed gradually over a long period. The construction of Frihamnen will start around year 2018-2019 and is presumed to be finalized approximately 15-20 years later. Frihamnen is estimated to contribute with approximately 300-600 apartments per year until 2035. However, the rate of expansion is highly dependent on the conjuncture; municipal planning as well as the market demand (Stadsbyggnadskontoret, 9th September 2014).

Frihamnen is suggested to be built where the construction will gradually increase in height towards the northeast with the highest buildings along Hjalmar Brantingsgatan. The drive is to create an open view, see Figure 31. The area will generate a new district, a district that is not only attractive for business purposes such as offices and business establishments but also the creation of consumer durables and different cultural activities (Stadsbyggnadskontoret, 9th September 2014).

Figure 31 Frihamnen and its open (Stadsbyggnadskontoret, 9th September 2014).

The construction of Frihamnen is divided four subdivisions. The four subdivisions will be constructed in 4-5 stages at different time. Each stage is to include a functional every-day life through public transportation, commercial services kindergartens, schools as well as cultural and club activities, see Figure 32.

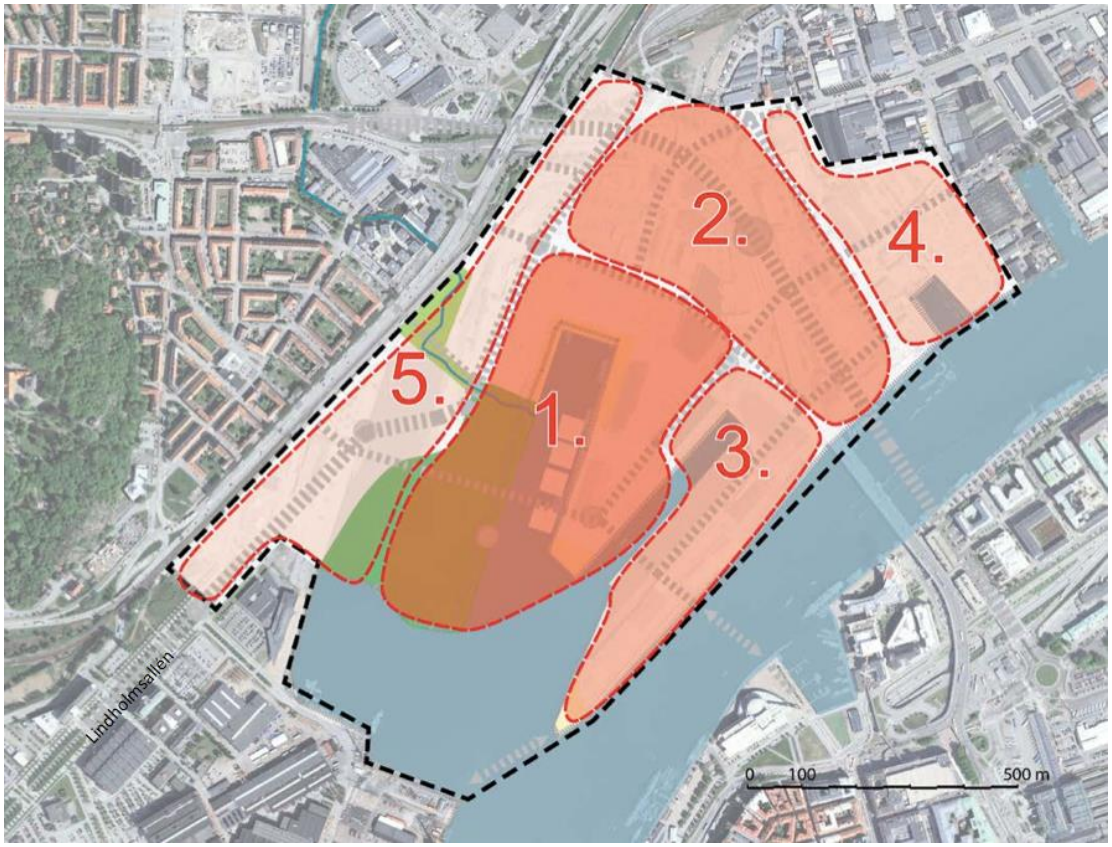


Figure 32 The Subdivision and different stages of Frihamnen (Stadsbyggnadskontoret, 9th September 2014).

The four subdivisions of Frihamnen are *Boulevardsstaden*, *Alléstaden*, *Hamnstaden* and *Ringön* (Stadsbyggnadskontoret, 9th September 2014).

Boulevardstaden is located along Centralstationen and Halmar Brantingsplatsen, which results in and expanded inner city, see Figure 33. This area will include 3000 residences, offices with an area of approximately 200 000 m^2, four kindergartens, one school, commercial shops and 0.2 hectare of green areas. The total amount of inhabitants will reach approximately 6 000 citizens (300 inhabitants/hectare). The buildings are planned to include 6-14 floors featuring 30 floor buildings (Stadsbyggnadskontoret, 9th September 2014).

Figure 33 *Boulevardstaden* (Stadsbyggnadskontoret, 9th September 2014).

The focus in *Alléstaden* is to create a residential area for the inhabitants along Lindholmsallén and Hisingsgatan, see Figure 34. This by including 3200 residences, walking distance to public transportation, offices with an area of approximately 150 000 m^2, five kindergartens, one school, commercial shops coffee shops, restaurants and 0.2 hectare of green areas. The total amount of inhabitants will reach approximately 6 500 citizens (325 inhabitants/hectare). The buildings are planned to include 6-8 floors featuring 16 floor buildings (Stadsbyggnadskontoret, 9th September 2014).

Figure 34 *Alléstaden* (Stadsbyggnadskontoret, 9th September 2014).

The characteristics of *Hamnstaden* are the small-scale buildings, 6-8 floor buildings and 3-5 floor buildings closest to the water, with a balance of small-scale activities along Östra Hamngatan and Lindholmen in order to strengthen the connection between Brämaregården and the inner city (see Figure 35). *Hamnstaden* will include 1500 residences, offices with an area of approximately 80 000 m^2, three kindergartens, one school, markets, bazaars as well as flexible outdoor environments in order to attract spontaneous activities and 0.2 hectare of green areas. The total amount of inhabitants will reach approximately 3 000 citizens (150 inhabitants/hectare) (Stadsbyggnadskontoret, 9th September 2014).

Figure 35 *Hamnstaden* (Stadsbyggnadskontoret, 9th September 2014).

The characteristics of *Ringön* today are to be protected. Thereby, the development within this area will be constructed slowly and organically, which requires flexibility as well as sensitivity in order to reach the aim. This area will include 1 300 residents, offices with an area of approximately 70 000 m^2, 0.2 hectare of green areas, two kindergartens, one school, restaurants, entertainments, trading and institutions. The total amount of inhabitants will reach approximately 2 500 citizens (250 inhabitants/hectare). The buildings are planned to include 6-8 floors (Stadsbyggnadskontoret, 9th September 2014).

3.4.2.3 How to deliver sustainability goals in Frihamnen

As a guarantee of fulfilment of Social Sustainability goals, the consortium members who should deliver rental housing will sign a collaboration agreement with the City Authority. The focus of this agreement will be to guarantee the provision of apartments to households with special needs, which will also be integrated with other housing, as agreed on with the City Authority. The Ecological sustainability will be guaranteed by following the Cities programme for environmentally adapted construction (Rivercity, 2014).

The rights for construction will be minimum and given based on the land applied for by the consortium member. These rights can be extended in the future if high quality work is observed. The construction rights will be sold on market price, determined by location price method and construction rights calculation (Rivercity, 2014).

The rents of new housing are planned to be relatively low, with 25% of all rental housing at SEK 1000 kr/m^2/year, 25% at SEK 1400 kr/m^2/year, 25% at SEK 1,850 kr/m^2/year and 25% above 2000 kr/m^2/year. The relatively low rental prices should be

subsidised through mix of condominiums and rental housing in same buildings, as well as commercial premises. The goal is to promote 60% GFA /40% GFA occupancy for residence/workplaces for the whole project, which should help generate revenues that will payback the project development costs. The rough cost estimation of the development for buildability in Frihamnen for Phase 1 is SEK 1.5 billion, which includes decontamination, demolition, reinforcement and landfills, bridge and other infrastructure construction. This high price sets a challenge to deliver economic sustainability for the project, but the challenge can be overcome by utilising the potential of the newly built district and generate income (Rivercity, 2014).

Finally, Figures 36 and 37 show the overall timeline of processes and agreements in Phase 1 Stage 1 of Frihamnen district development. The agreements should guarantee the fulfilment of the goals, and additional land allocation procedures should invite new stakeholders to help realise these goals (Rivercity, 2014).

Figure 36 *Timeline of processes during Phase 1 Stage 1 of Frihamnen development (Rivercity, 2014).*

Figure 37 *Timeline of Processes and Agreements during Phase 1 Stage 1 of Frihamnen development (Rivercity, 2014).*

3.4.3 Älvstranden Utveckling AB

The first point-of-view on the sustainability goals and processes is taken from the interviews with the project manager of Frihamnen and the manager in social sustainability in Älvstranden Utveckling AB, as well as the project manager in Frihamnen of the Gothenburg City Planning Council. The interviews show the

perspective of the current landowner - the city – as well as the focus on the main sustainability dimension focused in the Frihamnen project – Social sustainability. Furthermore, the questions were formulated in order to identify the following key points in Frihamnen (Areslätt, 2015):

- Vision, strategies and sustainability goals
- Exact rules, procedures, processes and tools
- Potential challenges

Älvstranden Utveckling AB is working on the detailed plan together with the eight consortium companies. Älvstranden Utveckling AB is currently the developer and the landowner of the land in Frihamnen. The role of the company is to be the process leader in the detailed planning stage as well as future stages of the project (Areslätt, 2015).

Based on the land allocation procedure, the companies know how many square meters GFA (Gross Floor Area) they are going to develop, however, the exact land plots will be allocated after the detailed planning is done. In addition, Älvstranden Utveckling AB plans to allocate 40% of the land in the future phases of the project to smaller companies, so right now the consortium is working on 60% of the whole district territory (Areslätt, 2015).

The main goal of Älvstranden Utveckling AB is to develop the Frihamnen district into the district that is dense, mixed and environmentally friendly. The district should have 15000 new flats; create 15000 new jobs, new schools, kindergartens, a hospital and a district park by the year 2035. Right now, the project is in the Phase 1, which aims to deliver 3000 apartments and 2000 work places. The closest set deadline is 2021, when 1000 flats, 1000 work places, a new school, a new hospital and the municipal park will be open to public. The flats should consist of 50% condominiums and 50% rental flats, with rental flats divided in three price levels. The lowest price level would be approximately 1000 kr per square meter per year. The first move in of residents is planned to happen in 2019-2020 (Areslätt, 2015).

3.4.3.1 What are the vision, strategies and sustainability goals?

As the vision, strategies and sustainability goals are playing a major role within the Frihamnen project it is wise to identify the exact formulations of each category. Now, Älvstranden Utveckling AB has three main strategic questions that the company discusses with The Consortium. The questions are “How to develop the land in Frihamnen?”, “How to manage future building logistics?” and “How to build effectively?” The answers and proposals from these questions will be transferred into future processes in Frihamnen district development (Areslätt, 2015).

The sustainability goals of Frihamnen, according Älvstranden Utveckling AB, are based on the classic three dimensions of sustainability: social, ecologic and economic dimensions. The company has called them as the following goals: social means “inclusive”, ecologic means “green” and economic is “dynamic” district (Areslätt, 2015).

The benefits from Frihamnen development for Älvstranden Utveckling AB is to have the fulfilment of the vision, strategies and the sustainability goals, to have a developed land and to sell it to The Consortium companies. The Consortium companies will be the future owners of the land, provided they perform satisfactory during the detailed planning and future stages of Frihamnen district development (Areslätt, 2015).

3.4.3.2 What are the exact rules, procedures, processes and tools?

Now that the three categories are defined in the previous section, the next step is to identify which exact rules, procedures, processes and tools should be implemented in order to fulfil the categories (Areslätt, 2015).

To reach the sustainability goals, Älvstranden Utveckling AB aims to develop the general, as well as detailed plan together with The Consortium. In addition, the company will develop a sustainability plan and a sustainability manifesto together with the other companies within the consortium. The manifesto will be a form of a guaranteeing contract, which should be the agreement of all the companies to follow the sustainability goals (Areslätt, 2015).

The goal of social inclusiveness will be realised through land allocation, in particular by setting different levels of rents both for flats, as well as for workplaces. Another way to mix people, as seen by Älvstranden Utveckling AB, is with creating work places and new jobs in the district, in addition to involving people in creative events in Frihamnen (Areslätt, 2015).

The Ecologic-green goal will be realised by setting a high standard for buildings regarding energy performance. Green buildings with characteristics of passive houses or even higher must be delivered in order to be "green-lighted" by Älvstranden Utveckling AB (Areslätt, 2015).

The economic sustainability goal is going to be satisfied with a specialised cost estimation method based on a new Swedish standard. The whole costs of the district are estimated at the same time as the detailed costs for each planned project within Frihamnen (Areslätt, 2015).

There are additional processes that aim to guarantee the sustainable district development. One of them is that the detailed planning is performed in a "cross-sectional way" or Three Dimensional property development. I.e. the district is planned floor by floor instead of building-by-building. The model developed together is helpful to; for example, manage the flow of the rainwater in the streets as well as the storm water. Moreover, the "cross-sectional" planning allows certain contractors to develop certain floors of the building, while other contractors continue upwards on the building. For example, one of the companies is developing the ground floor of the buildings, another company – the first and second floors with offices, and other companies – the rest of the floors with rental and condominium apartments (Areslätt, 2015).

3.4.3.3 Potential challenges

Due to the complexity of Frihamnen project, it is expected that challenges will be faced. Thereby, it is important to acknowledge the challenges that are already identified (Areslätt, 2015).

There are several challenges identified by Älvstranden Utveckling AB to realise the vision, strategies and sustainability goals in Frihamnen. Some of these challenges are risks that the company will have to shoulder themselves. Älvstranden Utveckling AB will take the risk and consequences of working with polluted soil, caused by the construction processes and previous harbour activities in Frihamnen. However, all the companies have the same other risks and same shares. Shares are equivalent to how much land is allocated to each of the companies. Overall, project actors work in an integrated way and the planning should be successful (Areslätt, 2015).

The biggest challenge in guaranteeing that Frihamnen is a "sustainable success", according to Älvstranden Utveckling AB, is to make the district, and the city, really mixed and inclusive. In addition, it is important to create sustainable mobility in the future district. It is possible that some projects or companies will want to slide to "Business As Usual" working procedures. To avoid this, it is important to hold on to the synergetic environment that is in the project right now, and to maintain the sustainability focus throughout the development (Areslätt, 2015).

3.4.4 The Consortium

The second point-of-view on the sustainability goals and processes is taken from the interviews with the project managers of six out of eight companies that are currently working as members of The Consortium in Frihamnen.

The company's representatives were contacted by electronic mail and by phone and invited to take part in the interviews. Before the interviews, the lists of questions were sent to the representatives for preparation. All of the representatives agreed to take part in the interviews, but due to time constraints, the interviews were in different formats. Representatives from companies No. 1, No. 2, No.3 took part in the face-to-face interviews, the representative from company No.6 took part in the phone interview. Representatives from companies No.4 and No.5 have answered the interview questions in written form.

Representatives from the one of the companies have informed us to use the land allocation proposal from the company to answer the questions. However, after further analysis of the document, the information did not answer the most important interview questions. The last company of the consortium did not agree to take part in the interview.

The Consortium has been created through public procurement and land allocation procedures that were led by Älvstranden Utveckling AB and the City of Gothenburg.

The planning organisational structure of The Consortium is presented in Figure 38. The structure consists of permanent groups, which are the Board of Directors, Sustainability Group, Workgroups, Communication and Contract Relationship Groups. The Workgroups are phase dependent, meaning that their members, functions and goals are dependent on the phase and the goals of the Frihamnen project. During Phase 1, the Workgroups take responsibility for the detailed planning as well as the project goals noted in Figure 38. An important point is that all members of The Consortium have representatives in nearly each of the Workgroups. The organisational structure of The Consortium is kept "flat" to provide equal opportunities to all of its members.

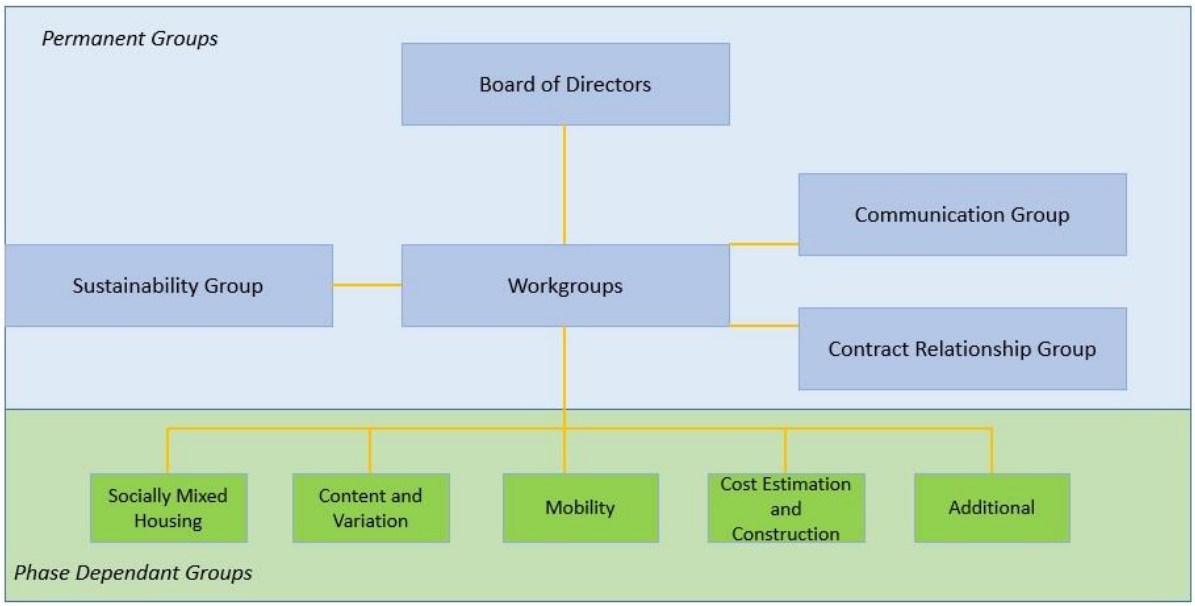


Figure 38 Planning Organisational Structure of The Consortium.

3.4.4.1 What is the understanding of sustainability goals?

All six of the interviewed companies agreed with the sustainability vision, strategies and goals, defined by Älvstranden Utveckling AB – that is, to create an inclusive, green and dynamic city. These proposed traits of the future district are seen by members of The Consortium to be integral to the whole Frihamnen development (see Annex 2 – Annex 7).

Both Company 1 and Company 3 points out that the criteria of social sustainability is attractiveness, affordability and openness to individuals with different backgrounds. Furthermore, Company 1 states that in order to develop towards ecologically sustainable solutions is to minimize the impact on climate change through wise choices when operating, constructing and refurbishing (see Annex 2, Annex 4).

The understanding of sustainability goals by Company 2 is that currently the project of Frihamnen has the sustainability vision and strategies defined but not the precise criteria. According to the company, The Sustainability Group should develop and provide the consortium with a specific list of defined sustainability criteria that can be implemented with help of certification systems (see Annex 3).

Overall, the details of what and how should be delivered as products of sustainability goals is not decided yet. The mutual agreement of following the sustainability vision, strategies and goals is supported by all six companies of The Consortium. In addition, all the companies are ready to work together and to come up with innovative solutions that should make Frihamnen a success.

3.4.4.2 How are the companies planning to achieve the sustainability goals?

All of the six interviewed companies agreed that achieving the sustainability vision and goals would be a challenging task. Due to the progression of the detailed planning phase, the final tools and procedures of reaching the goals are not set, but being discussed by the consortium members. Regardless, the companies have ideas on how to achieve this challenging task (see Annex 2-Annex 7).

A unique approach in the Frihamnen district development is how the ownership of the buildings will be decided. Usually a building or set of buildings is owned completely by a single real estate company, which decides, what part of the building will be used for housing, and what part – for commercial activities. In Frihamnen the allocation will be in a three dimensional "Floor to Floor" setting, which means that one company owns the ground floors of the district, another company – the first and second floors, and another – the rest of the floors (see Annex 6).

Both Company 4 and Company 1 believe that environmental sustainability can be achieved by following the Environmentally Adapted Construction Process programme (see Annex 3, Annex 5).

The dialogue tool within the organisation both locally as well as globally is continuously developing in order to spread knowledge including Gothenburg City, other cities and collaboration with academia. Both Company 1 and Company 3 state that the dialogue tool between the members of the consortium is important in order to achieve the sustainability goals (see Annex 2, Annex 4).

Other ideas include "green" parking house of reused materials, recreational spaces on the roof, modular buildings than can be dismantled for other buildings and multiple other ideas.

Three out of six companies noted that it is important to put the ideas that could make the sustainability goals feasible and to put these ideas into the detailed plan. One suggestion from Company 6 is to develop multiple small pocket parks instead of a single big isolated park. The smaller parks could be spread over the district and to create green pathways for residents and visitors throughout Frihamnen. Company 3 mentioned the importance of having smart logistics during construction phases. The same important areas were brought up by Company 2, so as to promote sustainable transportation within the district. The proposed idea is to have a parking lot on the outskirt of the district, while allowing inhabitants to hop in/hop off the cars with the groceries near the houses (see Annex 3, Annex 4, Annex 7).

Company 2 has developed a sustainability policy document with the intention to be used as a tool for the parking company regarding all future new construction, renovation and reconstruction of parking houses. It is said that the *"parking company shall be a leading player regarding parking solutions that create a sustainable society"*. The purpose of the sustainability policy document is to encourage more individuals to choose public transport as well as bike instead of the car. Furthermore, the implementation of the new system of parking spaces is to replace the parking spaces along the streets with parking either above or below ground. This will also leave the parking spaces along the streets for better usage when developing the social goals. Moreover, the company have developed five different focus areas where each focus area has different requirements and guidelines formulated. The five focus areas are considered the centre of gravity for sustainability work, these are: sustainable travel and parking, climate and resource efficiency, green city, safe and beautiful, cooperation and quality assurance. The aim is to reach a high quality in order to be rewarded with the award for good parking standards by European Parking Award (ESPA) (see Annex 3).

Finally, as mentioned by Company 1, the companies do not know, which land plot they are going to develop on. This way creates importance for all seven companies to work together and to achieve the common goals and objectives, as the exact plot will be allocated based on the quality of work (see Annex 2).

3.4.4.3 Which standards, codes, recommendations will be used for achieving sustainability goals?

Based on the interviews, four out of six companies have not decided yet, which standards and codes they are going to follow. This question should be discussed together by Älvstranden Utveckling AB and the Consortium companies, whether a single standard could be an outcome. The decision would affect all the companies, so the discussion on this topic is approached carefully. Right now, the Environmentally Adapted Construction Process program is one commonly approved initiative. However, three companies have decided on additional standards that particular companies would like to use.

Company 5 aims at delivering sustainable housing with the Building Assessment Label "Miljöbyggnad Silver" and sustainable offices with the label "BREEAM". (see Annex 6)

Company 2 will use the genuine assessment scheme of sustainability criteria that has not been tested on a project as big as Frihamnen. This sustainability program includes definition, assessment and use of targets, all included in the checklist. The checklist and the programme have been shared with the Sustainability Group of the consortium. Furthermore, a standard that the company may use is the high quality standard of good parking by ESPA in order to reach a good quality as well as reaching the aim of receiving the award (see Annex 3).

Company 1 will use the Swedish ecolabel Svanen, with a third party checking the company on fulfilment of the label. In addition, Company 1 has their own set of sustainability criteria and performs the yearly sustainability report on eight criteria of economy, workers conditions, environmental, living environment, housing supply, a cohesive Gothenburg, openness and transparency and knowledge development. An example of unique criteria is the environmental criteria of "no poisonous materials" – that is, a systematic way of classification to provide a healthy product (see Annex 2).

Company 2 pointed out, that companies, which have their own standards, are not aware yet on how these standards will be integrated in the project. For Company 2 it is an important topic, as they have their sustainability criteria assessment scheme. It should be decided, how the genuine standardisation scheme would work with standardisation schemes of other companies (see Annex 3).

To sum up, a single standardisation scheme has not been selected yet. It is up to all the members of the consortium and Älvstranden Utveckling AB to decide, whether to use a single standard, multiple standards, or to find another way to approach the issue practically.

3.4.4.4 Which project management processes will guarantee the fulfilment of goals?

Various project management processes are set by five companies to guarantee fulfilment of the sustainability goals as well as implementation of standards.

Company 5 has multiple processes that should deliver the vision of Älvstaden in Frihamnen. The company has a set of routines that ensures the following of BREEAM and Miljöbyggnad Building Assessment Methodologies (see Annex 6).

Company 6 is planning to follow the whole project through detailed planning, design, and construction and operation stages. The company aims to use additional resources for the construction stages, while making sure that every part of the company follows the goals for each of the stages (see Annex 7).

Company 3 mentioned the three workshops held this year (2015) as important tools for creating and supporting the dialogue between the Consortium parties, Älvstranden Utveckling AB and The Municipality. These workshops allowed the companies to discuss district planning, transportation planning, design and sizes in smaller discussion group (see Annex 4).

The Municipality currently makes most of the drawings, with Consortium companies contributing with specific blocks. This is done in order to simplify the planning of the development of the whole district. It is not known yet which of the companies will perform the construction works. The probable candidate is Company 5, however, the first construction phase will be connected with treating the polluted soil and ground works. Contracting procurement will definitely need to be performed, however, only after 1 – 2 years will the construction above ground floor start (see Annex 6).

Göreborgs Stads Parkering AB is ready to adapt to the decisions based on the sustainability vision in Frihamnen. However, the municipal company will probably use their genuine sustainability program for buildings of interest – for example, for the parking house. The checklist of the programme is adapted into project management processes of the company for buildings (see Annex 3).

Company 1 has an internal project organisation that reflects the consortium organisational structure. Currently, there are the Steering Committee, The Board and The Project Manager. Company 1 is leading the Working Group of The Social Mix, as well as the newly created "Strategic Procurement Group". The "Strategic Procurement Group" should help cut costs from the early stages of the project as well as provide jobs through procurement, this way supporting social sustainability (see Annex 2).

3.4.4.5 What are the exact rules, tools, procedures?

Five out of the six companies interviewed did not provide the answer on which exact rules, tools and procedures will guarantee the sustainability of Frihamnen district development. According to the companies, the consortium is at a stage, where it is too early to know about exact rules.

Company 3 noted that the dialogue is the most important tool, that all the members of The Consortium respect. According to Company 1, the development of exact rules is a possible demand for upcoming procurement stages (see Annex 4).

3.4.4.6 What are the benefits of the project?

Five out of the six consortium members recognise multiple benefits of participation in the Frihamnen project. The main benefits come from developing and operating housing, workplaces, commercial buildings and other buildings. Another highly appreciated benefit is the ability to test standards, procedures and innovative solutions on the district level. In addition, dialogue between the members is a great experience and source of knowledge sharing.

Company 4 mentioned that this project would play an active role development of the whole company. Company 5 see the project as the chance to prove success and test the "Company 5 City Blocks" model. Company 6 recognises the collaborative work between the companies beneficial to solve the complex task of building on the concrete pier structure (see Annex 5 - Annex 7).

Company 6 and Company 1 in particular appreciate the creation of social mixing in housing regardless of the income, which is unique to the Älvstaden area (see Annex 2, Annex 7).

Company 3 sees the project as the opportunity to test sustainability on the big scale that will hopefully bring interest from multiple people to visit, live and work in Frihamnen. Company 2 – sees Frihamnen as the opportunity to develop their knowledge in mobility. In addition, the company will be able to implement the mobility concepts together with The Consortium, concerning the value of the customers and economic feasibility of the companies. The company sees the cooperation as a more effective approach than the top-bottom instruction from the city authorities on mobility (see Annex 3).

3.4.4.7 What are the risks?

The Frihamnen project development is described by all seven Consortium companies as anything, but easy. Company 4 noted that the whole project is a collaborative effort, which means companies will have to compromise and accept practical consequences from the compromise solutions.

Company 5 mentioned, that barriers were observed when finding support of the fine graded plot network from other companies. Several companies would prefer to develop on bigger areas that the model would provide for them. However, other companies, such as Company 3, have good cooperation with Company 5 in development of ground floor commercial areas (see Annex 4, Annex 6).

Company 3 sees the risk of knowledge dispersal with later phases, when The Municipality will process the results of the dialogues. According to the project manager from Company 3, one of the key issues is to get the commercial businesses on the ground floor to be successful with following up on the sustainable mobility principle of reduced cars. It is important to create interest for people to want to go shopping or for other commercial activities in Frihamnen. Residential buildings are not seen as a risk area, as the growing demand on housing will support the development of housing, but the aim is to not make the commercial facilities exclusive for the residents of the district. Moreover, Company 3 recognise the financial risks in the project. Companies with financial power will support the economic feasibility of the long construction processes, low rental rates and inclusion of smaller companies of The Consortium. The risk here is the capacity of the companies to carry the financial risk (see Annex 3).

To sum up, multiple ideas, negotiations, compromises and dialogue may be both useful for selecting the best decision, or risky for implementing the complexity.

3.4.4.8 What is the biggest challenge?

The Consortium identified several challenges in the project development of Frihamnen.

According to Company 4, the challenge is to avoid focusing too much on a small zone in relation to the entire area of Frihamnen. Company 5 sees the biggest challenge in setting the fine graded plot network to work. The Swedish Property System requires performing much work on implementing the network, as well as to determine the overall responsible parties for the costs and construction details. Another challenge will be to make the Frihamnen area attractive during the construction phases, as the construction will go on for many years. The people will have to have courage to move there first (see Annex 5, Annex 6).

Company 6 recognises the biggest challenge to be the long-term effects of sustainable development in Frihamnen (see Annex 7).

Company 3 sees the challenge in commercial areas that will bring a sustainable, rich street life without increasing the pollution from cars and that can be a strong competitor to Nordstan and Backaplan. Frihamnen currently has the image of the secluded former industrial area, and it will be challenging to get people to visit the district (see Annex 4).

Company 2 recognises the challenge of meeting theoretical ideas with practical implementations. The current sustainability goals should be further developed. Furthermore, The Consortium must choose which criteria will be the focus point of the project. Currently, many city development projects focus on environmental goals, however, Frihamnen district development might built its strength from social sustainability of the social mix. The choice of the most important criteria and subdivision into detailed criteria will be a challenging process for companies with different interests to achieve. What is most important, these criteria should be feasible and "buildable" by the developers, but not focus only on profit generation or other "business as usual" (see Annex 3).

Company 1 sees the biggest challenge to be the scope and the limited time resource. The big scope requires expended time in performing proper planning. Limited time means that decisions will have to be made fast. These create a paradox, which can cause conflicts in future stages. However, if the companies are willing to work hard, these conflicts will be solved (see Annex 2).

3.5 Results

In this section, summaries are formulated to display the Swedish current practice, best practice and the practice of Frihamnen regarding sustainable urban development. These summaries are necessary in order to set the overall picture of sustainable construction in Sweden, to perform Gap Analysis of Frihamnen between the current and best practices, and subsequently to formulate suggestions for improvement.

3.5.1 Current practice, situation in Sweden

According to the literature review, the situation around sustainable development in the Swedish construction industry shows great intentions, but insufficient practice – both from The Client's and The Supplier's side. Swedish recommendations have clauses recommending sustainable construction to be one of the deliverables in procurement

of construction services. However, only 38% of Swedish clients follow these recommendations for design procurement.

One of the major reasons for this is difficulty of understanding, what exactly is required to be delivered. Clients want to be in power to make the final decision, and to have competent and committed procured suppliers. However, miscommunication of what is expected from the clients and the suppliers, as well "fluffy" sustainability goals make it difficult for the project to realise the intended positive impacts. In addition, trust, community involvement and learning from mistakes are underestimated as important criteria for project success.

Another reason is the expensiveness of sustainable construction. Costs continue to increase for clients on the construction market, which makes it more important to get more value from the project. However, sustainable development brings limited short-term financial benefits as well as has long payback periods. Suppliers also describe the rewards of sustainable practice as "soft", forming the image and experience – but not the profit.

74% of clients pay attention on reducing the environmental impact of construction processes. However, tools for environmental practice do not translate directly to financial figures of construction companies. That might be the reason of limited recognition of power of the environmental manager in the construction project. 35% of overall production costs can be described as "Waste costs", which increase with increasing complexity of a sustainable construction project. Due this, construction focus on the waste management aspects of the project, while solving environmental aspects through administrative procedures.

On the positive side, more and more clients recognise multiple criteria satisfaction and value of work over lowest bids during competitions for design services. Quality management of construction in Sweden is considered to be on a high level, and tolerance for risks is low. Both large contractors and SME have some sort of sustainability indicators in the project management procedures, and large contractors even have detailed routines to follow Key Performance Indicators of sustainability.

From the innovation perspective, Research and Development in the construction industry has significant advances in raw material extraction, construction product development, development of communication technologies and quality assurance procedures. However, it is challenging to measure influence of these innovations on the input/output productivity ratio. Moreover, the project based setting often brings rotation of specialists between departments or even companies, causing loss of knowledge and experience for subsequent projects.

Overall, the current practice of sustainable construction in Sweden can be described as focused on the environmental dimension, with quality and waste management as important factors for consideration. Costs are set high by default and high, fast profits are not expected.

3.5.2 Summary of the situation in Frihamnen

As a start, Fastighetsnämnden is the one responsible for the development of residential and land policy commissions as well as for the exploitation activities, land activities and residential planning in Gothenburg city. Älvstranden Utveckling AB is cooperating with Fastighetsnämnden to coordinate the land-use and the development activities to equivalent the vision of the company. The policy of land zoning, the city's budget, the development planning strategy, the regional growth strategy as well

as the criteria for Gothenburg city's land allocation agreement are defined within Frihamnen project. The new construction must contribute to a sustainable urban development in terms of environmental, social and economic aspects with the purpose to create good living conditions for all citizens.

The area will generate a new district that will create consumer durables and different cultural activities starting around year 2018-2019. Frihamnen will contribute with approximately 300-600 apartments per year until 2035. Currently, the district is divided into four subdivisions (*Boulevardstaden, Hamnstaden, Alléstaden and Ringön),* whereas the four subdivisions will be constructed in 4-5 stages. Each stage is to include a functional every-day life through public transportation, commercial services, kindergartens and schools.

The consortium members will sign a collaboration agreement with the City Authority as to guarantee fulfilment of the social sustainability goals. The agreement includes households/apartments with special needs that will be integrated with other housing. The environmental sustainability goals will be guaranteed by following the Cities programme for environmentally adapted construction. Furthermore, the consortium members have agreed on reaching the different rental levels as well as the same standard for both the rental and condominiums apartments. The budget for Phase 1 of Frihamnen is set to SEK 1.5 billion and includes decontamination, demolition, reinforcement and landfills, bridge and other infrastructure construction.

Currently, the detail plan is being developed between Älvstranden Utveckling AB and the eight consortium companies. The role of Älvstranden Utveckling AB is to lead the process in the detailed planning stage as well as to develop the landowner of the land in Frihamnen. The land plot will be allocated after the detailed planning is done, thereafter the companies will know how many square meters GFA they are going to develop. Presently, the consortium is working on 60% of the whole district territory. The project is in Phase 1 at the moment and aims at delivering 3000 apartments and 2000 workplaces. The closest deadline is 2021, when 1000 flats, 1000 work places, a new school, a new hospital and the municipal park will be open to public.

The sustainability goals of Frihamnen are based on the classic three dimensions of sustainability: social, ecologic and economic dimensions, whereas the social is defined as "inclusive", ecologic as "green" and economic as "dynamic" district. In order to reach the sustainability goals the general, the detailed plan, a sustainability plan and sustainability manifesto is to be developed between Älvstranden Utveckling AB and the consortium. The companies will sign a guaranteeing contract in order to agree on following the sustainability goals. The goal of social inclusiveness is going to be realised through land allocation, mixing people with different means, creating workplaces, new jobs as well as involving people in creative events within the district. The Ecologic-green sustainability goal is going to be realised by setting a high standard for buildings regarding energy performance. The economic sustainability goal is going to be satisfied with a specialised cost estimation method based on Swedish standard. The whole costs of the district are estimated together with the detailed costs for each planned project within Frihamnen.

The challenge for Älvstranden Utveckling AB is the risk and consequences taken when working with polluted soil, which is caused by the construction processes and previous harbour activities. The consortium members will share the same risk as well as other risks. If the project actors work in an integrated way and shares a good dialogue the challenge should be successful. However, the biggest challenge is to

guarantee that Frihamnen is a "sustainable success". Thereby, it is important for companies to exclude "Business as Usual" and focus on the synergetic environment that is in the project right now as well as to maintain the sustainability focus throughout the development.

The organisational structure of the consortium consists of permanent groups, which are the Board of Directors, Sustainability Group, Workgroups, Communication and Contract Relationship Groups. The Workgroups are phase dependent. Currently within Phase 1 the Workgroups are taking responsibility of the detailed planning as well as the project goals, which are socially mixed housing, content and variation, mobility, cost estimation and construction.

As for the consortium companies, the understanding of sustainability goals, vision and strategies are agreed upon to reach. However, the exact, measurable sustainability criteria are not defined yet - except for the criteria of differentiated housing cost by income.

More specifically, the details of what and how the sustainability goals should be delivered is not decided yet, but the consortium is ready to work together to come up with innovative solutions. Additionally, four companies have not decided the standards and codes that they are going to implement within Frihamnen. It is important the Älvstranden Utveckling AB discusses this issue together with the consortium companies.

Right now, the Environmentally Adapted Construction Process program is one commonly approved initiative. However, three companies decided wish to implement the following standards: the Building Assessment Label "Miljöbyggnad Silver", sustainable offices label "BREEAM", the Swedish ecolabel Svanen, Company 2's genuine assessment scheme of sustainability criteria as well as Company 1's set of sustainability criteria (economy, workers conditions, environmental, living environment, housing supply, a cohesive Gothenburg, openness and transparency and knowledge development).

The proposed project management processes will guarantee fulfilment of the sustainability goals as well as the implementation of standards.

These are:

- The management routines when following BREEAM and Miljöbyggnad Building Assessment Methodologies
- Following the project through detailed planning, design, construction and operation stages
- The implementation of workshops in order to allow the companies to discuss district planning, transportation planning, design and sizes in smaller discussion group.

The consortium has not provided any rules, tools and procedures that guarantee the sustainability of Frihamnen. The companies are at a stage where it is too early to determine what exact rules that are going to be implemented.

The consortium members recognized the main benefits of Frihamnen project to be the development and operation of households, workplaces, commercial buildings and other buildings as well as the dialogue tool that provides a great experience and

source of knowledge sharing. In addition, Frihamnen project will allow to test strategies and methodologies on a bigger scale.

The biggest challenge stated by the consortium companies is different. Company 4 sees the biggest challenge is to avoid focusing on a small zone in relations to the entire area of Frihamnen, while Company 5 sees the biggest challenge as setting the fine graded plot network to work, Company 6 sees the biggest challenge as to be the long-term effects of sustainable development within Frihamnen, Company 3 sees the biggest challenge as to be bringing a sustainable, rich street life without increasing the pollution from cars within the commercial areas and Company 1 sees the biggest challenge as to be the limited time resources when delivering the first phase until year 2021.

3.5.3 Best practice according to theory and cases

As a start, sustainable construction can be realised with clearly defined goals, which can be measured. Sustainability criteria can serve this role, provided they clearly formulated, effective and not difficult to measure. In addition, sustainability criteria should be addressed to benefit the society, and feasible to be delivered by clients and suppliers.

The Life Cycle Analysis (LCA) is a concept that can simplify the transformation of the criteria into deliverables. The concept offers measurable deliverables of material and energy consumption, feedback schemes on improvement and role division for stakeholders.

In addition, a carefully selected Building Assessment Methodology (BREEAM, LEED, Miljöbyggnad etc.) can provide the checklists for assessment of deliverables. The BAM should be chosen according to what kind of project will it be used for, the type and functions of the planned building, the phase of the project, location and compatibility with local conditions.

To recognise the economic value of a sustainable construction project, a sustainability index can be used. The index combines the formulated sustainability criteria with equations for measuring their financial, environmental and productivity impacts.

Waste management can be assisted with standardisation of construction processes, products and elements. Modular building is one example of high level of standardisation, when most of the construction processes are outsourced to the factory. Another approach to minimize waste is Lean thinking. Lean thinking can help divide the activities into useful and wasteful, to minimise wasteful activities and to save time and resources.

As identified by the Swedish construction clients, the biggest perceived challenges within the construction field are the adversarial behaviours, short-term focus and resistance to change within the industry. It is wise to implement an improved interaction between the construction client and the key stakeholders in order to address these challenges. Furthermore, to implement a structure which is more effective by the construction clients.

As construction waste is one of the biggest issues the implementation of waste reduction is recommended. Waste can be handled by decreasing production costs and increasing value, which may be reached by adapting to a long-term approach towards the client's value support using the "value pyramid" as well as eliminating waste in

resource consumption by prior waste discovery. This will not only strengthen the bonds between the client and the supplier but also increase the profitability within projects.

What is more, the construction industry is in need of implementing alternative productivity measurements as well as improving schemes of construction processes. There are several measurement examples offered, such as estimate user-oriented capacities, discounted future energy use of facilities, future disruption of user activities and risks of these disruptions, comparable user comfort and negative non-market effects. But also the 31 recommendations developed by researchers which increases the productivity of the whole project lifecycle with focus on customer need, satisfaction, management decisions on long-term benefits and moreover.

Another suitable implementation is platforms as tools that can be used in order to accumulate, standardise and distribute knowledge to and from construction specialists and other stakeholders. This implementation contributes to integrations as well as knowledge sharing and guiding within construction processes.

As a focus on the promotion of sustainability goals there are several tools worth mentioning taking both the environmental as well as the cost of environmental decisions. The key guidance for the promotion of environmental goals is to establish a role within the firm, an environmental specialist that takes on the firm's position, integrity and pushes the decisions towards green building. As for sustainability performance there is the refined tool Green ACAP, which stresses on external knowledge from benchmarking and successful experiments. Further on, one can also implement a corporate event in order to influence key stakeholders and make them committed. Such events better the understanding on how to meet the target of the project ahead. There are two different approaches that can be considered when taking on the cost of environmental decisions and those are The Lifecycle Costing (LCC) and Cost of Environment Errors (CEE). On one hand, LCC can be implemented when aiming at considering investment costs and operating costs for the whole lifecycle of a building. This tool measures the environmental impact in monetary units. On the other hand, CEE can be implemented when aiming at a decision-supporting tool when economic impact of environmental decisions within a construction company is taking into consideration. This since it addresses the financial, environmental and goal fulfilment perspective within the areas of living environment, built environment and the population of these environments.

A living example of best practice is the project of Norra Djurgårdsstaden in Stockholm city. The development of a sustainable district brought a total of 40 contractors and an investment of 21 billion SEK with the aim of building 500 residents per year including student housing, condominiums and rental apartments. Currently the first two stages are finalized which contributed with 1 000 apartments within the area. The project included the political will, cooperation and training, requirements and monitoring as well as research and development in order to implement new knowledge and new solutions. The implementation of accommodation meetings and seminars with different themes, such as preschool, waste management, recycling, transport and energy, have contributed with that newcomers are engaged and committed. The statistics through social media have also shown that engagement and commitment was increased significantly. As an outcome, it has been shown that the contractors are able to reach the requirements of Norra Djurgårdsstaden. Statistics say that the contractors reached 91% of the sharp energy requirements goal, 75% of the parking requirements for bicycles, 82% of the requirements for local generation of

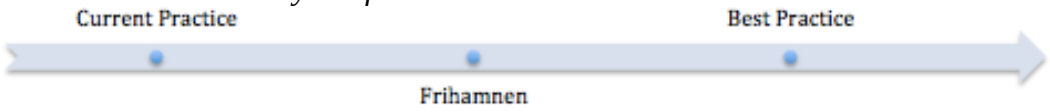
solar power and lastly 100% of the fulfilling green areas with the three functions (biodiversity, climate change adaption and social values.

3.5.4 Gap analysis - what is the difference between these two practices? Where is Frihamnen?

The following section summarises the situation of sustainable construction in Sweden. The Gap analysis is performed to identify the difference between what is the current average practice based on literature, what is the current practice in the target project Frihamnen and what is the best practice (recommended by literature and by comparison with Norra Djurgårdsstaden).

Table 5 illustrates the three practices, with gaps displayed by blue text. The arrows show the direction of the gap - either between current practice and Frihamnen, or Frihamnen and best practice. The main focus is the gap between the Frihamnen project current practice and best practice. Based on identified gaps, suggestions will be formulated in later sections.

Table 5 GAP analysis of sustainable construction in Sweden.



1. "Fuzzy" sustainability goals	1. "Fuzzy" sustainability goals	1. Defined and measurable sustainability criteria
2. 35% of construction costs go to waste	2. Underdeveloped standardisation (idea stage)	2. Standardisation
3. Environmental dimension as main sustainability focus (74% of clients).	3.Environmental and social sustainability goals (no economical sustainability goals)	3. Environmental, social and economical sustainability goals
4. 38% of clients demand sustainable design	4. Strong sustainability vision	4. Strong sustainability vision for all stakeholders including inhabitants
5. Lack of trust	5. Consortium creates trust	5. --------
6. Lack of societal involvement.	6. Lack of social media to demonstrate plan, design, construction and maintenance.	6. Platforms and processes for community interaction in the whole project
7. Lack of learning from mistakes.	7. Change arena	7. --------
8. Innovation mostly in raw materials, prefabrication, communication and quality assurance.	8. Innovation within the Consortium.	8. Triple helix (academy, industry and society)
9. Contractors use sustainability indicators (Large contractors have routines)	9. Non-harmonised sustainability methodologies	9. Sustainability methodologies, routines, standards etc.
10. Benefits for image and experience- not so much for profit (long payback, less short-term benefits)	10. Unidentified measurement of economic benefit	10. Measured economic benefits (LCC, green ACAP, CEE etc.)
11. Low risk tolerance	11.Equally shared risk	11. --------
12. ----------	12.Ambitious project vs. tight schedule	12. Lean thinking

3.6 Discussion

Frihamnen project has been identified to be a strategic complex as well as ambitious project where multiple stakeholders are involved. On the one hand, according to the gap analysis the sustainability practice in Frihamnen is above the average current practice in Sweden, however, has the potential to be further developed. On the other hand, the difficulty comes from under defined sustainability goals, miscommunication on what is expected from both clients and suppliers as well as deciding which tools and processes will be used.

At this moment, the sustainable construction in Sweden is focusing on the environmental dimension. This results in misunderstanding the concept of sustainable development when clients and suppliers only follow goals for reducing the

environmental impact while forgetting the implication on the society and economy. Frihamnen partially overcomes this misunderstanding by focusing on both the social and the environmental dimensions in the project. However, it is not enough in the sense of not including the economic dimension. At the moment, the only economic dimension included is on how to reach the different rental levels, which supports the sustainability goal of social diversity. Thereby, the project is lacking clear tools that takes on both the environmental as well as the cost of environmental decisions. This could result in addressing the financial, environmental and goal fulfilment perspective within Frihamnen project.

One important aspect missing is the processes and procedures that would guarantee fulfilment of the sustainability vision and strategies are to be decided. This creates a challenge of reaching the sustainable urban district due to the close deadlines and limited resources, which means that the longer procedure are undefined - the more difficult it is to predict actual costs and material consumption.

The interview results shows that the companies have different understandings on what is the main challenge in Frihamnen. As it has been identified, the challenges mostly relate to management processes within the Consortium with just a few directly addressing the long-term effects of sustainable development within Frihamnen.

3.7 Suggestions for Frihamnen - based on literature review and best practice

Frihamnen project has shown to outperform several of common practices in sustainable construction projects in Sweden, based on the literature review. According to several of comparison points from the GAP analysis, Frihamnen might even be considered as a “Best practice” for pre-planning and planning stages of sustainable district development.
There exists a strong vision for sustainability, which was derived from a bottom up approach by interviewing inhabitants of Gothenburg, and formulated by the municipality and Älvstranden Utveckling AB. The project vision and strategy focus mainly on the social and environmental dimensions of sustainability, which is a step ahead considering environmental and sustainable goals are often defined to be synonyms in common Swedish practice. The trust is created within the companies of The Consortium by workshops and shared risks, which is a tough task to accomplish, but the right path for delivering the district for multiple stakeholders. Even the inhabitants of Gothenburg city have had several occasions to take part in workshops for planning processes of Frihamnen, to ask questions about the project during cultural events and to give own suggestions to members of The Consortium. As for implementation and measurement of sustainability indicators, the Consortium has several proposed sustainability methodologies, which they aim to design on during the continuation of the detailed planning phase. Finally, Frihamnen district development is seen as a change arena, where experimentation of delivering a sustainable district is welcomed, and learning from lessons during multiple phases and stages of construction and operation are expected.

To sum up, Frihamnen project is on the right track with delivering sustainable success. However, nine key points have been identified through the GAP analysis, that could guarantee that the project stays on the path of success - especially, when construction starts and when most of the financial and material resources will be

consumed. The following sections shortly mention the suggestions for ”better” practice in Frihamnen.

3.7.1 Defined and measurable sustainability criteria

The project has a clearly stated vision and strategies for the whole Norra Älvstaden (Northern River City) development. Mainly, the same vision and strategy is to be implemented in Frihamnen, with additional goals specific to the renewed district. However, as it been established during the interviews, exact criteria of sustainability have to be decided.

So far, the main criteria that has been identified is the social criteria of rental prices, which should allow residents to live in this district in similar flat conditions, regardless of income difference. This criteria is even measurable, as the price levels have already been decided, and the real rent can be later compared to the planned rent to ensure following of the criteria.

A suggestion would be to use the same approach and define more exact criteria, which would work for the whole Frihamnen district. The Compass is one tool that can be used to divide criteria according to their belonging to Nature (Environmental), the Economy, the Society and the Well-being dimensions of sustainability. (Robert et.al. 1997) In this case, the three main dimensions are the supports for Well-being of all inhabitants, employees, visitors of the future district.

Most importantly, after the criteria are defined, a suggestion would be to come up with a measure that could be used throughout the entire project. Whether a certain sustainability methodology could propose these measures, or they are created from discussion between Älvstranden Utveckling AB and The Consortium - multiple alternatives should be carefully considered. A well-defined, measurable set of sustainability criteria could not only be a tool for controlling the adherence to sustainability goals, but also a tool for clearly understanding and deciding, what exactly is to be delivered.

3.7.2 Standardisation

As mentioned above, the measurability of sustainability criteria can be delivered by careful choice of sustainability methodologies. They can be Building Assessment Methodologies, national environmental standards, labels and other documentation that clearly state the deliverables, measurements and responsibilities of stakeholders. However, it is important to ***carefully*** select the methodologies that are relevant for the project goals and that is within the project boundaries.

Based on interviews of The Consortium members, the single, all-inclusive BAM is yet to be decided. The complexity comes from different deliverables for different companies. The use of a single sustainability methodology for a parking lot, an office building, a residential building and a public park can have different consequences, because a selected BAM mostly deals with a single building type. On the other hand, using a multitude of methodologies for all of the different buildings might escalate the cost of the project in a “wasteful” way, as some methodologies might have repeating goals, assessments and measures. This is further complicated with the strategy of developing residential, office and commercial premises in the same building, as this

could require to use three methodologies for the same building and make the whole building assessment overcomplicated.

Regardless of the obstacles, having a methodology or a set of methodologies in place is better for measuring sustainability criteria. The suggestion would be to carefully consider, how a certain methodology does fit not just to the premise functions, but the building as a whole. This way, by comparing the criteria from multiple methodologies in the same building and/or area, an interaction can be projected and possible cost reductions might be identified.

3.7.3 Environmental, social and economic sustainability goals

Frihamnen, as stated above, focuses mostly on the social goals of creating an open district for everyone to live, visit and work in. The environmental goals are to be delivered through fulfilment of the by delivering buildings that perform on a standard of ***at least*** of a passive house. This should help achieve the EU target to increase energy efficiency by 20% and reduce greenhouse gas emissions by 20% by 2020.

The research has identified that there is a lack of economical sustainability goals within the project. These goals do not necessarily need to be connected to the profitability of the district development. However, they can be defined clearly for potential businesses to see the attractiveness of opening shops, restaurants and offices in the new districts. Moreover, the economic sustainability goals can help to choose effective strategic tools for driving the project delivery from a resource management perspective. For example, circular economy and sharing of certain resources between companies might be a suggestion.

To sum up, the success of a sustainable project lies on all three of the sustainability dimensions. Even though a sustainable project is considered a project with long payback and lack of short-term profit, the focus of economic goals can help avoid unnecessary costs on a holistic perspective of an entire district, rather than of business entities.

3.7.4 Strong sustainability vision for all stakeholders

A strong sustainability vision is necessary to keep on track of delivering Frihamnen as a sustainable district. However, since the project is strategic and will potentially run for decades, it is important to see that the vision will stay current after the first phase - regardless of political decisions.

The vision can be reinforced by continuous communication with the community. It is important to show with actions, models, workshops and other ways, that the project is on the right way. Frihamnen stakeholders have done just that by using city events, such as Volvo Ocean Race 2015 in Frihamnen, and other events, which invite people to come and see with their eyes and to meet the stakeholders. A suggestion would be to continue the communication throughout the whole project, especially during the construction phases during and after the first phase. This way, an interest for residents to move into the newly built housings might increase, and inhabitants as well as business owners would better tolerate working in the construction site, as they would see the whole picture of what is to come.

3.7.5 Platforms for community interaction

This suggestion is strongly connected with the previous section of communicating results to the community. One of the most effective ways to do that would be to utilise social networks like Facebook, Twitter and others.

The suggestion would be to create an account dedicated to the planning, construction and maintenance of Frihamnen district. This way, readers could be up to date on what is going on at the moment, as well as to comment and voice suggestions for the project. The Facebook account has been used in delivering the Norra Djurgårdsstaden project in Stockholm and has been a great tool of communication and interaction (https://www.facebook.com/norradjurgardsstaden?fref=ts). The same approach would most likely assist transforming Frihamnen into a socially mixed district, which includes voiced opinions of the public.

3.7.6 Innovation within the triple helix

Currently, innovative ideas and solutions are being created among the Consortium members within Frihamnen project. As multiple researchers have identified noted the importance of interconnections between different sectors. There is not only a need for innovative environmental solutions as well as transformative by strategic alliance among institutions, but also within different levels of technology, academic research groups, operating areas and governmental workshops.

The suggestion for Frihamnen project would be to implement the Triple Helix, where the society, business and academy are interacting together. This suggestion would contribute with innovative environmental solutions as well as transformative solutions by including what is now, what is missing and what is needed for future studies. This would create knowledge sharing among different stakeholders contributing to a positive outcome and innovative ideas and solutions.

3.7.7 Harmonised sustainability assessment tools

As identified in previous sections, the Consortium members have agreed upon reaching the sustainability goals, vision and strategies of Frihamnen project. However, exact measurable sustainability criteria and other assessment tools have yet not been defined- except for the criteria of differentiated housing cost by income. A suggestion would be to specify through details on what and how the sustainability goals should be delivered. Currently, the Consortium members are working together in order to develop innovative solutions. Additionally, three companies have decided which standards to implement. But, this decision could create confusion on which assessment tool to implement and where as it has been identified that different companies would work on different floor in one building. It is therefore important that Älvstranden Utveckling AB discusses this issue together with the Consortium members. A suggestion would be to build upon the already commonly approved initiative, which is the Environmentally Adapted Construction Process program.

3.7.8 Identified measurement of economic benefit

Currently, the environmental and social aspects are the only sustainability goals discussed leaving out one important aspect, which is the cost of environmental decisions. It is wise to identify what economic benefits exist within Frihamnen project in order to recognise whether it is feasible or not. A suggestion would be to implement tools measuring the economic benefits, such as LCC, green ACAP and CEE. The refined tool green ACAP could be implemented in order to measure the sustainability performance within the project. Furthermore, for cost of environmental decisions the two different approaches (LCC and ECC) could be implemented. LCC could be implemented in order to consider the investment costs and operating costs for the whole lifecycle of a building and CEE could be implemented in order to consider the economic impact of environmental decisions within a construction company. The suggestion of CEE would apply to all Consortium members. This suggestion would result in that the financial, environmental and goal fulfilment perspectives are being addressed.

3.7.9 Lean thinking implementation

Finally, the huge scope of the Frihamnen project and the deadline for the first stage of the first phase coming at 2021 suggest, that logistics and processes have to be carefully planned. To avoid missing deadlines and cost overruns, a lean thinking methodology is suggested to be used from the start of the material delivery and first construction stages. The benefit of lean thinking would come from using time and resources more efficiently, eliminating construction activities that do not bring value, and carefully planning the supply chain and cutting down on construction costs.

A concrete example would be to utilise the machinery at the construction site on the 24/7 schedule, as the district at the moment is situated sufficiently far away from other living quarters. Another example would be to deliver construction materials and structure elements in shifts before the start of the workday and in the evening/night, when the traffic is not as big in the city. Utilising the river and the railroad for transporting construction materials could be of great help as well.

3.8. Conclusion

The research questions addressed within this thesis identifies the need of developing sustainability criteria and implementation processes in order to deliver sustainable urban district in Frihamnen. The research questions are answered as follows:

RQ1: What is the precise understanding and definition of the sustainability criteria in Frihamnen, derived from are Älvstrandens Utveckling AB?

As identified, there is a clear vision, strategies and goals but no clear measurable criteria within Frihamnen project. The Consortium members have a clear understanding as well as they are willing to work towards the vision, strategies and

goals. However, the Consortium members acknowledged the need of developing clear sustainability criteria and how to reach them.

RQ2: What are the concrete actions that Älvstranden Utveckling AB has implemented to make the realization of the criteria really happen?

Currently, Älvstranden Utveckling AB actions is the role taken to lead the process in the detailed planning stage as well as to develop the landowner of the land in Frihamnen. However, the sustainability goals are yet in need to be realised. The next step for Älvstranden Utveckling AB is to develop a detail plan, a sustainability plan as well as sustainability manifesto together with the Consortium members. Thereby, the companies will sign a guaranteeing contract in order to agree on following the criteria as well as fulfilling them.

The main process for organising construction work is the Three Dimensional property development. It utilises the "cross-sectional" planning which will allow certain contractors to develop certain floors of the building, while other contractors continue upwards on the building.

RQ3: How do the contractors/suppliers have in mind to meet these criteria?
As answered above in research question 1 there are no clear decisions on how the meet the criteria. However, one commonly approved initiative is the Environmentally Adapted Construction Process program. Further on, three out of six companies wish to implement certain standards, which are: the Building Assessment Label "Miljöbyggnad Silver", sustainable offices label "BREEAM", the Swedish ecolabel Svanen, Company 2's genuine assessment scheme of sustainability criteria as well as Company 1's set of sustainability criteria (economy, workers conditions, environmental, living environment, housing supply, a cohesive Gothenburg, openness and transparency and knowledge development). It is worth mentioning, that further tools are to be decided within the different planning stages.

RQ4: Which suggestions can help to implement the sustainability criteria in Frihamnen?
The master thesis has contributed with nine suggestions through the gaps identified. These suggestions are: "Defined and measurable sustainability criteria", "Standardisation", "Environmental, social and economic sustainability goals", "Strong sustainability vision for all stakeholders", "Platforms for community interaction", "Innovation within the triple helix", "Harmonised sustainability assessment tools", "Identified measurement of economic benefit" and "Lean thinking implementation". The suggestions could be of benefit within the Frihamnen project when developing the sustainability criteria more clearly. This will also benefit the project when aiming at developing a sustainable urban district.

3.9 Future studies

The end results of the thesis identified gaps and suggestions, which can be further developed. Research on implementing the suggestions could be of benefit for Frihamnen in the future in terms of sustainability success.

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Annexes

Annex 1 Areas of Research for challenges and solutions of Sustainable Urban Development

Table 6 Area of Research for challenges and solutions – Open Innovation and Collaborative Projects.

Open Innovation and Collaborative Projects		
WHY	HOW	Example projects
Innovation today is for business as usual	Raise the importance of shared visions	HSB Living Lab
Business as usual locks up transitions	Satisfy interests of different stakeholders	
Old regimes are resilient to innovation	Sharing results	

Table 7 Area of Research for challenges and solutions – Participation in City Planning.

Participation in City Planning		
WHY	HOW	Example projects
What is wellbeing in context of a city?	Invite local people to share useful knowledge for the sake of the city	Angered district development
What is a sustainable city?	Artificial Intelligence	

Table 8 Area of Research for challenges and solutions – Energy.

Energy		
WHY	HOW	Example projects
Climate change	A business model, that integrates renewable energies	Energy on campus
Robust vs Efficient	Subtle change management – for renewable energy	
Path dependency	Optimization based not only on costs	
Unequal distribution of Earth's resources	Scientific research driving the use of renewable energy	
	Empower new	

	producers	
	Link to urban development	
	Enable on campus	

Table 9 Area of Research for challenges and solutions –Water.

Water		
WHY	HOW	Example projects
Storm water	Access to clean water	Frihamnen
Water for life	Subtle change management – for renewable energy	District 10
Health of the marine ecosystem	Optimization based not only on costs	
Sea level	Scientific research driving the use of renewable energy	
	Empower new producers	
	Link to urban development	
	Enable on campus	

Table 10 Area of Research for challenges and solutions – Circular Economy.

Water		
WHY	HOW	Example projects
What is Circular Economy?	Intra generational justice	Textiles used, recycled and reused for multiple purposes
Drivers of economy activities - companies	Avoiding dissipative usage	
Creating value in a refined way	Preserve materials for future generations	
How to implement circular economy through business models?	Respect the assimilation capacity of the planet	
How to measure?		

Annex 2 Interview answers from Company 1

Interview with Kristina Hulterström, Company 1

1. Would you be so kind as to describe your role in the company?
The Company 1 group is owned by the city. We have the same commission as Älvstranden Utveckling AB. The Company 1 group is the mother company, with subsidiaries including Bostads AB Poseidon, Bostads bolaget, Familjebostäder i Göteborg and other companies. We own today +70000 rental apartments all over the city through the subsidiaries.
We are supposed to provide good housing – that is our main objective. We have competed in Markanvisning (Land allocation) and we were given 60000 m^2 GFA to build approximately 400 apartments for rental housing and 200 apartments for housing associations. The special task is to provide the housing with low rent – and that is our biggest challenge. We have to solve what business models to use for this task.

2. What is the role of the company in Frihamnen district development?
Älvstranden Utveckling AB has pointed out certain companies, which should take the lead in answering certain questions. We are leading the group that is working with the socially mixed housing and the question of integration.

3. What is the company going to deliver in Frihamnen?
We will provide housing with lower rent than usual – 25% with 1000 kr/m^2/year, and apartments with 1450 kr/m^2/year and 1850 kr/m^2/year.
The other question is the integration question. Frihamnen will be a place for everybody. The aim is attract people from all over the city, and not just the people with most money, to create a mix of people and the extension of the city centre.
We will also have around 1000 m^2 on the ground floor together with Göteborgs Lokaler.

4. What are the sustainability goals for Frihamnen as defined for the company by Älvstrandens Utveckling AB?
The social goals will be providing housing that is affordable for everyone. In addition, to create a district that attracts the people from the entire city.
The environmental goals concern the real estate department. The real estate department have the Miljöanpassad byggande program that must be followed. We have connected many things in the Land allocation contract. We have said "Yes" to lots of demands when we took the challenge.
We also need to make it work in the economical perspective.

5. Which standards, codes and recommendations will be used for achieving the sustainability goals in Frihamnen?
Miljöanpassad byggande program. In addition, we have the Svanen - Swedish ecolabel.
There will be a third part objective checking up on us that we fulfil the Svanen.
We also have our own criteria when it comes to the sustainability questions, for example, using no poisonous materials – one of environmental criteria. It is a systematic way of classification to provide a healthy product.

We also have our sustainability report that we do every year on eight different clusters: economy, workers conditions, environmental, living environment, housing supply, a cohesive Gothenburg, openness and transparency and knowledge development.

6. How is the company planning to achieve these sustainability goals?
By working with all of these goals and by working together with other parts of The Consortium to achieve the goals and the objectives.
The companies have the same demands from Älvstranden Utveckling AB, and they have their own sustainability criteria. However, when we are working together to create the detailed development plan, it is a big group work. In addition, we do not know which plot we will build on in the end, so everyone has to take the responsibility to the whole area. We will contribute to the group with what we can.

7. Which project management processes will guarantee the fulfilment of the goals?
We have the internal project organisation that reflects The Consortium project organisation. There will be different processes depending on where we are. Now we have the steering committee, the board, the project manager.
We are taking part in all of the working groups of The Consortium. We are leading the social mix group. We have also created a new group – strategic procurement group, to look strategically on the issues of procurement on the early stages to both cut costs and provide jobs through the procurement. That is part of our mission when it comes to the social dimension.

8. What are the exact rules, tools and procedures for fulfilment of the goals?
We are working on it now. It is a work to be done to see how we can do it in the best way. We are breaking new paths, so to say. However, when it comes to creating new jobs – this will most probably be a demand in the upcoming procurement.

9. How will this project be beneficial for the company?
We hope to contribute to the city with a new part of the city that is open for all. We hope to provide people to get jobs. In addition, we will also deliver rental housing for people who is interested, and some of the apartments will be with lower rent. We will also learn a lot from this process.

10. In terms with cooperation with other companies working in Frihamnen district development, how will fulfilment of the goals for your company correspond with the goals from other companies? How will risks be addressed regarding goals for your companies and the rest?
The companies in The Consortium do not know yet which plot they will get. That is why all companies have to work together, and possible conflicts should be solved together. The goals have to be reached in collaboration. In addition, we have to deliver the project that is economically feasible.

11. What are the biggest challenges in making Frihamnen a "sustainable success"?
There are many challenges. We have a short time schedule – 1000 apartments and 1000 work places and a part of the Jubileumsparken by 2021. That is the biggest challenge. As for "sustainable success" – we need to connect Frihamnen to other city

districts, like Backaplan and Ringön. There will also a new bridge coming, so we need to connect the traffic flows.
Planning takes time. There will be conflicts to manage. We will succeed, but it will be hard work.

Annex 3 Interview answers from Company 2

Interview with Karin Lindroth, Company 2

1. Would you be so kind as to describe your role in the company?
My role is the senior project manager. I am responsible in the number of projects in the city development-planning department. One of my main projects is the Frihamnen project.

2. What is the role of the company in Frihamnen district development?
Our role is to take part in the project not only from the perspective of car parking, but also from the perspective of mobility, to facilitate mobility development in other perspectives. That includes cars, bicycles and other vehicles that will be part of the mobility of Frihamnen. In addition, the other perspectives of mobility when the new city is "up and running" such as waste transportation, goods transport, mail and package delivery, food transportation etc. How to minimise the role of the car as the main facilitator of daily functions.
It is important to develop how Company 2 should take part in the Frihamnen project and an important issue is to develop our (P-bolagets) matureness and skills in the area "mobility" that we could contribute in the big scope of the Frihamnen project.
So, our role is both to contribute to modern mobility solutions in Frihamnen via the consortium partnership, and to develop our internal definition and role in mobility solutions in the city development.
Our official role, based on the Land use Agreement, is to use the 6500 m^2 BTA assigned from land allocation to develop parking and mobility hubs.
To organise the Frihamnen project, the board of directors is formed by all of The Consortium parts, with Älvstranden Utveckling AB being chairman of the board. Below the board of directors is the working group, which is responsible to realise Frihamnen. The group is divided into multiple theme groups, one of which is the mobility group. Company 2 has taken the chairman role of the mobility group in the bigger issues of mobility. How to reduce the environmental impact of the transportation and the need of the car is our first role.

3. What are the sustainability goals for Frihamnen as defined for the company by Älvstrandens Utveckling AB?
The sustainability goals were not defined in the beginning, more the intentions of making the district sustainable was raised. There is one theme group in the work group working on the issues of sustainability, and they should make the rules on the sustainability according the certification systems. For now, we have not received any absolute rules on how it should be in Frihamnen, more the intentions and the vision. It is up to us together with the other members of The Consortium to make it real.

4. Which standards, defined rules will be used for achieving the sustainability goals in Frihamnen?
The standards and rules are not defined yet. It is the challenge for the theme group Sustainability to deliver suggestions for the standards during this autumn. Probably the companies in The Consortium have their own standards, and it is unknown yet how will they arrange it. For example, Company 5 probably has a company code for how to deal with sustainability and certifications in their company and when they are

involved in a consortium and they will use a certain standard, but how this works with the standards of other companies has to be decided.

5. How is the company planning to achieve the sustainability vision?
Part is to adapt to whatever will be decided as the guiding rules according to the sustainability vision. However, we have our own sustainability program. When we need to build something, for example aparking house, we use our sustainability program.
Our sustainability program is like a checklist which shows, what should be the main target, description of the target, how to use it etc. The checklist is adapted into our building project management processes. We have also communicated this program in the sustainability group of The Consortium. However, we have not really tested it yet on a big scope, like Frihamnen.
In addition, if we build something, we will follow the municipality decided code on how to deliver projects - GBP (Gemensam Byggprocess, English: "Common Building Process"). We have taken our sustainability program and made it the part of our processes when delivering projects.

6. Which project management processes will guarantee the fulfilment of the goals?
GBP. When we go into the pre study phase, which Frihamnen is now at according to the GBP, we follow different checklists, forms to fill in. It is a quite structured format, requiring reports through our board, all the way through the project. Among the reports are the economic reports that help make the economical choices. In addition, the sustainable issues are touched in these reports – for example, whether ordinary concrete or green concrete should be used, or the water issues for parking places.
As an example of how our sustainability program can be used in reality, we have just build a big parking lot at the Nya Arena in Kviberg. There we have cooperation with the wastewater management body of the city worked on rain garden system for rainwater. There we will try to mix of both reducing the environmental impact and finding new solutions.
In addition, in Frihamnen we have many ideas on what to build – for example, a "green" parking house or one of reused materials. But most important is to make it flexible in use over time. One example could be by adding recreational spaces on the roof, so as not to have the parking lot perform the function of just car parking. Another example could be to build it in a format that could be transferred to other uses if parking no longer is needed, or parts of it dismantles making space for other building initiatives.
Overall, the sustainability has to have different dimensions. The economical dimension, the environmental dimension (reduce direct impact on environment, like rainwater contamination, or use of "green" construction materials)) and social dimension (increase safety and feeling of safety in parking lots – for example, people walk through the building more). In addition, facilities such as bicycle parking, carpools and different activities would make Frihamnen lively.

7. How will this project be beneficial for the company?
It is a great opportunity to be part of the Frihamnen project. We have discussed and are developing our competence in mobility as well as influencing the decisions of people on switching from using the cars to public transportation, bicycles. Our idea is not to stop people owning or using the cars – it is the free will to choose.

Nevertheless, we have part of our goal to make it easier to make a choice between, and hopefully prefer, other modes of transportation.
Nowadays, Frihamnen is in the front of building the transportation roots in the city, so we need to try to implement and build. We are in a sense, forced to go forward and build together with other members of The Consortium, and not just communicate/talk, what must be done. We have chosen to work with the companies in The Consortium, because the companies know what the customers want and what is economical and manageable to be delivered in real life. This way is more effective than if the city just tells the companies, what must be done.

8. In terms of cooperation with other companies working in Frihamnen district development, how will fulfilment of the goals for your company correspond with the goals from other companies? How will risks be addressed regarding goals for your companies and the rest?
There probably will be many negotiations on how to receive and implement the goals in the big Frihamnen project. It will probably be not an easy journey – so far, we have only communicated on how to put the vision on the plan. However, when the project gets closer and closer towards realization and implementation the project will be put on its real test. We need to decide on how will we can cooperate with business models for all the companies and together decide which goals are superior to others – there will probably be many give or take situations. The plan for my company is to stand up for our parts of the plan, on what we think is important, and be strong in the negotiations of the issues we think is necessary to fulfil the vision and the goals.
For our own part of the construction we will probably also need to make choices: for example, in our sustainability programme, we could aim to build something "top of the line" and get the best results, or we can build something that fulfils the basic standards of the program (and the basic standards are in itself is high standards) and get the satisfactory results. The satisfactory results is the minimum condition we would agree on, but we will try to stretch the decisions in negotiations as far to the best results as possible.
What is important is to motivate, why we have the decision, which is not for the best result. We need to motivate, calculate and prove in order to make the conscious choices and hopefully our solutions will correspond to both the other parties as well as the overall vision for the new city. In the end it is our board in Company 2 which finally will decide the

9. What are the biggest challenges in making Frihamnen a "sustainable success"?
First, we have to decide on what we think is sustainable in Frihamnen. The sustainability criteria – economical, environmental and social – can be subdivided into many parts. Many cities used the environmental criteria as the most important criteria, but we have not decided on it yet. I think, we are going to choose the social mix as the most important criteria, and the challenge will be to decide on what we mean on that, and how not to give in to other goals on the way, brought up by other stakeholders. In addition, we need to take the consequences on what it means as well as the consequences of a city so close and "car-free" as the vision describes it. It has to be feasible and buildable by the developers, so that it is not stuck on the theoretical phase. On that way not to give in to the frustration of the developers, because they want to build, get profit and achieve their goals.

Annex 4 Interview answers from Company 3

Interview with Jonas Dahlstrand, Company 3

1. Would you be so kind as to describe your role in the company?
I work for Company 3. The company is a part of The Consortium, however, I work for them on the consultancy basis, being employed by Company 3. I am their contact person in Gothenburg, assisting them with project management by coordinating the budget, coordinating external resources such as the early sketches and architectural drawings from the architectural company, financial services such as market demand and retail space on the market of the marketing company. We also work with jurisdiction on three-dimensional property issues with a law firm. This, because we are working with the ground floor of the house for commercial purposes, whereas other Consortium companies work with the floors above, mainly for residential purposes.

2. What is the role of the company in Frihamnen district development?
Each part from The Consortium has different role, all selected for different abilities. The contribution of Company 3 to The Consortium is to bring good commercial businesses on the ground floor.

3. What is the company going to deliver in Frihamnen?
Company 3 is going to deliver commercial businesses. Both retail shops, cafes and restaurants, as well as public spaces like libraries. Thus, it can be a wider perspective than commercial. However, Company 3 will not deliver office spaces.

4. What are the sustainability goals for Frihamnen as defined for the company by Älvstranden Utveckling AB?
All the companies in the Consortium must deliver the same sustainability goals, defined by Älvstranden Utveckling AB – an inclusive, green and dynamic city.

5. How is the company planning to achieve these sustainability goals?
In different aspects. Developers of the residential area will address the social goal in more detail. For us it is more about how to create commercial areas that can be sustainable. For instance, the mobility aspect, how can we style Frihamnen to promote walking and cycling with contribution to car driven consumers, how to promote logistics within Frihamnen – electrified vehicles instead of gasoline trucks. That can be a contribution to the overall goals for Frihamnen.

6. Which standards, codes and recommendations will be used when designing buildings for the commercial ground floor?
Älvstranden Utveckling AB and The Consortium have not yet decided whether we should classify this part of the city. But there is a group of representatives from each Consortium member that will look into this question to see what it would give, what focus is most important.
In the end, the standard will be chosen in collaboration between Ävstranden Utveckling AB and the companies in The Consortium. It will affect all The Consortium members, so we need to decide together in collaboration to solve the questions. For example, how to efficiently distribute energy – one developer can have

a bigger demand on heat, and the other might have overload of heat. So how to transfer the heat to have a good usage between the parties.
Another topic discussed – the height of the ceiling should be standard. This is necessary to make the buildings functions more flexible. During the first phase of Frihamnen development, consumers will be limited to use a certain space, as the rest would be a construction site for many years. The standard height could simplify conversion of space functions in later phases, when there are more consumers in the area.

7. Which project management processes will guarantee the fulfilment of the goals?
This spring we have had three workshops to have the dialogue between The Consortium parties, Älvstranden Utveckling AB and The Municipality. Each has been up to three days long. The dialogues have been on different perspectives in smaller discussion groups – such as design, size, purpose and functions of the park, how should streets be developed with regards to bicycle lanes, pedestrian paths and busses, how close should the bus stations be etc. The dialogue has been very good.
Now we are in detail planning of the first phase, where we will bring more detailed plan of the area. We will decide on what kind of businesses we will have in the area, because this will influence how we will reach the sustainability goals. Some businesses will not be placed in Frihamnen – for example, businesses dependent on car traffic. These will probably be located outside of Frihamnen.

8. What processes are used in working on the detailed planning? Does each company submit their own proposal to The Consortium? Or more together?

More together. The Municipality does many of the drawings, and we do smaller contributions with the drawings in The Consortium – for example, on a specific block. The Municipality takes the whole picture and guarantees that we will work together on the rest of the city.

9. Which are the specific tools that Company 3 uses to contribute to the project?
The biggest contribution is the dialogue. It is great to have it to share the information between the participants. Whether it will help to achieve the sustainability goals will be seen later, and it still poses challenges when putting the information on detailed plans. Unfortunately, some of the knowledge from the dialogue might get lost in later phases, when processed by The Municipality. We have studied different perspectives and different insides, but it is a challenge to get it all together. It is easy to do just what Company 3 would like, but how to include other perspectives together – that is the challenge.
I think, one of the key issues is to get the commercial businesses on the ground floor to be successful. It would be much easier to make Frihamnen just a residential area, because it central in the city, situated near water, with good communications. There is a lack of appartments in Gothenburg, so they could be built almost either way. But the commercial aspects are harder, because there are already heavy commercial areas such as Nordstan and Backaplan. So why should there be one in Frihamnen? Of course, the residents in the district would use the services, but that is not enough to achieve the good street life like in Magasinsgatan in central Gothenburg. People should come from the entire city to reach this level. So, how should we attract the visitors here, without them bringing their cars into the district? There needs to be some attraction to the districts for those who will live outside Frihamnen.

10. How will this project be beneficial for the company?
It is a new part ow town that should be a test arena for sustainability. I hope this will bring interest to come and see how this is a good contribution. Otherwise, it must create interest in order to get the demand and interest into the commercial areas such as cafes.
JR will own the ground floor areas and take care of them for long time. It is easier to adapt to the residential tenants according to the market demand. However, when the landlord owns just a few commercial units, it is difficult to offer much and to develop it. But if the landlord owns more commercial units and some on the other side of the street, that means that the client who wants to bring commercial business has a bigger choice and it is easier to develop.

11. In terms with cooperation with other companies working in Frihamnen district development, how will fulfilment of the goals for your company correspond with the goals from other companies? How will risks be addressed regarding goals for your companies and the rest?
I think, participants of The Consortiums have different aspects, understandings and business models on how to achieve the goals. The sustainable solution for the long period can be guaranteed by the variety within the Consortium, because choosing aspects from just one company will lead to loosing aspects from other companies. So the variety is welcome, as well as for company sizes and different solutions. The mix will be sustainable, and the financial power of big companies will be used to support the long construction processes. Maybe, the spaces cannot be rent out on preferred rates for, for example, the first 5 years, so need financial support. Also, smaller companies have greater flexibility.

12. Which companies will take part in the construction works?
We do not know yet. Probably, Company 5, one of the companies in The Consortium, will take part. But it is necessary to do the contracting. The first phase will be connected with the ground and polluted soil. It will take probably 1 – 2 years before the constructions above the ground floor start.

13. What are the biggest challenges in making Frihamnen a "sustainable success"?
I think the commercial areas will be a big challenge in how to get a sustainable street life. How to have rich shopping without using cars? How to have a good mix of shops and restaurants? That is hard between Nordstan and Backaplan.
Frihamnen will always be attractive for the residents that live in Frihamnen, but how to attract other people. In addition, how to make the smaller streets in Frihamnen secure, when the main streets usually have the flow of the street life? Frihamnen was originally built as a very secluded district, so now it is quite hard to integrate it with the other city districts.

Annex 5 Interview answers from Company 4

Interview with Clas Hjort, Company 4

1. Vänligen beskriv er roll i företaget?
Fastighetsutvecklare.

2. Vad är företagets roll inom Frihamnen projekt samt utvecklingen av distriktet?
Utveckla bostäder och ett hotell.

3. Vad skall företaget leverera i Frihamnen?
Bostäder och ett hotell

4. Vad är de hållbara målen för Frihamnen identifierade av Älvstrandens Utveckling AB?
Se deras hemsida.

5. Hur har ert företaget planerat att uppnå dessa hållbarhets mål?
Genom en miljö- och hållbarhetsanpassad byggprocess.

6. Hur kommer Frihamnen projekt vara till nytta för företaget?
Kommer att vara en aktiv del i vårt eget utvecklingsarbete.

7. I de fallen då samarbete med andra aktörer skall ske för utvecklingen av Frihamnen distrikt, hur kommer uppfyllandet av målen för ert företag överensstämma med målen från andra företag? Hur kommer risker tilltalas vad gäller företagets samt Frihamnens mål?
Hela projektet är ett samarbetsprojekt, vilket innebär att alla parter kommer att få kompromissa. Då målet är klart och definierat, blir kompromisserna praktiska konsekvenser av det.

8. Vad är den största utmaningen vad gäller målet att göra Frihamnen en ”lyckad hållbar” stadsdel?
Att exploateringen inte blir på en för liten yta i förhållande till hela området.

Annex 6 Interview answers from Company 5

Interview with Anna-Lena Isacson, Company 5

1. Would you be so kind as to describe your role in the company?

I am a project manager, working with developing housing projects, multi family houses. My role is mainly to participate during the detail planning and design process, but I follow the project all the way through construction until the apartments are handed over to the customers.

2. What is the role of the company in Frihamnen district development?

We have a large role in creating offices in the area, and contribute to the place making. We also will develop about 70 apartments in the form of a housing company. And we have a responsibility to help "byggemenskaper" (building communities? I don't know the English word) to establish in Frihamnen.

3. What is the company going to deliver in Frihamnen?

20.000 squaremeters (BTA in Swedish) offices and 6.000 squaremeters housing area, beside the "building communities" (byggemenskaper).

4. What are the sustainability goals for Frihamnen as defined for the company by Älvstrandens Utveckling AB?

All companies have overall the same goals, but Company 5 has a special promise to contribute in the Social sustainability area by working for a fine graded plot network ("finmaskig fastighetsbildning" in Swedish, I don't know the English words for it). We are developing a new model, "Company 5 City Blocks", which makes it possible for several different builders to build on small plots in the same block and still have a reasonable production cost. Usually, it becomes too expensive to build maybe only 20 apartments by one developer, but with our model we believe we can achieve this. If Company 5 can build a whole block at the same time, but with many different developers responsible for a small part of the block, the production cost will be reasonable. It is also possible within our model to have commercial areas in the ground floor, or as a part of the big block.

5. How is the company planning to achieve these sustainability goals?

Company 5 have already designed and built some projects with high performance in the ecology sustainability area, e g with the label "Miljöbyggnad Silver", a Swedish certificate for housing. With offices, we work with certificate "BREEAM".
As for the Social sustainability area, our model is our main contribution, but there are other thoughts within the consortium which Company 5 should be able to join, e g to employ people who for different reasons, e g foreign background, has no job. And multiuse buildings, e g all the offices maybe isn't empty outside office hours, some parts can maybe be used by other functions during evenings and weekends.
As for the Economic sustainability area, it goes hand in hand with the above mentioned model and certification.

6. Which standards, codes and recommendations will be used for achieving the sustainability goals in Frihamnen?

Housing certificate "Miljöbyggnad Silver".
Offices certificate "BREEAM".

7. Which project management processes will guarantee the fulfilment of the goals?
Company 5 has routins to achieve the goals towards BREEAM and Miljöbyggnad. The "Company 5 City Blocks" model is new and goes in line with Frihamnen as a testbed.

8. What are the exact rules, tools and procedures for fulfilment of the goals?
Can't answer this, feels like company secrets.

9. How will this project be beneficial for the company?
We hope it will take Company 5 another step forward in proving we are successful in creating new areas, and we hope to get the opportunity to test our new model "Company 5 City Blocks".

10. In terms with cooperation with other companies working in Frihamnen district development, how will fulfilment of the goals for your company correspond with the goals from other companies? How will risks be addressed regarding goals for your companies and the rest?
We have some difficulties to get the other companies to like the fine graded plot network, because they seem to prefer larger units than our model provides.
A good cooperation with JR, who are responsible for creating commercial ground floor, is essential, and we have a good cooperation already.

11. What are the biggest challenges in making Frihamnen a "sustainable success"?
To get the fine graded plot network in place. Because it is heavy work to get it done properly in the Swedish property system and it is a lot of questions to be solved about who will be responsible for what, both when it comes to costs and construction details.
It will also be a big challenge to make the area attractive in an early stage, because construction work will be going on for a very long time and we need a lot of people who have the courage to move there first, and many companies to establish there in an early stage.

12. During the interview with Hanna Areslätt, project manager in Älvstranden Utveckling AB, we have found out that Company 5 is working on a unique strategy, that will help realise the complex planning processes "floor by floor" in Frihamnen. Would you be so kind as to briefly describe this strategy?
I described the model "Company 5 City Blocks" above.
I can add that the "floor by floor" thinking is that the block could be divided both horizontally and vertically. E g you could have a housing company above apartments for rent, and on the ground floor you have commercial areas. But the main idea in the model is to make small plots within the block, so you have many entrances on the street and a common yard on the inside, which will create meetings between people who maybe not normally meet during the day. That will create social sustainability, when different kinds of people meet and get in touch with each other.

Annex 7 Interview answers from Company 6

Interview with Magnus Jälminger, Company 6.

1. Would you be so kind as to describe your role in the company?
My role in the company is connected with business development and housing. For example, I look at how we can get more of use from a floor of building, how to build a new house next to the building.. In addition, I perform checking of possible problems when developing the property. For example, the property is old and it is necessary to find, if the property has valuable parts that must be saved – like architecture. I also work in buying properties from different municipalities, like Göteborg, Helsingborg.

I have also been a fulltime chairman for 4 years in the Helsingborg City Board planning Committee. Before that, I have been working with properties for 14 years. I have been working in Helsingborgshem, Helsingborgs city's property development, about 12000 appartments. I have been also working with marketing, the whole functions of running the company with the properties.

2. What is the role of the company in Frihamnen district development?
The company role in the Frihamnen project is to build 100 housing apartments that should be finished in 2021, for now we are working on the city planning. We are a group of companies and city who is running the project and working on detailed planning, after that we can start building. Now it is a lot of work to decide on how to mix the park, buildings, houses, how to make it so that people with different incomes can live in the newly developed city area.
We are also working on planning, how to connect people between Frihamnen and other districts (for example, Kvillebäcken), how should people move in the area, how to use the water area. One of the interesting ideas we are thinking of is how to make it possible to grow plants in the new city area, like vegetables. The land area for this is small, but we are considering if we can get boats instead and grow vegetables on them.

We do not know exact details yet, but we will put the ideas all together into the consortium in order to together build it and make it economic and good place to live.

3. How is the company planning to achieve the sustainability goals in Frihamnen?
At the moment, the company has to put the ideas all together in the detailed plan in the current phase. We need to get the possibility to put something on water, to build the streets and park correctly. For example, now we are wondering if it is possible instead of an isolated big park to have the big park coming through the whole area and to have also many small pocket parks in every block, so that, for example, they are close to schools. That way it is possible to make the area more interesting and save space.

4. Which standards will be used when working on houses in Frihamnen?
We have not decided yet which exactly to use. We might take the approach with bringing buildings by boat from Piteå. We haven't decided if to build buildings here or bring them by boat. Don't know that system yet, it is a coming step.

5. Which project management processes will guarantee the fulfillment of the goals?
We have the same goals with the consortium. I will follow the whole project, from now till we build the finished buildings. We will connect also the part of the company that will take care of the area when it is build, after the summer. Then they also will be in the whole process.
We are doing the city planning now, and on the next level we will have also taken in our parts of the company that work on the building projects, and every part of the company has to follow the goals for the separate part.

6. How will this project be beneficial for the company?
The special part with this project is that we want to try a new way of getting people together because we are going to build in the area where usually only people who have a lot of money can live. This time we should build around 600 apartments, 200 of which we should sell. And another 200 we should set it down on the rent together with the city of Göteborg. The city authorities will tell who should live in the 200 apartments, but this will not be visible through the apartments, since they will be the same outside and inside, just with a lower rent. We will spread them around 400 apartments, This is because if, for example, a family has 2 kids and not a very high income, it should still be possible to live here. And we call this the "Frihamnen model". That is the most important and special part in this project.
Another special part is that we are building together with many other companies in a consortium. And the ground setting is different than we are used to build on, which makes it complex to put the building on the ground.

7. Are the goals between the companies, working in the consortium, same or different? How are the risks addressed?
The goals are same, but the interests are different in the project. For example, there is the company JR that will build the ground floor with shops, then another company Botrygg will build the property probably nearly the same as we will, and then the Company 5 will develop different structure on how to put the blocks together. We are working in different groups at the moment, and it is very interested to work in this way. And we have a lot of trust with each other.

8. What is the biggest challenge in making Frihamnen a "sustainable success"?
At the moment, the biggest challenge is to split the areas. Should it be a big park, a park between the areas? How to make it sustainable for a long period of time? Because we will have to live with the decisions that we make now. If it is done right, it will be wonderful. If it is done wrong, we can have problems with comments later on. If it is done really wrong, no one will want to live here. It is the most important for the moment to make the ground planning- to split the area, to decide which area will have which functions, and that these different functions can work nicely together. That is the biggest challenge at the moment.