Circular supply chain management

The role of the municipality within circular supply chain collaboration to achieve upscaling of circular renovation of Dutch owner-occupied housing

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master thesis.

preface.

In front of you lies the thesis 'Circular supply chain management', in which the role of the municipality is investigated within circular supply chain collaboration to achieve upscaling of circular renovation of Dutch owner-occupied housing. This thesis was written as part of my graduation from the master Management in the Built Environment of the Faculty of Architecture at the Delft University of Technology and was commissioned by my internship company, the Municipality of Rotterdam. The research itself and the writing of this thesis took place from September 2020 to June 2021.

The transition to a circular construction economy has received increasing attention in the Netherlands since the government-wide program 'The Netherlands Circular in 2050' was drawn up in 2016. The reason for choosing this research field is that I have always been interested in making the built environment more sustainable, both during my bachelor Architecture, Urbanism and Building Sciences and during my master. In addition, during my first year of my master I became more familiar with the Global Sustainable Development Goals of the United Nations and the motives of the Ellen MacArthur Foundation. I became more aware of the circular economy, which will be the future for the next generations. Moreover, after completing my master's degree, I would like to focus on sustainability and circularity in the built environment in my future career. This way, my drive and perseverance can contribute to creating a better future.

The research I conducted was innovative and complex. With the help of my supervisors, from both my study and my internship, I formulated the research questions. Due to the current COVID-19 pandemic, the entire research was conducted online, which entailed both advantages and disadvantages. From home I was able to spend my time effectively and I was able to concentrate well. Unfortunately, I hardly had any 'live' contact with both my supervisors and the participants in the research. However, all supervisors understood this and helped me when I got stuck. After extensive market, literature and qualitative research, I was able to answer the research questions. The aim of this thesis was to contribute to the development of the Dutch circular construction economy.

During this research my supervisors from my faculty department Erwin Mlecnik, Henk Visscher and Queena Qian and my internship supervisors Oubbol Oung and Wouter Streefkerk were always there for me. They have always answered my questions so that I could continue my research. Therefore, I would like to thank them for the great guidance and their support during my research process. Moreover, I would like to thank all respondents who participated in this research. I would never have been able to complete this investigation without their cooperation. Finally, I would like to thank my parents in particular. I also received wise advice from them, and they supported me morally during the whole process. Their involvement and motivational words helped me to successfully complete this master thesis.

I hope you enjoy reading this thesis!

Suzanne Oskam

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abstract.

Collaborations and partnerships between supplying parties are of great importance for adopting circular principles in the built environment and should be investigated within the development of circular supply chain management (CSCM). Therefore, the focus of this research is on collaboration opportunities within CSCM, where the need for active and dynamic actor networks, supply chain learning, future visions and circular business models will be discussed in more detail. During this research I worked together with the Municipality of Rotterdam through an internship. They also found research into collaboration opportunities within CSCM interesting and necessary. Besides, they added that they wondered what the role of the municipality could and should be in supporting (local) circular supply chain collaboration (CSCC) in order to scale up the circular renovation of the private housing stock in Rotterdam. Therefore, the ultimate goal of this research is advising the Municipality of Rotterdam on their position in this innovative process of CSCC. To achieve this goal, this research focusses on the following research question:

How could CSCC be facilitated by municipalities to achieve upscaling of circular renovation of Dutch owner-occupied housing?

First, an **analysis into the state-of-the-art** has been carried out, which has looked into the current circular construction and renovation concepts and principles being used in Europe, the Netherlands and the city of Rotterdam. Based on this analysis, the following research variables have been identified, which needed to be further investigated: adoption of innovations, actor networks, supply chain learning, future visions and circular business models. Second, a literature review is given of relevant theories and concepts related to these variables, which has identified the main research indicators that I wanted to use to reflect upon during and after the empirical part of the research (listed in the theoretical framework). Third, a stakeholder analysis has been carried out, consisting of two phases of semi-structured interviews, an (additional) internal survey and a focus group discussion. In the first interview phase, interviews were held with public parties, including municipalities, universities and knowledge institutions. In the second interview phase, interviews were held with private parties and civil organizations, including actors of different (local) market parties, branch organizations within the building sector and interest groups for homeowners. This analysis has resulted in four main barriers of CSCC in which the municipality could exert influence: insufficient internal integration, insufficient communication, insufficient realisation and insufficient facilitation. To find more clarity with regard to the first main barrier, an internal survey was circulated within the municipality, which provided more insights from a broader group of employees from different clusters and departments. The remaining three main barriers have been discussed within a focus group, where I have investigated from a management perspective whether the suggested opportunities in terms of (more) concrete strategies mentioned by different stakeholders, will work or not to solve these identified barriers and mismatches in practice. Fourth, the results of the stakeholder analysis have been **compared with literature**, examining the importance of obtained solutions for the identified mismatches in more detail. This has resulted in an **advisory action plan** for the Municipality of Rotterdam, which states that the municipality should act as a director and should focus more on the following main tasks:

(1) Internal integration: stimulate and coordinate internal integration between colleagues, visions, ambitions and social challenges of different clusters and departments.

(2) Communication: create an open, transparent and accessible local communication network between public and private parties, including the municipality, knowledge institutions, market parties, interest groups for homeowners and residents.

(3) **Realisation:** implement developed circular and modular building and renovation ideas, principles and concepts, starting with designating municipal buildings and public space where the local market is given the opportunity to experiment.

(4) Facilitation: offer various municipal (learning) tools to help the local market in the start-up phase, like (online) theme sessions, comprehensive courses and teaching programs/workshops.

The full advice (section 7.2, p. 119) is drawn up on the basis of these four main tasks. Practical recommendations are given that could be a positive stimulus for CSCC to achieve upscaling of circular renovation of Dutch owner-occupied housing. These recommendations answer the main research question.

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list of abbreviations.

BM	Business model
CBM	Circular business model
CCE	Circular construction economy
CE	Circular economy
COI	Circular oriented innovation
CSC	Circular supply chain
CSCM	Circular supply chain management
EED	Energy Efficiency Directive
EPBD	Energy Performance of Buildings Directive
EU	European Union
LE	Linear economy
LSC	Linear supply chain
SBM	Sustainable business model
SC	Supply chain
SCC	Supply chain collaboration
SCL	Supply chain learning
SCM	Supply chain management
SDG	Sustainable development goal
SOI	Sustainable oriented innovation
UN	United Nations

list of terminology.

Bio-based economy	"economy that does not run-on fossil fuels, but runs on biomass as a raw material. In a biobased economy it is about the use of biomass for non-food applications" (TKI-BBE, 2020).
Blue economy	"economic philosophy that derives its knowledge from the way in which natural systems form, produce and consume. This knowledge is applied to the challenges we face and is converted into solutions for local environments with specific physical and ecological properties" (The Blue Economy, 2020).
Business model	"conceptual tool to help understand how a firm does business and can be used for analysis, comparison and performance assessment, management, communication, and innovation" (Osterwalder, Pigneur and Tussi, 2005, p. 3).
Circular economy	"economic system in which the use and value of raw material flows are optimised without impeding the functioning of the biosphere and the integrity of society. This means that the aim is to protect biological and technical material stocks, avoid environmental impact and create existing value. preserve" (Platform CB'23, 2019b, 2019, p. 8).
Circular construction	"developing, using and reusing buildings, areas and infrastructure, without unnecessarily depleting natural resources, polluting the living environment and affecting ecosystems. Building in a way that is economically responsible and contributes to the well-being of people and animals. Here and there, now and later" (Platform CB'23, 2019b, 2019, p. 7).
Circular renovation	refurbishing or improving the technical and/or functional quality of an existing (construction) product with the intention of contributing to a circular economy, by using product parts from a discarded product with a similar function, without unnecessarily depleting natural resources, polluting the living environment and affecting ecosystems (own definition).
Circular strategy	"activity carried out with the intention of contributing to a circular economy" (Platform CB'23, 2019b, 2019, p. 8).
Circular supply chain collaboration	"connecting a network of actors in their supply chain by managing data transparency, material flows and exchanges, responsibilities, predictability and sharing of benefits" (Leising et al., 2018, p. 977).
Cradle-to-cradle	"materials in industrial and commercial processes are considered as raw materials for technological and biological reuse. Design is literally from cradle to cradle – in the design process the entire life cycle of the product and the raw materials used are considered. Technical raw materials do not contain any components that are harmful to the environment; biological raw materials are completely biodegradable" (Braungart and McDonough, 2009).
Doughnut economy	"model for measuring the earth's prosperity, based on the SDGs and the planetary boundaries. Many of the planetary boundaries relate directly to 'unlocked' cycles, such as those of greenhouse gases, toxic substances, eutrophication, fresh water, aerosols and oxygen radicals" (Raworth, 2020).
Eco-effectiveness	approach that attempts to maintain resource quality and productivity through multiple cycles of use, rather than aiming for zero waste (Newton et al., 2014, p. 5), which includes rethink, reuse and upcycling.
Eco-efficiency	"concept that proposes a reinvention of products" (Newton, Tymms & Charnley, 2014, p. 6), which include reduce and recycle.
Green economy	economy that results in increased well-being and increased social equality, while at the same time greatly reducing environmental risks and ecological scarcity (United Nations, 2020).
Industrial ecology	"science of material and energy flows, where waste within industrial cycles serves as a raw material for a subsequent process. Production processes are designed in such a way that they resemble ecological processes" (Lanau, Herbert & Liu, 2021).
Innovation	social process from development to implementation of new ideas, knowledge and solutions at different social-structural levels (project-, company-, industry level) (own definition, based on Bygballe & Ingemansson, 2014).
Linear economy	system in which (fossil, non-reusable) raw materials are extracted, edited and processed on a large scale into various products that cause waste at the end of their lifespan (Ellen MacArthur Foundation, 2013).
Modular building	"modules are individually designed, produced, and assembled with the efficiency of industrialisation" (Yu, Al-Hussein, Al-Jibouri & Telyas, 2013).
Performance economy	"vision of a closed-circle economy, including the principles of life extension, product repair and waste prevention. Selling services instead of products is an important part of this way of thinking: everyone pays for the performance of a product" (Stahel, 2010).
Product-service system	"marketable set of products and services capable of jointly fulfilling a user's need. The product/service ratio in this set can vary, either in terms of function fulfilment or economic value" (Mont, 2002).

Recover	"recovering energy from raw materials that would otherwise have been waste" (Platform CB'23, 2019b, 2019, p. 22).
Recycle	"reclaiming materials and raw materials from discarded products and re-using them to make products" (Platform CB'23, 2019b, 2019, p. 23).
Redesign	"reducing the use of new raw materials and the number of raw materials while guaranteeing the same functionality and quality" (Platform CB'23, 2019b, 2019, p. 23).
Reduce	"reducing the use of new raw materials and the number of raw materials while guaranteeing the same functionality and quality" (Platform CB'23, 2019b, 2019, p. 23).
Refuse	"preventing the use of products, elements or materials" (Platform CB'23, 2019b, 2019, p. 23).
Remanufacture	"reusing a (partial) object from a discarded (partial) object to create a "new" object with the same function" (Platform CB'23, 2019b, 2019, p. 24).
Renovation	"refurbishing or improving the technical and/or functional quality of an existing (construction) product, by using product parts from a discarded product with a similar function" (Platform CB'23, 2019b, 2019, p. 16).
Repair	"making longer use of a product or construction through preventive or corrective measures" (Platform CB'23, 2019b, 2019, p. 24).
Re-purpose	"reusing a (partial) object that has been discarded for another function" (Platform CB'23, 2019b, 2019, p. 24).
Re-use	"reuse construction products or construction parts / elements in the same function, whether or not after processing" (Platform CB'23, 2019b, 2019, p. 26).
Sustainable business model	"business model that creates competitive advantage through superior customer value and contributes to a sustainable development of the company and society" (Lüdeke-Freund, 2010, p. 23).
Supply chain learning	inter-organizational learning, where the focus is on creating collective knowledge through the collaboration of actors within a network (Mariotto, 2012).
Sustainable oriented innovation	innovation in which a holistic view of sustainability is integrated is referred to in the literature as sustainable oriented innovation (Brown et al., 2019).
Sustainability	"development that meets the needs of the present without the ability of future generations to provide for their own needs" (WCED, 1987).

"Waste isn't waste until we waste it."

-Will.i.am

introduction.

At the moment, the majority of the world's population lives in cities. In Europe that is even 75% (United Nations, 2014). This development will continue in the coming years. By 2050, more than three-quarters of the nine billion people on earth will be living in cities (United Nations, 2014). This global urbanization leads to major issues. Most people on earth live in a linear economy, in which primary raw materials are slowly depleted. To make the transition from a linear to a circular economy, in which raw materials are less or not depleted, collaboration within supply chains is necessary. Certainly, at the beginning of this global transition, the role of cities is crucial. Public and private parties need each other to realise a circular economy. Therefore, this research focuses on the role of cities within the development of local circular supply chain collaborations.

1.1 Build a better future

In September 2015, the leaders of 193 states of the United Nations (UN), including the Netherlands, approved the resolution 'Transforming our world: the 2030 Agenda for Sustainable Development' (United Nations, 2015b) in New York. The Sustainable Development Goals (SDGs) are at the heart of this resolution. The SDGs consist of 17 goals and 231 indicators that should make the world a better place by 2030. The goals, shown in Figure 1.1, were created on the basis of global input from organizations and individuals. The SDGs started in 2015 and will run until 2030. They will form the global compass for challenges, including the climate crisis, the depletion of fossil fuels and the necessary transition to a circular economy (CE). The idea behind the SDGs is that no one is left behind and that everyone should be able to build a better future (United Nations, 2015a).



Figure 1.1 - 17 Sustainable Development Goals (SDGs) until 2030 (United Nations, 2015a).

Implementation of the UN Agenda and the realisation of the SDGs are not tasks for governments only. The construction industry and built environment also have a crucial role. Sustainability is a topic that has long been indispensable in the building sector. The UN report 'Our Common Future' of the Brundtland Commission (World Commission on Environment and Development, 1987) first introduced sustainability as "a development that meets the needs of the present without the ability of future generations to provide for their own needs". The construction industry and built environment increasingly see sustainability as an important success factor for the future of their organisations, in which, in addition to the financial return of their investments, the consequences for society and the environment are also made transparent (van den Griendt, 2019).

Many countries in the European Union (EU) have realised that there is a need save energy and transitions towards renewable energy sources (SDSN & IEEP, 2019). The EU has a strong starting position when it comes to sustainable development and is, together with its Member States, committed to being at the forefront of the implementation of the UN 2030 Agenda (SDSN & IEEP, 2019). However, although Europe is a global leader implementing this agenda, no European country is on track to meet the 2030 targets, according to the 2019 Europe Sustainable Development Report (SDSN & IEEP, 2019). If we add to this the increasing population and the negative effects of global climate change in the coming years, achieving the targets in the future does not seem feasible. The report states that international and national climate actions in line with the UN Paris Climate Agreement (United Nations, 2015c), also signed in 2015, are closely linked to the SDGs. The most important aspect of this Agreement is to end the use of fossil fuels, as this makes a major contribution to global CO2 emissions. The UN Agenda and the Paris Agreement should be seen much more as one package. The SDGs are aimed at 2030 and the Paris Climate Agreement is aimed at climate neutrality by 2050, with significant progress by 2030.

Based on the topic 'Circular supply chain management', the main focus in this research will be on the following goals: SDG9 Industry and innovation, SDG11 Sustainable cities and SDG17 Partnerships for the goals. Each of these goals will be further defined in the following sections: the needs for transformation towards a circular construction industry (1.2), innovative renovation of the current building stock (1.3) and the required collaboration to achieve the goals (1.4). For each of these goals, the relevant indicators will be explained to which this research aims to contribute.

1.2 Need for transformation towards a circular construction industry

The current global construction industry can be described as a linear economy (LE) of winning, consuming and throwing away (Ellen MacArthur Foundation, 2013). The LE is a system in which (fossil, non-reusable) raw materials are extracted, edited and processed on a large scale into various products that cause waste at the end of their lifespan (Ellen MacArthur Foundation, 2013). The raw materials of this waste are then not reused or only partly reused (see Figure 1.2). This system will inevitably lead to the depletion of non-reusable resources and is not sustainable in the long term. Research by CBS and Rijksoverheid (2020) shows that almost 24 million tons of construction and demolition waste are released annually. In Dutch context, the construction sector is responsible for the use of 50% of the raw materials and 40% of the waste stream (Rijksoverheid, 2016).

To stimulate and increase the use of reusable resources and to reduce the use of raw resources and the emission of greenhouse gases, a transition to a circular economy (CE) is necessary (Ellen MacArthur Foundation, 2013). Although there are different schools of thought about CE, they do have a common principle: resources need to be better managed (Ellen MacArthur Foundation, 2013). Nowadays, the focus in the construction sector has mostly been limited to reducing carbon emissions and energy use (Pomponi & Moncaster, 2016). According to Ellen MacArthur Foundation (2013), "a circular economy aims to redefine growth, focusing on positive society-wide benefits. It entails gradually decoupling economic activity from the consumption of finite resources and designing waste out of the system." Before production, maintenance, repair and especially reuse are taken into account. This reduces the need for primary raw materials. For the construction sector, this means that circular building methods are needed, which will make it possible to reuse and recycle materials. The value created in the product is retained; waste and harmful emissions to soil, water and air are prevented as much as possible (Ellen MacArthur Foundation, 2013).



Figure 1.2 – Transition towards a circular economy (based on Ellen MacArthur Foundation, 2013)

The Dutch government also wants to contribute to the transition towards a CE, in which the construction industry is identified as one of the most important sectors (Rijksoverheid, 2016). With the program 'Nederland Circulair in 2050' (Rijksoverheid, 2016), the government presented the efforts of the national government: a fully CE in 2050. Hereby, the SDGs can serve as a guideline for sustainable developments in the construction sector, because there are many cross-overs of links between the built environment, CE and the SDGs. Sustainability in the construction industry is increasingly related to the term 'circular construction' in the context of CE. A project that is circular in some respect will most likely also meet several SDG targets. Due to the high impact that the construction sector has on the environment, this sector plays a crucial role within CE. There are significant opportunities in this sector with regard to reductions of carbon dioxide emissions, the use of raw materials and the use of energy (Pomponi & Moncaster, 2016).

To achieve the (inter)national climate and energy goals, progress is needed (United Nations, 2015a). Derived from **SDG9**, innovation and industrialisation are crucial here. Without innovation and technology there will be less industrialisation, so that less developments will take place (United Nations, 2015a). Urban transformations and innovations in the construction industry have the potential to make an important contribution to achieving these goals, because the built environment forms the platform on which the SDGs must land and thus have a place in our society. The built environment largely creates the preconditions, which means that the real estate- and construction sector has a lot of influence in shaping the SDGs, literally and figuratively (Van den Griendt, 2019). Table 1.1 shows the relevant indicators of **SDG9** and how they will be followed up in this research.

Table 1.1 – How to follow up the relevant	indicators of SDG9 in this research	(own table based on United Nations, 2015a).
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SDG	Relevant indicators	How to follow up in this research?
SDG9	9.3 Increase the access of small-scale industrial and other enterprises , in particular in developing countries, to financial services, including affordable credit, and their integration into value chains and markets.	Within this research, the focus is mainly on small and medium-sized businesses and how they can work together in the supply and value chains to scale up circular renovation of owner-occupied homes. Besides, this research could also contribute to the development of supporting local policy instruments.
	9.4 By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities.	This research focuses on stimulating and managing circularity in Dutch supply chains in the construction industry, which is related to more efficient use of materials and greater acceptance of clean and environmentally friendly processes.

1.3 Need for innovative renovation of the existing building stock

The current built environment in Europe is slowly changing and is quite old. No less than 85% of the European building stock has been built before the year 2001 and an estimated 85-95% of the current built environment will still exist in 2050 (European Commission, 2020a). However, a large part of this building stock is not energy efficient and uses scarce resources to cool or heat the buildings. In Europe this is still a major problem to this day; the built environment is responsible for 36% of the air pollution by greenhouse gases and consumes 40% of the total energy (European Commission, 2020a). These percentages correspond reasonably with the data from the Netherlands; the Dutch construction sector is responsible for 35% of the emissions of greenhouse gases and 40% for the use of energy in the country (Rijksoverheid, 2016).

The current COVID-19 pandemic has major consequences for the construction industry and built environment. Compared to 2019, activities in the construction sector decreased by 15.7% and investments in more efficient energy by 12% in 2020 (European Commission, 2020a). There is a growing importance for the life cycle and vulnerability of the existing building stock (European Commission, 2020a). During this global pandemic, for millions of people on earth, their home had become their complete living environment. When the effects of the pandemic persist, homes will probably set new requirements with regard to efficient resources and energy use. Furthermore, due to the pandemic, house hunters are expected to attach more value to extra living space and outdoor space. Working from home also means that people are less tied to a trip to the office. In addition, due to the high demand and lower supply of housing, Dutch house prices continue to rise (CBS, 2021), which will also encourage residents to first look at renovation options before deciding to move.

However, the pandemic also offers unique opportunities for the renovation industry to transform, redevelop and modernize the housing and building stock into an energy efficient built environment (European Commission, 2020a). The pandemic has provided acceleration of new insights into construction principles, such as adaptability and modularity. In order to respond quickly and efficiently to the health consequences of COVID-19, modular building strategies were applied in several places around the world in order to rapidly expand hospitals with temporary intensive care units. Because these units were prefabricated and dismantled, it was and is easy to reuse or recycle the materials. Because these techniques are now being developed in high gear due to the COVID-19 crisis, these circular construction methods will also become more attractive in the future (Ellen MacArthur Foundation, 2020). So, the multifaceted consequences of the crisis require a new way of (re)designing and thinking. CE offers many potential

opportunities to boost the recovery of the global economy. By lowering the impact on the environment, reducing the use of scarce resources, stimulating innovation, creating new jobs and fostering competitiveness, the transition to a CE can lead the world through the economic crisis brought on by the pandemic (Ellen MacArthur Foundation, 2020).

To date, only 0.2% of the current building stock in the EU is undergoing major renovation, reducing annual energy consumption by 60% (European Commission, 2020a). With these low numbers, reducing CO_2 emissions in the construction sector is not feasible. So, action must be taken. "In 10 years, the buildings of Europe will look remarkably different. Buildings will be the microcosms of a more resilient, greener and digitalised society, operating in a circular system by reducing energy needs, waste generation and emissions at every point and reusing what is needed." (European Commission, 2020a, p. 25).

As a target for 2030, the European Commission (2020b) has set that greenhouse gas emissions must be reduced by 55% compared to 1990. To achieve this target, action is required within the construction sector. The 'Climate Target Plan 2030' (European Commission, 2020b) states that the built environment should emit 60% less greenhouse gases, use 14% less of the total energy and decrease 18% in energy consumption for cooling and heating buildings in 2030, compared to 2020. The construction industry must focus on how the built environment can be made more sustainable and energy efficient throughout its life cycle, while emitting less greenhouse gases. Although there is no specific data yet, it is assumed that greenhouse gas emissions (due to the use and transport of certain building materials) can be reduced when circular principles are applied in building renovation (European Commission, 2020b).

In addition to the opportunities related to energy consumption and gas emissions, renovation also offers economic, social and environmental benefits. With the same renovation, a building can become more accessible, greener, healthier, more connected to the neighborhood and resilient against climate change. With the so-called 'Renovation Wave' (European Commission, 2020a), which is part of European Green Deal, the European Commission wants to have the annual renovation rate of buildings doubled by 2030, compared to 2020. "To kick-start this large-scale, sustainable deployment of renovation all over Europe, it is necessary to break the key barriers at every point of the supply chain." (European Commission, 2020a, p. 5). The Renovation Wave is an essential tool to achieve the desired economic, future-proof and climate-neutral recovery from the COVID-19 pandemic, with regard to the construction sector (European Commission, 2020a). Moreover, this document states that in order to achieve the environmental and economic goals, it is required to carry out renovations in line with circular thinking. Circular renovation will increase the sustainability, energy efficiency and adaptability of buildings and reduce the environmental impact and use of scar resources (European Commission, 2020a). The EU construction industry aims to become the global leader of innovative renovation activities with application of circular principles, which will contribute to the global SDGs (European Commission, 2020a).

However, the success of the Renovation Wave will depend on how well the highlighted intervention plans (within the intended timeline) are translated into actions in the coming period. The Building Performance Institute Europe (BPIE, 2020) describes the main points of attention of the Renovation Wave strategy and how these points can be translated into actions. The key elements of the Renovation Wave, with the corresponding views of BPIE, related to this research are summarized in Appendix I. Related to the management of the Renovation Wave by local authorities (where the focus is on in this research) BPIE (2020) shows that there are already plans and initiatives for circular renovations, but that the time has now really come to implement them and to take action.

Within the construction industry, the housing sector is one of the main users of energy (Rijksdienst Ondernemend Nederland, 2020c). Housing renovation is also the largest growth market in the Netherlands. In November 2020, the Dutch housing stock consisted of almost 8 million homes (CBS, 2020b), of which at least 90% is expected to still be there in 2050 (Hanzehogeschool, 2020). The private sector is clearly the largest within this housing stock; approximately 5 million homes are privately owned (Hanzehogeschool, 2020). All existing homes in the Netherlands will have to undergo at least one major intervention to comply with the national climate agreement (Rijksoverheid, 2019a). After all, every home has a maintenance cycle of approximately 30 years, which means that every home is due for renovation every 30 years (Hanzehogeschool, 2020). The housing stock is growing by an average of 0.9% new-build homes per year (CBS, 2020c), but the recently completed newbuild homes will also need major maintenance in 2050.

Private homeowners, the largest and most difficult group within the sustainability task, generally only decide on an investment in the home at a select number of times; with a purchase, with a family expansion or family dilution, if a care

need arises or with an increase in assets such as an inheritance (Hanzehogeschool, 2020). When investing in homes, the choice is mainly made for home expansion, comfort improvement or sustainability at product level such as PV panels or new glazing (Hanzehogeschool, 2020), not yet so much in the circular area (Leising, Quist & Bocken, 2018). This type of measure alone will not achieve the government's sustainability and circular ambitions, which lead to a great need for sustainable and circular renovation of owner-occupied housing (Hanzehogeschool, 2020). However, this will be a major challenge, because (local) authorities have difficulty influencing this sector.

SDG11 is mainly about making cities and societies more sustainable, which is seen as a major challenge for the future built environment. Within this research the focus is on sustainable cities. All urban areas together cover only 3% of the global land area. However, cities are responsible for 75% of the CO₂ emissions and 60-80% of the energy consumption on earth (United Nations, 2015a). So, future urban areas must offer space for development and innovation (United Nations, 2015a). Table 1.2 shows the relevant indicator of SDG11 and how they will be followed up in this research.

Table 1.2 – How to follow up the relevant indicator of SDG11 in this research (own table based on United Nations, 2015a).

SDG	Relevant indicators	How to follow up in this research?
SDG11	11.3 By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries.	This research falls within 'sustainable urbanization', where I want to contribute to making existing owner-occupied housing in the Netherlands more sustainable, from a management perspective.

1.4 Need for circular supply chain collaboration

To achieve the global SDGs by 2030, governments, companies, citizens and organisations have to collaborate (United Nations, 2015a). The successful sustainable development agenda requires partnerships between governments, business and civil society. According to the UN (2015a), "shared principles and values, a shared vision and shared goals are needed at the global, regional, national and local levels". Stimulated by SDG17, which stands for partnerships for the goals, the focus in this research is on collaboration opportunities within circular supply chain management (CSCM). How can active and dynamic actor networks, supply chain learning, future visions and circular business models within circular supply chains (CSC) contribute to achieving these global goals? Table 1.3 shows the relevant indicators of SDG17 and how they will be followed up in this research.

SDG	Relevant indicators	How to follow up in this research?
SDG17	17.14 Enhance policy coherence for sustainable development.	Because this research into circular renovation of owner-occupied housing also examines the possible role of municipalities, this research may also contribute to their policy making.
	17.17 Encourage and promote effective public, publicprivate and civil society partnerships, building on the experience and resourcing strategies of partnerships.	The main aim of this research is to provide collaboration and partnership opportunities for actors within supply chains to scale up circular renovation of owner-occupied housing. In addition, also central to this research is the importance that companies should learn from each other's experiences and strategies in order to realize a circular construction economy. This research will result in possible public, public private and social collaborations and will show how the Municipality of Rotterdam can stimulate and promote these.

Table 1.3 How to follow up the relevant indicators of SDG17 in this research (own table based on United Nations, 2015a).

Literature about circular principles in the building sector has recently received more attention (Pomponi & Moncaster, 2017). However, studies lack to address the complexity barrier within circular construction techniques and methods (Luscuere et al., 2016; Pomponi et al., 2017). The complexity of circular construction projects is greater than that of non-circular construction projects, due to the larger amount of material flows (Pomponi & Moncaster, 2017) and several different relationships and necessary collaborations between the traditional and new stakeholders involved (Luscuere et al., 2016). In order for innovations in the construction sector to succeed, the actors within a project have to collaborate (IMSA Amsterdam, 2013; ARUP, 2016; Adams, Osmani, Thorpe & Thornback, 2017). An active network (Mlecnik, 2013b) and exchange of knowledge between projects (Geels and Deuten, 2010; Adams et al., 2017) are required for innovative interventions. Miozzo and Dewick (2002) state that it is important, as an organisation in the 'complex' construction sector, to rely on and learn from the capacities and experiences of other companies. Good partnerships between actors of different organisations and projects make the production of innovation less difficult (Miozzo & Dewick, 2002). To realise

these partnerships, exchanges of knowledges, collaboration and active networks efficient supply chain management (SCM) is needed (Subramanian and Gunasekaran, 2015). "Successful supply-chain management requires competent human resources with breadth, depth, and longevity that build trustworthy partners, maintain clear communication, adopt appropriate performance measures, and promote innovation" (Subramanian and Gunasekaran, 2015, p. 217).

The need for collaboration and partnerships also applies to circularity; building a trusted network between actors of different projects is crucial to enable circular processes (IMSA Amsterdam, 2013; ARUP, 2016; Geldermans, 2016; Adams et al., 2017). Leising et al. (2018, p. 977) define circularity in supply chain collaboration (SCC) as follows: "connecting a network of actors in their supply chain by managing data transparency, material flows and exchanges, responsibilities, predictability and sharing of benefits". An integrated and interdisciplinary approach is required for circular construction. However, this aspect has so far been underexposed in current literature and research (Pomponi & Moncaster, 2017). For adopting CE principles in the built environment, collaborations and partnerships between supplying parties are of great importance and should be investigated within the development of CSCM (Adamas et al., 2017; Leising et al., 2018). In response to these recommendations, the focus in this study is on collaboration opportunities within CSCM, where the need for active and dynamic actor networks, supply chain learning, future visions and circular business models will be discussed in more detail.

During this research, I will work for the municipality of Rotterdam, through an internship. They also found research into collaboration opportunities within CSCM interesting and necessary. Moreover, they wondered what the role of the municipality could and should be in supporting (local) circular supply chain collaboration (CSCC) in order to scale up the circular renovation of the private housing stock in Rotterdam. Therefore, the ultimate goal of this research is to advise the municipality of Rotterdam on their position in this innovative process. Because no research has been done on this before, this is seen as a challenge to which I would like to contribute.

1.5 Thesis structure

Figure 1.3 shows an overview of the structure of this thesis. The research consists of three phases: define and design (1), prepare, collect and analyze (2) and conclude and advice (3). Each phase is linked to the corresponding chapters and research activities.



Figure 1.3 – Overview of research steps and content of this thesis



research approach.

This chapter will provide an overview of the research approach, including the problem statement (2.1), research questions (2.2), research methodology (2.3), research output (2.4), research relevance (2.5), data management plan (2.6), ethical considerations (2.7) and a concluding overview of the total research design (2.8).

2.1 Problem statement

The Netherlands must be circular by 2050. That is the 'dot on the horizon' set by the national government (Rijksoverheid, 2016). This is an objective that can only be achieved if all sectors in the economy make a significant contribution to it (Rijksoverheid, 2016). Also, innovations in the construction sector are crucial, because this sector in general creates a lot of waste through demolition and new construction and is a major consumer of energy and raw materials (Pomponi et al., 2016; Splunter, 2016; WEF, 2016).

As mentioned in the introduction, there is a need for transformation towards a circular built environment, a need for innovative renovation of the existing building stock and a need for collaboration to achieve the desired goals. However, research by Van der Wijk (2018) shows that many innovations within the construction sector have difficulty entering the mainstream market. This also applies to the innovations of the circular construction economy (CCE) (Adams et al., 2017). Possible reasons for this problem are a lack of coordination and management and insufficient formal communication within the organisation (Milway & Saxon, 2011). Furthermore, a possible lack of demand from the market (Mlecnik, 2013a), keeping the results within the organisation and not learning between different projects (Geels and Deuten, 2006) could also be reasons. Currently, CE principles are often applied in a particular project or sector (Adams et al., 2017). Because of this project or sector orientated approach, there is a lack of wide scale adoption of CE principles in construction (Adams et al., 2017). Also, the construction industry is traditional and conservative, as mentioned by Van der Wijk (2018), supported by Davidson (2013) and Mlecnik (2013a). Innovation requires new knowledge and skills and deviates from the traditional and familiar conditions within the sector, which makes further development difficult (Davidson, 2013).

Adams et al. (2017) have investigated the key challenges for adopting CE industrywide. What emerged from this research and what is considered as a major challenge, is the structure of the construction industry. This structure faces multiple obstacles, including a fragmented SC and the general lack of knowledge, interest and awareness. Furthermore, the more technical challenges, such as the complexity in the design of buildings (Dubois, & Gadde, 2000) and the sharing of experiences and knowledge, are not only an obstacle for new construction, but an even bigger obstacle for the renovation and transformation of the existing building stock, where CE principles have not yet been adopted (Adams et al., 2017). However, despite the fact that there is a significant body of literature about the challenges and drivers of CE, there is a lack of clarity about the actions that must be taken within the SC of the construction industry, in particular the renovation sector, to become more circular. The main problem is that, in the current market, the supply of circular renovation principles is still scarce. According to the Municipality of Rotterdam, 'to achieve the upscaling of the supply as quickly as possible, innovative solutions are needed' (O. Oung, personal communication, October 9, 2020). This makes collaboration between local market parties in SCs (IMSA Amsterdam, 2013; ARUP, 2016; Geldermans, 2016; Adams et al., 2017), active network-building (Mlecnik, 2013b) and sharing knowledge (Geels and Deuten, 2010) of great importance. The transformation from an LE to a CE, aimed at the construction industry and built environment, is emphatically about joint tasks, which ultimately leads to different ways of working through awareness and sharing knowledge and experience (Adamas et al., 2017; Leising et al., 2018). Some circular initiatives in the Dutch construction industry are being taken, but they are not yet able to achieve the desired upscaling. So, there is a gap between what the literature advises and what is currently happening in (circular) construction and renovation practices.

As mentioned in the introduction, the Municipality of Rotterdam wondered what the role of the municipality could and should be in supporting (local) circular supply chain collaboration (CSCC) in order to scale up the circular renovation of the private housing stock in Rotterdam. In response to this, the research question emerged (see section 2.2). The focus in this study will be on collaboration opportunities in SCM of circular renovation of owner-occupied housing. Based on existing literature, there is a need for further research on how different stakeholders, such as local governments, market parties, branch organisations within the building sector, knowledge institutions and interest associations (involved in circular renovation of the private housing stock) should collaborate to make it a more circular system.

2.2 Research questions

This research aims to identify the barriers and opportunities of collaboration within the current SC of (circular) renovation of Dutch owner-occupied housing, derived from different stakeholder perspectives. The main goal of this research is to make a contribution to the theory on how SCs of circular renovation of owner-occupied housing can be better managed and facilitated, to achieve the desired upscaling at a rapid pace and to advise the Municipality of Rotterdam in what role they should play in this process. To achieve this goal, this research will focus on the following research question (**RQ**):

RQ How could CSCC be facilitated by municipalities to achieve upscaling of circular renovation of Dutch owneroccupied housing?

This research question consists of three parts: circular renovation of Dutch owner-occupied housing, facilitation of CSCC and the role of the municipality. With the support of the following three sub-questions (**SQs**), an answer will be given to the main research question (covering the three parts). For each sub-question, a brief explanation is given for how the sub-question will be answered in the research. Section 2.3 will provide a more detailed description of the research methodology.

SQ1 What is the state-of-the-art of circular renovation of Dutch owner-occupied housing?

Chapter 3 contains an exploratory research, which will look into the current CCE concepts and principles being used in Europe, in the Netherlands and in the city of Rotterdam. Based on this research, a conclusion will be drawn, which will give an answer to **SQ1** and what will give the motives for relevant literature research: what is, at this moment in time, urgently needed when looking at the state-of-the-art of circular building and renovation in the Netherlands? From this chapter, the research variables (that are identified as urgent at the moment) will follow, which should be further investigated in the next theoretical chapter.

SQ2 Which factors are needed to facilitate CSCC according to literature?

Chapter 4 will give an overview of relevant theories and concepts concerning the identified research variables following from the previous chapter: adoption of innovations, actor networks, supply chain learning, future visions and circular business models. This chapter will identify the main research indicators that I will use to reflect upon after the empirical part of the research. Based on existing literature a conclusion will be made, which will give an answer to **SQ2** and in which the theoretical research framework will be developed. This framework will be used as guidance for the empirical part of the research.

SQ3 How do different actors of CSC networks see and experience the role of the municipality within CSCC to achieve upscaling of circular renovation of owner-occupied homes?

The third sub-question will be answered by means of a stakeholder analysis (Chapter 5), consisting of two phases of semi-structured interviews, an internal survey and a focus group discussion. In the first phase, this sub-question will be discussed by means of interviews with actors from different municipalities, universities and knowledge institutions. This collected data will then be analyzed based on the theoretical framework, linking back to existing literature. In the second phase, the questions will be discussed again, but this time by means of interviews with actors from different (local) market parties, branch organisations within de the building sector and interest groups for homeowners. This analysis will result in four main barriers of CSCC in which the municipality could and should exert influence. To find more clarity with regard to the first main barrier, an internal survey was circulated within the municipality. The remaining three main barriers will be discussed within a focus group, where I will investigate from a management perspective whether the suggested opportunities in terms of (more) concrete strategies mentioned by different stakeholders, will work or not to solve these identified barriers and mismatches in practice. This stakeholder analysis will answer **SQ3**.

In Chapter 6 (Discussion), the results of Chapters 5 will be compared with the theory, examining the importance of the obtained solutions for the identified mismatches in more detail. Additionally, possible practical recommendations, research limitations and further research will be discussed.

In the conclusion (Chapter 7), advice will be given to the Municipality of Rotterdam on what role they could and should play in stimulating CSCC to scale up the circular renovation of local private homes. This will result in an advisory action plan for the Municipality of Rotterdam, which will give an answer to the main **RQ**. Figure 2.1 provides a global overview of the research design. In the following sections, each part with the corresponding research method will be explained in more detail.



Figure 2.1 - Overview of the various parts of the research with the associated research questions.

2.3 Research methodology

This section will provide a more detailed description of the research methodology.

2.3.1 Type of research

In this study, a qualitative research method will be used to obtain in-depth information about people's motivations, thoughts, experiences and expectations within the SC of circular renovation. The purpose of this type of research is to gain insight into the research field from different perspectives and interpretations of stakeholders. (Bryman, 2016). This qualitative empirical research will be combined with exploratory and scientific literature research. In this way, triangulation (multiple techniques for gathering data) is applied, promoting the validity, reliability and scientific character of the research (Doorewaard & Verschuren, 2007; Yin, 1994).

The introduction in Chapter 1 has clearly explained what is focused on in this research and how the problem statement and research questions have been developed. It has highlighted the gaps and shortcomings within the existing literature in the research field of SCM in the circular renovation sector and the needs for transformation towards a CCE, innovative renovation of the existing building stock and CSCC. The research into the state-of-the-art in Chapter 3 will be an exploratory research, which will look into what is currently happening in this research field. This chapter will be mainly based on recent information from (local) government documents, websites and news articles. Chapter 4 will discuss the relevant theories and concepts of the identified research variables followed from Chapter 3: adoption of innovations, sharing visions, learning processes, network-building and circular business models. Based on these theories and concepts, research indicators will be identified, after which the theoretical framework will be developed. This framework will form the scientific justification for this study and will be used by reflecting and evaluating the interview data. The development of this framework will fall within scientific literature research. According to Yin (1994), a scientific literature study is essential in a research design. The theoretical framework provides guidance in the following phases of the research and will be used by the preparation of the semi-structured interview protocols.

For both, the development of the introduction (Chapter 1) and the literature review (Chapter 4), systematic research is used. Bryman (2016) finds that the systematic research approach is not always easy to apply in student research. The main limitations for this are limited resources and time. However, some aspects of this approach apply, which I have

used myself. First of all, in the first phase of the research there will be regularly meetings with my supervisors and with employees of the Municipality of Rotterdam. This support will help me to define the boundaries of the subject and the scope of the research, to delineate the literature research and to find the right searching terms. In addition, within a systematic review it is important to examine the literature in a transparent manner and to record what you have already done (Bryman, 2016).

2.3.2 Empirical research

The empirical research (Chapter 5) consists of three phases and is carried out by means of two interview phases, including an internal survey, and a discussion within a focus group, see Figure 2.2. In the following sections, these three phases will be explained in more detail.



Figure 2.2 – Empirical research design (own figure).

2.3.2.1 Conducting and analyzing two phases of interviews

The stakeholder analysis consists of two interview phases. In the **first interview phase**, the perspective of the government will be investigated and interviews will be held with various municipalities to find out what the government expects from the market, how they see CSCC and what they think about their own role in the transition towards a CCE. Governance bodies could play an important role in CSCC by arousing the interest of individuals, organisations and companies in showing social and environmentally friendly behavior. To promote and stimulate the implementation of CE principles, governments could develop appropriate goals, plans, measures, guidelines and policies for the transition to a sustainable and circulating society (González-Sánchez et al., 2020).

In addition, knowledge institutions and universities will also be interviewed in the first phase, because based on innovation theories, an innovation (such as this transition) requires the development and dissemination of knowledge and experiences. The involvement of knowledge institutions and universities within CSC networks will have a positive influence on the diffusion of CE implementation (Salvioni & Almici, 2020). They publish scientific articles on CE, provide student education about CE and establish relationships with organisations and companies, resulting in information and knowledge transfer about the adaptation and implementation of CE principles (Salvioni & Almici, 2020). In addition, these actors stand between the market and the government and usually have an independent advisory role towards both sides. The collected data will be analyzed based on the theoretical framework, linking back to existing literature.

In the **second interview phase**, the perspective from the market will be investigated by means of interviews with branch organisations within the building sector, individual market parties and interest groups for private homeowners. Branch organisations represent a large part of the market and are necessary for the transition to a CCE. In contrast to individual market parties, these organisations can influence national laws and regulations and should guide, stimulate and convince their members concerning the value of a CE. In addition, the circular transition cannot develop without supply from individual market parties. That is why it is very important that market parties also join circular networks in order to achieve national and local ambitions. And because this research focuses on private homeowners, it is important that this group is also represented, in this case through a number of interest groups that work for residents. During this second phase, research will be conducted on the expectations of the market regarding CSCC and what role the market themselves and the municipality should play in this transition. Moreover, this collected data will be analyzed based on the theoretical framework, linking back to existing literature. This interview method is chosen to gain better insights on who is involved in CSCs of the construction industry and how these stakeholders think about facilitation of CSCC and the role of the municipality herein, even if they may have little or no practical experience (yet).

Selecting stakeholders who are relevant to interview was done by means of two different sampling methods: theoretical sampling and snowball sampling. The **theoretical sampling** technique is based on grounded theory and concepts (Chapter 3 +4), with the aim of interviewing a large range of stakeholders with different backgrounds, opinions, perspectives and interests (Merriam & Tisdell, 2016). However, the chance that certain parties are still missing as key stakeholders is possible in theory, because new stakeholders may emerge in the innovation phase of the transition. Based on prior research into the state-of-the-art and existing literature, the different groups were selected: municipalities, universities, knowledge institutions, branch organisations within the building sector, individual market parties and interest groups for private homeowners.

Another sampling technique that is used is **snowball sampling**, where one participant recommended another, until the range of stakeholders will 'snowball' to a large number of participants (Merriam & Tisdell, 2015). Prior to the interview phases, I discussed with my supervisors from the Municipality of Rotterdam whether they recommended certain stakeholders to participate in the research. In this way, I mainly came into contact with colleagues from different departments within the municipality and a number of local market parties. I also asked these participants whether they recommended parties, such as branch or knowledge organisations. All interviews ended with the question of whether there were any specific stakeholders that I should include in the research. A selection criterion was that the potential participant understood my research area and could reflect on it (Merriam & Tisdell, 2015). In addition, the participant should also understand my role as a researcher and be able to offer different perspectives by sharing opinions, thoughts, feelings and insights from their point of view. (Merriam & Tisdell, 2015). Using this sampling method, more and more (local) participants were added, which ultimately resulted in a wide range of stakeholders may have the same social or professional background and interest, which results in limiting the perceptions and range of data collected. In this research, I tried to prevent this by questioning a wide diversity of participants (based on the theoretical sampling). Table 2.1 gives an overview of the two used sampling methods.

Sampling method	Opportunities	Limitations
Theoretical sampling	Approaching a wide range of stakeholders with different backgrounds, opinions, perspectives and interests.	Chance that certain parties in current theory are still missing as key stakeholders.
Snowball sampling	Developing an extensive overview of the parties involved, including those that are (still) unknown to me.	Range of stakeholders with potentially the same social or professional background.

Table 2.1 – Theoretical and snowball sampling method (own table).

Most (potential) participants were first introduced to the research by telephone and were asked whether they were willing to participate. When the participant agrees, an email is sent with further information, including the informed consent letter to be completed. The (potential) participants that I could not reach by phone were contacted directly by email. This way of collecting contacts went smoothly. Most of the participants were enthusiastic about the topic and indicated that they would like to participate in my research. A few did not respond or indicated that they were not sufficiently involved in this topic to participate as a representative party in the study. However, using the snowball sampling method, I was able to collect a sufficient number of participants (22 in total), which is shown in Tables 2.2 (phase 1) and 2.3 (phase 2).

With the help of these semi-structured interviews (also called qualitative or in-depth interviews), I will discover the expectations and needs of the various actors in the SC of the circular renovation. A general interview schedule with predetermined, more generally formulated questions is drawn up in advance on basis of the identified research variables and indicators. Although the topics of the conversation are fixed, the exact wording and sequence of questions will differ per conversation. Interview questions will be discussed in more detail if it is noted that an interviewee is knowledgeable about a particular topic. The interview protocol that will be used as a guideline during the interviews can be found in Appendix II.

Table 2.2 - Interviewees of phase 1 (own table).

Public parties

ntermediaries

rivate parties

Stakeholder	Function interviewee	Date
Municipality of Rotterdam	Alliance Manager Next Generation Residential Areas	25-02-2021
Municipality of Rotterdam	Program Manager Circularity	17-03-2021
Municipality of Rotterdam	Consultant Circular & Climate adaptive	18-03-2021
Municipality of Rotterdam	Residents coach (advisor home maintenance and sustainability)	11-03-2021
Municipality of Amsterdam	Senior Advisor Energy and Circular Development	05-02-2021
Delft University of Technology	Doctoral Researcher Housing Management	08-03-2021
Rotterdam University of Applied Sciences/ BouwhulpGroep	Consultant at BouwhulpGroep and lecturer Sustainable Renovation at the knowledge center Sustainable Port City and Rotterdam University of Applied Sciences	11-03-2021
Dutch Organization for Applied Scientific Research (TNO)	Scientist Integrator Sustainable and Circular Construction Concepts at TNO	15-03-2021
Platform31	Project Leader Sustainability, Circular Society and Upscaling	08-03-2021
C-Creators	Circular Construction Specialist	01-04-2021

Table 2.3 - Interviewees of phase 2 (own table).

Stakeholder	Function interviewee	Date
Sector organization for demolition contractors and asbestos removal companies (VERAS)	Secretary	09-03-2021
Sector organization Recycling Breaking and Sorting (BRBS)	Director and member of the circular construction economy transition team	11-03-2021
Dutch Association of Supplying Building Materials Industry (NVTB)	Director and member of the circular construction economy transition team	12-03-2021
Sector organisation Technology Netherlands	Team leader Technology Netherlands Advice	04-03-2021
Architect Maken	Founder and Architect	23-04-2021
A van Liempd	Circular demolition specialist	26-04-2021
Copper8	Consultant	29-04-2021
Van Omme en de Groot	Director Transformation, Renovation & Maintenance	22-04-2021
Raab Karcher	Deputy Director of Greenworks	20-04-2021
Stichting !WOON	Consultant and member of the Natural Gas Free project team in Amsterdam	18-03-2021
Association Eigen Huis (VEH)	Construction Specialist at the Knowledge Center of VEH	21-03-2021
Het Groene Bureau	Entrepreneur and private homeowner who has renovated his house in a circular manner	21-04-2021

Prior to the interviews, participants' approval will be requested before recording the interview, so that I have the opportunity to listen back and transcribe the conversations. After transcribing the interviews, the transcripts will be analyzed using the coding process of Williams and Moser (2019), see Figure 2.3. "This approach supports the evolution of constructing meaning from the data, in turn enabling contributions to the related literature and enhancing our understanding of the world." (William and Moser (2019, p. 45).

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Figure 2.3 - Overview of coding process: open, axial and selective coding (Williams and Moser, 2019, p. 47).

First, the interviews will be imported into the computer program Excel, after which the data will be analyzed in several phases. In the first phase there will be '**open**' coding, where important findings are highlighted. From a management perspective and with the researched theory and literature in mind, values will be linked to these first findings. In the second phase, coding will be '**axial**', whereby the open codes will be subdivided under the research indicators originating from the developed theoretical framework. The final phase consists of '**selective**' coding. Because the aim of this study is to advise the municipality in what role they should play in the initial phase of the circular transition, the codes from phase two will be linked to a limited number of tasks that the municipality could and should perform. After the selective coding, meaning will be constructed and theory developed. "Recognising the interdependent relationship among data organisation, categorization, and theory development construction of meaning, coding plays a pivotal role in facilitating the researcher's ability to advance effectively the research process." (William and Moser, 2019, p. 47). The purpose of this method of analysis is to reduce the many pages of interview data to a number of themes (main barriers and opportunities) that will provide answers to the research questions and could contribute to the theory. Figure 2.4 shows an example of how the coding process of William and Moser (2019) will be applied in this research.



Figure 2.4 - Example of how the coding process of William and Moser (2019) will be applied in this study (own figure).

The main purpose of these two phases of interviews is to gather different insights from different groups of stakeholders within the CSC of private home renovations. These interviews will be used to investigate the barriers and opportunities of the role of the municipality in initiating circular chain cooperation. In Chapter 5, these barriers and opportunities will be discussed in more detail.

2.3.2.2 Conducting and analyzing results of the internal survey

In addition to the interviews that will be held, an **internal survey** will be circulated within the municipality, consisting of four questions and four statements. These questions and statements are based on the first main barrier which will result from the interviews (**insufficient internal integration**). Through various means of communication, such as the internal platform RIO (Rotterdam Inside Out), groups in Microsoft Teams and multiple group WhatsApp's from different departments, the internal survey will be distributed with the question whether people involved in circular renovation would like to participate. This will be done by colleagues from different departments. The purpose of this survey is to gain more clarity about the internal bottlenecks which will be mentioned by the interviewees. The complete survey can be found in Appendix III and will be explained in more detail in section 5.2.

2.3.2.3 Focus group discussion

The other three barriers (insufficient communication, realisation and facilitation), resulting from the interviews, will be discussed within a **focus group.** I will investigate from a management perspective whether the suggested opportunities, in terms of (more) concrete strategies mentioned by different stakeholders, will work or not to solve the identified barriers and mismatches in practice. A focus group belongs to the qualitative research method in which a group of people is brought together to discuss predetermined topics or statements (Bryman, 2016). Using a focus group will help in discussing the findings and to argue underlying thoughts, problems and causes. Moreover, quality control takes place during this discussion. Different participants will provide arguments from their perspective. It is assumed that it will be easy to see in which areas participants agree or disagree.

The advantage of a focus group is that it does not work with an interview format in which participants answer questions one by one, but that participants are encouraged to discuss with each other. Participants with different opinions can respond to each other, ask each other questions and exchange anecdotes so that you can observe as researcher how arguments develop in a discussion. This interpersonal communication between participants is expected to provide additional information and deeper insights. The group dynamics that will emerge will help stakeholders to express their representations and opinions. This interaction is lacking in an individual interview. The focus group is therefore a suitable (additional) data collection technique for researching people's knowledge and experiences.

The focus group will consist of five participants from different departments within the Municipality of Rotterdam, shown in table 2.4. Before the discussion starts, I will clearly show the viewpoints from the market parties, branch organisations within the building sector, interest groups of homeowners and knowledge institutions (based on the interview results). In will do this in order to avoid that the predetermined topics and statements will only be discussed from the viewpoint of the Municipality.

Stakeholder	Function interviewee	Date
Municipality of Rotterdam	Consultant Circular & Climate adaptive	28-04-2021
	Residents Coach (Advisor Home Maintenance and Sustainability)	
	Sustainability Advisor Urban Development	
	Project Leader and Consultant Sustainability	
	Consultant Building Physics, Circularity and Integrated Sustainability	

Table 2.4 – Participants focus group (own table).

The themes and questions that will be discussed follow from the results of the interview phases. The main purpose of the discussion in the focus group is to further discuss three recurring barriers from the interview results: **insufficient realisation, facilitation and communication**. Based on these barriers, three questions will be presented on which the participants can share their views and opinions. Table 2.5 shows these barriers and associated questions, including the suggested opportunities mentioned by different stakeholders in the interview phases. Only the barriers where clear differences of opinion emerged during the interview phases were chosen as themes for the discussion. For the other recurring barriers, it was generally clear in the interview phases (including the internal survey) how the municipality could and should act when initiating CSCC. During the discussion I will continuously monitor that the goal of the discussion will be achieved, and I will direct the discussion when it threatens to drift into other themes.

Barrier	Discussed question	Suggested opportunities
Insufficient communication	Hoe could the municipality reach, inform and enthuse its residents about circular renovation options?	Set good examples with own real estate and public space and use as communication tool
		Facilitate circular (renovation) platform for both supply and demand and use as communication tool
Insufficient realisation	How could cooperation between policymakers and non-policymakers be organised in orger to realise future visions?	Draw up visions together (policy and non-policymakers)
		Designate experimental areas in the city
Insufficient facilitation	How could (local) chain cooperation be facilitated and stimulated?	Organise workshops and knowledge sessions for market, residents and municipality to stimulate cooperation
		Make location available for local construction hub and link to existing initiative(s)

Table 2.5 - Barriers with associated questions and suggested opportunities that will be discussed in the focus group (own table).

Due to the current COVID-19 situation, the discussion will take place online, for which an hour has been reserved. A few days prior to the discussion, participants will be informed by email about:

- the purpose of the research;
- what the interim conclusions are from the interview phases;
- the purpose of the focus group discussion;
- the online tools that will be used during the discussion (Microsoft Teams + Mentimeter)
- with necessary on explanation how to use these tools;
- how I can be reached as moderator when a participant is unable to open or use one of these online tools;
- what is expected of them during the discussion;
- the practical agenda of the discussion, including the topics and propositions that will be discussed.

The practical agenda for the discussion can be found in Appendix IV. To start the discussion and keep it going, a combination will be made of asking questions to the whole group ('someone who disagrees with this?') and addressing participants personally ('how do you think about this? '). In this way, it is expected that the discussion results in valuable insights and a high information density. Everyone's opinion will be heard, and the topics and statements will be discussed from all perspectives. By using the online presentation tool Mentimeter in addition to Microsoft Teams, brainstorming and discussion about the topics and statements becomes clearer and easier. Certainly, now that no physical conversation is possible, some control over the group dynamics can be maintained with this online tool and participants will lose attention less quickly.

Due to the online setting, it is important that before and during the discussion there is a regular check whether each participant is clearly visible and understandable. The discussion will be recorded with the consent of the participants, after which the results will be transcribed and analyzed. During the discussion, I will make some written key notes so that there will be an opportunity to return to relevant discussion points. After transcribing the group discussion, the transcript will be analyzed using the same coding process (Williams and Moser, 2019) used in the analysis of the individual interviews. By examining both the (current) barriers and the (future) opportunities of CSCC related to circular renovation of private homes and testing the partial conclusions with related concrete feasible strategies in a focus group, a substantiated advice to the Municipality of Rotterdam can ultimately be developed.

2.4 Research output

This research intends to provide an overview of barriers and opportunities of CSCC within the current circular renovation process of private homes and how these can be better managed. Through innovation within SCM, the circular renovation should be stimulated and upscaled. This research should result in collaboration opportunities that could be applied within CSCM to contribute to the upscaling of circular renovation of owner-occupied housing.

First of all, with this research I want to map the state-of-the-art of circular renovation in a Dutch context, with a special focus on owner-occupied housing. **Second**, I want to develop a theoretical framework, based on innovation, actornetwork theories, supply chain learning concepts, future visions and business models, for researching, reflecting and evaluating the Dutch (circular) renovation process. **Third**, by means of two interview phases I want to collect different insights about the barriers and opportunities of the current CSCC and what the role of the municipality should be in these processes. **Fourth**, by discussing the main interview results within a focus group, I will investigate from a management perspective whether the detected opportunities will work or not to solve the barriers and mismatches in terms of concrete strategies. The results of the interviews and focus group discussion will be compared with the theory, examining the importance of obtained solutions for the identified mismatches in more detail. **Fifth**, because the transition to a CCE is still in the innovation phase, follow-up studies will be necessary to be able to delve deeper into certain aspects of the recommended collaborations. **Last**, I will end with an advice addressed to the Municipality of Rotterdam on what role they should play in SCC in order to scale up the circular renovation of private homes and on improving local governance within this theme. Figure 2.5 gives an overview of the main research outputs.



Figure 2.5 – Overview of the research output (own figure).

This research can be used by municipalities in order to achieve the climate goals and get insight into the main collaborative barriers and opportunities of CSCC of circular renovation of owner-occupied housing. In particular, the Municipality of Rotterdam was interested in this study. However, this report is not only important on this regional level, but also on a larger scale. The transition towards a CE is a global task to which the construction industry can make a major contribution. Based on the outcomes of this study, various collaborative innovations can be made (national and international) which will benefit the production speed and upscaling of the supply of circular renovation principles.

2.5 Research relevance

2.5.1 Societal relevance

Currently, there is a lack of clarity about the activities that must be taken within the SC of the construction industry, in particular within the renovation sector, to become more circular. The focus of this research is on the gap between what the literature advises and what is currently happening in (circular) construction practices. The development in society, the needed global transition towards a CCE, the rise of circular renovation, the need of collaboration within SCs and the question of the Municipality of Rotterdam which role they should play in the circular renovation process of private homeowners provides an interesting starting point for the formulated research questions. To achieve this upscaling as quickly as possible, it is important that local governments, market parties and knowledge-institutions collaborate, build an active network, share visions and knowledge and create circular business models.

2.5.2 Scientific relevance

For adopting CE principles in the built environment, collaborations and partnerships between supplying parties are of great importance and should be investigated within the development of CSCM (Adamas et al., 2017; Leising et al., 2018). In response to this recommendation, the focus in this study is on collaboration barriers and opportunities in CSCC, especially on the circular renovation for owner-occupied housing, where circular renovation principles are still hardly implemented. The way in which this research is conducted and how the results are interpreted are based on existing literature and theories. On the one hand, the study is influenced and informed by the existing literature. On the other hand, the outcomes of this research can be added to the stock of knowledge within the relevant literature according to circular renovation of private homes.

2.5.3 Practical relevance

The national government sees an increasing need among regions and municipalities to set the transition to a CCE in motion. The results of the conducted research into the barriers and opportunities of CSCC within circular renovation processes are also important to the Municipality of Rotterdam. They are interested in how the supply of circular renovation principles can be scaled up as quickly as possible. And in particular, what the role of the municipality could be in scaling up the circular renovation of owner-occupied housing. I will end with an advice addressed to the Municipality of Rotterdam, which also could be used by other Dutch municipalities, on what role they should play in CSCC in order to scale up the circular renovation of private homes.

2.6 Data management plan

After completion of the research, the thesis is owned by Delft University of Technology, by the Municipality of Rotterdam and by myself. In the internship agreement, the property right is signed by all three parties. The thesis will be findable and accessible via the online educational repository of the TU Delft (https://repository.tudelft.nl/). The list of references used for this thesis can be found in Chapter 9 and has been drawn up according to the APA style (English; 7th edition), whereby the information and data are interoperable.

Data is stored on my own computer (as Word file) and on an external hard drive. Moreover, research data will be stored on a dedicated project storage drive, which can be requested from the ICT department. This will be accessible to myself and my (first) TU Delft supervisor. I will back up the data on the project storage drive in a timely manner during this research.

Prior to the interviews, an informed consent letter will be drawn up describing the goals of the research, asking whether the results may be used for the research and whether the interview may be recorded in order to be able to transcript and translate it afterwards. In this document, the potential participants in the research are informed about the design of the research, the way in which the data are used and treated and the risks they may run by participating in the research. This document also contains agreements on what will happen to the data after the research has been completed. When the interviewee and I as a researcher have signed the consent letter, the interview can take place. When the interviewee chooses to participate anonymously, their participation cannot be traced. If they do not want to participate anonymously, only their name and the name of the company/organisation will be mentioned in the report (for example with a quote) when it becomes publicly available. Personal information or sensitive documents of the Municipality of Rotterdam will not be made publicly accessible. This data will be handled with care and will not (or anonymously) be shown in the thesis.

2.7 Ethical considerations

Because this research can only be carried out with the cooperation of human participants, it is mandatory to adhere to ethical rules to protect the human rights (Hammersley & Traianou, 2014; Rijksuniversiteit Groningen, 2019). The most important ethical rules for research with human participants are full information, informed consent, debriefing and confidentiality. Based on the informed consent letter, a potential participant can make an informed and formal decision regarding participation in the research. This research is carried out with the approval of the Human Research Ethics Commission (HREC) of TU Delft.

2.8 Total research design

As mentioned in the introduction, this research consists of three parts: (1) define and design, (2) prepare, collect and analyze and (3) conclude and advise. Figure 2.6 shows an overview of the total research design, in which all the research phases and related activities are shown.



Figure 2.6 – Total research design (own figure).

state-of-the-art.

This chapter will be an exploratory research and will provide an answer to the first sub-question; **what is the state-of-the-art of circular renovation of Dutch owner-occupied housing?** The transition towards a CE and construction industry is still in motion. In recent years, various parties have developed definitions, strategies and principles to shape a CCE. Therefore, the first section of this chapter (3.1) will provide an overview of these different views that have already been developed in the Netherlands. The following sections will zoom in on the European (3.2) and Dutch (3.3) policies and legislation on circular renovation. Next (3.4), the progress towards circular construction industry in the Netherlands will be explained and finally circularity in the city of Rotterdam (3.5) will be described. Based on this research, a conclusion will be made, which will give an answer to SQ1 and will give the motives for relevant literature research: what is urgently needed when looking at the state-of-the-art of circular building and renovation in the Netherlands? From this chapter, the research variables (that are identified as urgent) will follow, which should be further investigated in the next theoretical chapter.
3.1 Circular definitions, strategies and principles being used in the Netherlands

3.1.1 Circular definitions being used in the Netherlands

Because the transition to a CCE is still in full development, many different definitions of circular terms exist in literature. The necessary definitions in this research will be formulated, according to the Transition Agenda CCE (Rijksoverheid, 2018) and the Lexicon Circular Construction drawn up by Platform CB'23 (Platform CB'23, 2019b). A conscious choice is made to maintain these definitions, because they are used by most of the Netherlands, including the Municipality of Rotterdam. The first important definitions for this research are those of circular economy, circular construction, circular strategy and renovation:

Circular economy	"Economic system in which the use and value of raw material flows are optimised without impeding the functioning of the biosphere and the integrity of society. This means that the aim is to protect biological and technical material stocks, avoid environmental impact and create existing value. preserve" (Platform CB'23, 2019b, 2019, p. 8).
Circular construction	"Developing, using and reusing buildings, areas and infrastructure, without unnecessarily depleting natural resources, polluting the living environment and affecting ecosystems. Building in a way that is economically responsible and contributes to the well-being of people and people. animal. Here and there, now and later" (Platform CB'23, 2019b, 2019, p. 7).
Circular strategy	<i>"Activity carried out with the intention of contributing to a circular economy"</i> (Platform CB'23, 2019b, 2019, p. 8).
Renovation	"Refurbishing or improving the technical and/or functional quality of an existing (construction) product, by using product parts from a discarded product with a similar function" (Platform CB'23, 2019b, 2019, p. 16).

However, what is still missing in the Transition Agenda and Lexicon is the definition for circular renovation. Based on the above definitions, I have formulated the following working definition for circular renovation:

Circular renovation *Refurbishing or improving the technical and/or functional quality of an existing (construction) product with the intention of contributing to a circular economy, by using product parts from a discarded product with a similar function, without unnecessarily depleting natural resources, polluting the living environment and affecting ecosystems (own definition).*

3.1.2 Circular strategies being used in the Netherlands

Circular design strategies provide designers with tools for both new projects and existing objects. However, these strategies are not new (De Angelis, Howard, & Miemczyk, 2018; Ellen MacArthur Foundation, 2013). Origins can be found in literature about industrial ecology, economics and corporate sustainability, based on their impact on the business community (De Angelis et al., 2018). The transition towards a CE is one of the most important transitions facing the construction industry in the Netherlands. We need to deal with raw materials in a fundamentally different way than the products that the earth makes available to us and with materials and products that we make from these materials. Circularity, developed by Prof. Jacqueline Cramer, offers a tool for this circular system thinking, which is well known in the real estate and construction sector (Cramer, as cited in PBL, 2019). The degree of circularity is often related to this ladder. Figure 3.1 shows that there are different degrees of circularity. The following applies: the higher up the ladder, the more circularity is involved and the less raw materials are used, which also reduces the environmental pressure. According to Cramer (as cited in PBL, 2019), refrain from new construction by first looking at whether the existing construction, through renovation or transformation, can provide an appropriate answer to questions from the market. It is important to think differently about buildings and construction processes. This is one of the reasons why this research will focus on the renovation of the existing built environment.

Reduce <i>"Reducing the use of new raw materials and the number of raw materials while guaranteeing the same functionality and quality"</i> (Platform CB'23, 2010b, 20	23,
2019b, 2019, p. 25).	23,
Redesign <i>"Redesigning a product based on circular design principles"</i> (Platform CB' 2019b, 2019, p. 23).	
Re-use "Reuse construction products or construction parts/elements in the same function, whether or not after processing" (Platform CB'23, 2019b, 2019, 26).	p.
Repair <i>"Making longer use of a product or construction through preventive or corrective measures"</i> (Platform CB'23, 2019b, 2019, p. 24).	
Remanufacture "Reusing a (partial) object from a discarded (partial) object to create a "r object with the same function" (Platform CB'23, 2019b, 2019, p. 24).	ew"
Re-purpose "Reusing a (partial) object that has been discarded for another function" (Platform CB'23, 2019b, 2019, p. 24).	
Recycle <i>"Reclaiming materials and raw materials from discarded products and re using them to make products"</i> (Platform CB'23, 2019b, 2019, p. 23).	-
Recover <i>"Recovering energy from raw materials that would otherwise have been waste"</i> (Platform CB'23, 2019b, 2019, p. 22).	
 Recycle "Reclaiming materials and raw materials from discarded products and reusing them to make products" (Platform CB'23, 2019b, 2019, p. 23). Recover "Recovering energy from raw materials that would otherwise have been wants" (Platform CB'22, 2010b, 2010, p. 22). 	

Figure 3.1 – Levels of circularity: 10 R's (Cramer, as cited in PBL, 2019).

The footprint of the construction industry on earth is far too big and needs to decrease (PBL, 2019). Renovation and transformation of the built environment offer excellent opportunities to move the building practice in a different direction, higher up the Ladder of Circularity (Cramer, as cited in PBL, 2019). The reuse and adaptation of the existing building stock is in a high position of this ladder and therefore has plenty of potential to bring a CCE closer.

The way in which the world is made more sustainable differs between an LE and a CE. On the one hand, in an LE the focus within sustainability concepts is on **eco-efficiency**, which include reduce and recycle (Figure 3.2). "Eco-effectiveness is a concept that proposes a reinvention of products" (Newton et al. 2014, p. 6). This means that the ecological impact on the environment is minimised with the same input (Di Maio, Rem, Baldé, and Polder, 2017). On the other hand, in a CE sustainability is about maximising **eco-effectiveness**, which includes rethink, reuse and upcycling. "An eco-effective approach attempts to maintain resource quality and productivity through multiple cycles of use, rather than aiming for zero waste" (Newton et al., 2014, p. 5). In addition to reducing the ecological impact (as in an LE), the ecological, social and economic impacts are maximised (Kjaer, Pigosso, Niero, Bech & McAloone, 2018). According to Kwon and Mlecnik (2020, p. 14), to evaluate the (eco)-effectiveness and (eco)-efficiency of municipal policy instruments, policymakers use the following criteria:

- **Effectiveness** "whether the municipality achieved what they wanted to achieve".
- **Efficiency** "the extent of outcome compared to investment and justification of the resources spent".

Another circular strategy being used in the Netherlands is that of Steward Brand (1995), who states that a building consists of different 'layers', each with its own function and lifespan. These 'shearing layers' serve as the basis for a circular design strategy to determine and maintain value. By making a distinction according to lifespan within buildings, natural materials can be cascaded, and technical materials can be kept valuable.



Figure 3.2 – Differences between eco-effectiveness and eco-efficiency

The model shown in Figure 3.3 (Brand, 1995) distinguishes the following layers: site, structure, skin, services, space plan and stuff. It is important here that the different layers are mutually detachable, both on the basis of their function and on the basis of their lifespan. This makes it possible to retain the value of specific layers when adjustment is required in other layers.



Figure 3.3 – Different building layers, each with its own lifespan (Brand, 1995).

Figure 3.4 – Circular design strategies based on future scenarios (Brand, 1995).

Circular design strategies build on these different building layers, with the intention of enabling multiple reuse scenarios after the first use. This strategy, shown in Figure 3.4, was also developed by Steward Brand (Brand, 1995). By means of this strategy, it is assumed that a building can retain its value, even if there is a need for a function other than that for which the building was made after the first use phase (Brand, 1995).

3.1.3 Circular principles and models being used in the Netherlands

"Circularity contributes to a more sustainable world, but not all sustainability initiatives contribute to circularity" (Versnellingshuis Nederland Circulair, 2020). While circularity focuses on closing raw material circles, sustainability is more broadly oriented to people, planet and profit (Versnellingshuis Nederland Circulair, 2020). However, visions, theories and models regarding sustainability and circularity are mainly related to each other. In section 4.5 there is a more detailed discussion of sustainable and circular business models. This section will give an overview of several design principles that are applied in practice in the Netherlands that contribute to the transition to a CCE, shown in Table 3.1.

Table 3.1 - Design principles that contribute to the transition to a circular construction	industry.
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Principle	Definition
Bio-based economy	An economy that does not run-on fossil fuels, but runs on biomass as a raw material. In a biobased economy it is about the use of biomass for non-food applications (TKI-BBE, 2020).
Cradle-to-cradle	Materials in industrial and commercial processes are considered as raw materials for technological and biological reuse. Design is literally from cradle to cradle – in the design process the entire life cycle of the product and the raw materials used are considered. Technical raw materials do not contain any components that are harmful to the environment; biological raw materials are completely biodegradable (Braungart and McDonough, 2009).
Blue economy	An economic philosophy that derives its knowledge from the way in which natural systems form, produce and consume. This knowledge is applied to the challenges we face and is converted into solutions for local environments with specific physical and ecological properties (The Blue Economy, 2020).
Doughnut economy	A model for measuring the earth's prosperity, based on the SDGs and the planetary boundaries. Many of the planetary boundaries relate directly to 'unlocked' cycles, such as those of greenhouse gases, toxic substances, eutrophication, fresh water, aerosols and oxygen radicals (Raworth, 2020).
Green economy	An economy that results in increased well-being and increased social equality, while at the same time greatly reducing environmental risks and ecological scarcity (United Nations, 2020).
Modular building	Modules are individually designed, produced, and assembled with the efficiency of industrialization (Yu, Al-Hussein, Al-Jibouri & Telyas, 2013).
Performance economy	The vision of a closed-circle economy, including the principles of life extension, product repair and waste prevention. Selling services instead of products is an important part of this way of thinking: everyone pays for the performance of a product (Stahel, 2010).
Product-service systems	A marketable set of products and services capable of jointly fulfilling a user's need. The product/service ratio in this set can vary, either in terms of function fulfilment or economic value (Mont, 2002).
Industrial ecology	The science of material and energy flows, where waste within industrial cycles serves as a raw material for a subsequent process. Production processes are designed in such a way that they resemble ecological processes (Lanau, Herbert & Liu, 2021).

To go deeper into the state-of-the-art of Dutch housing, I will give a few examples with regard to some of these strategies. First of all, more and more student flats in the Netherlands are being built up from modular and stackable one-room residential units that are relatively easy to disassemble and move (Van Bueren, 2015). This mainly relates to new construction, but attention for the reuse and recycling of building materials is also increasing. The existing built environment is increasingly seen as an urban mine (Van Bueren, 2015). More and more Dutch municipalities are adopting circularity as a target for redevelopment. For example, the municipality of Haarlemmermeer is one of the first municipalities in the world that have joined the Ellen MacArthur Foundation, which focuses on bringing about the CE (Ellen MacArthur Foundation, 2020). Within the municipalities of Rotterdam and Amsterdam, attention for circularity in the construction and renovation sector is also growing. These cities are exploring opportunities to create an international hub of materials, combining logistics and distribution with the development of knowledge, technology and jobs (Gemeente Rotterdam, 2019b; Gemeente Amsterdam, 2020). In addition, various municipalities have joined Cirkelstad, a movement of public and private partners who create waste-free, participatory cities with the help of a Green Deal (iCircl, 2020a). The development of lease models for various parts of buildings is also receiving more attention, which is in contradiction with the current institutional structure in the real estate sector, aimed at the ownership and rental of buildings or parts thereof. So, the Dutch built environment also appears to be on the eve of major changes that contribute to the transition towards a CE.

In conclusion of the first part of this chapter, it becomes clear that the concept of circularity includes a broad scope. Circularity is based on a system perspective, involving different industries, such as the environment, economics, technology, policy and education. This broad scope offers many opportunities for the transition to a CE, because many involved actors can contribute with their own specific specialties, goals and interests. Now that the most important circular definitions, strategies and principles have been discussed, the following sections will zoom in on the European and Dutch policies and legislation on circular renovation.

3.2 European policies and legislation on circular renovation

The EU aims to stop using fossil fuels by 2050 and to switch completely to renewable energy sources (European Commission, 2020a). In addition to switching to electricity, this transition also involves tax shifts and raising awareness among people (Ebrahimigharehbaghi et al., 2019). The Energy Performance of Buildings Directive (EPBD) is a European directive which includes measures to make users and building owners aware of the energy use of their buildings and encourages them to take measures to save energy (Rijksdienst voor Ondernemend Nederland, 2020a). The EPBD has been implemented in the Netherlands through the Energy Performance of Buildings Regulation. In addition, building owners in the Netherlands, including large companies and municipalities, are obliged to perform an energy audit. This obligation follows from the European Energy Efficiency Directive (EED) of the European Commission (Rijksdienst voor Ondernemend Nederland, 2020b).

The future European climate and environmental policy is determined in the context of the Green Deal. The European Green Deal (European Commission, 2019) is a broad program of the current European Commission Von der Leyen and is intended to ensure that the old growth model for the economy, focused on fossil fuels and pollution, is replaced in a sustainable manner by a new growth model based on climate objectives. The substantive spearheads of the Green Deal include realising energy transitions, implementing CO2 taxes, integrating alternative fuels, tackling biodiversity, air, water and soil pollution, and stimulating research and innovation (European Commission, 2019).

On 11 March 2020, the European Commission published the 'Circular Economy Action Plan' (European Commission, 2020c). This Action Plan proposes various legislative and non-legislative measures to reduce the consumption footprint and increase the circular use of products and raw materials in the EU. Sustainable products must become the norm in Europe. To this end, the entire life cycle of products must be made more sustainable. Therefore, the Action Plan includes initiatives to make the production design of products more sustainable, as well as the composition, (re)use and recycling of products and raw materials. In addition, the Commission also wants to strengthen the position of consumers in the field of sustainable products. For example, there must be better access to reliable information about the sustainability of products. Since the extraction, transport and processing of products and raw materials make a major contribution to greenhouse gas emissions, achieving a CE is an important step in achieving the European climate neutrality target of 2050 (European Commission, 2020c).

The proposed measures in the Circular Economy Action Plan (European Commission, 2020c) are mainly aimed at sectors that use a lot of raw materials, including the construction sector. This sector also influences the policy of Dutch local authorities. To increase material efficiency, the European Commission will publish a strategy for a sustainable built environment in 2021. This strategy will specifically promote circularity in the life cycle of buildings. The Commission is keen to review the Construction Products Regulation, which would allow them to introduce a required amount of recycled material for certain construction products. In addition, the Commission intends to integrate a review of the material recovery targets for construction and demolition waste and a life cycle assessment into public procurement, which will be an important aspect for local authorities, like municipalities. In addition to the Sustainably Built Environment Strategy, the Commission has also announced the Renovation Wave initiative in the European Green Deal to increase energy efficiency and optimise life cycle performance (European Commission, 2020c). The EU construction industry aims to become the global leader of innovative renovation activities by applicating circular principles, which will contribute to the global SDGs.

Another tool that will stimulate sustainability and circularity in the built environment that the European Commission (2018) has developed is 'Level(s)', which is defined as "a voluntary reporting framework to improve the sustainability of buildings" (European Commission, 2018, p. 3). This framework aims to establish a common language of a sustainable

built environment and provides a set of metrics and indicators that could be used by measuring the environmental performance of individual buildings, including the full life cycle. Using this framework, professionals working in the construction industry could contribute to environmental improvements at European level (European Commission, 2018). "Level(s) holistic approach and incorporation of life cycle thinking is key to contributing to long-term goals such as Circular Economy, while supporting national initiatives" (European Commission, 2018, p. 5).

In addition to developments at European and national level, the EU also finances projects aimed at a smaller scale, like individual homeowners. An example of such a project is the **European Interreg 2 Seas project Triple-A** (Meijer, Straub & Mlecnik, 2018b; Mlecnik, Meijer & Bracke, 2018), which aims at local authorities to encourage individual homeowners to make their homes more energy efficient. This is a project financed by the European fund for Regional Development. The three A's stands for awareness, access and adoption. First, this project makes homeowners more aware of the various carbon-saving technologies available in the market and then tries to convince them of the associated benefits. At the same time, it examines how the various available technologies can be made as accessible as possible to citizens, so that they can choose the option that best suits their own needs and financial resources at that time. This process of awareness-raising and easy access should ultimately lead to effective actions, with homeowners moving towards energy-efficient renovations (Meijer et al., 2018). Because this research also focuses on the role of the municipality in the circular renovation process of private homeowners, a number of relevant results from the Triple-A project are summarized in Table 3.2. These results relate to supporting actions from the Municipality in order to make the sustainable renovation process more transparent for private homeowners.

Supporting actions	Examples
Better organization of digital resources	Developing various web modules, such as feedback forms, information about financial incentives, cost calculation module and success stories.
Make energy use transparent	Offering Home Energy Monitoring Systems (digital monitoring systems) to increase the urgency for renovation.
Visit the neighborhoods	Pop-up shops, cars or information consoles can be used in which advice can be given.
Demonstration projects in neighborhoods	Model homes can be decorated to show residents what a renovation does and what it can look like.

Table 3.2 – Relevant results from the Triple-A project (based on Meijer et al., 2018b; Mlecnik et al., 2018; as cited in VPNG 2021)

Besides, **CircE** is also one of the Interreg projects, which is aimed at accelerating the transition to a CE in Europe. This project has eight partners, including the Dutch Province of Gelderland, and will steer their economy towards a circular model, by supporting them to increase the capability of their policy instruments. "Every Partner will draft an action plan to transfer the lessons learnt in the interregional exchange into its own policy instrument, according to the prioritised opportunities and the highlighted barriers." (European Union, 2020).

Another example funded by the EU is the program **Horizon2020** (Bureau voor Publicaties van de EU, 2014), which offers opportunities for any organisation or entrepreneur active in research, technological development and innovation. This program is set up as a channel for municipalities and other stakeholders to get money for international collaboration. In comparison, the mentioned Interreg programs also aim for international collaboration, but more between neighbouring countries and regions. Appendix V provides an overview of a number of finished and ongoing projects within the Horizon2020 program that contribute (or have contributed) to my research field.

To support European agreements, various financing constructions are available through the European Structural Funds and/or other channels linked to the Structural Funds (RVO, 2021). A number of these focus specifically on developments in the urban living environment, such as **ELENA** (European Local ENergy Assistance). ELENA is a grant for the development of a project plan for a large-scale investment and is intended as an incentive to support local authorities to better develop large energy projects, for example with a more extensive business plan. 90% of the costs for this development will be reimbursed (RVO, 2021). ELENA offers the possibility to finance (under certain conditions) the often expensive and necessary research, in both time and money, which is necessary to realise ambitions in the field of energy and innovation. The province of South Holland, in collaboration with nine of its municipalities (including Rotterdam), is also applying for a subsidy from the European Investment Bank.

In conclusion, this section has given an overview of European policy and legislation related to circularity within the built environment. Besides, some relevant outcomes of EU funded projects are discussed, including sustainable and circular renovation aspects for owner-occupied housing. The next section will focus on policy and legislation for circular renovation in Dutch context.

3.3 Dutch policies and legislation on circular renovation

One of the strategic goals of the national government is to link the CE in construction, where possible, to actions that have already been (partially) set in motion, also referred to as 'linking opportunities'. The cabinet wants activities related to the realisation of a CCE to link up with other major urban tasks where possible, such as the energy transition, making homes more sustainable, climate adaptation and quality of life issues (Rijksoverheid, 2016). Efforts can also be combined in the renovation and transformation of the existing stock. For example, within the energy transition, there are also opportunities for circularity that should be exploited, with the focus on the task of natural gas-free neighborhoods. An integrated approach is needed to achieve the CO2 reduction targets of 2030 and 2050, which includes the achievement of a CE. Platform31 recently conducted research into the significance of this integration of various tasks for the implementation strategy in a neighborhood or area (Platform31, 2020b). Among other things, the researchers looked at examples from practice where these assignments were already linked. It was remarkable that smart connections can be made, which makes investing in circular construction and renovation more attractive. The research has also shown that one of the success factors for an integrated approach is collaboration. Multidisciplinary collaboration is crucial in order to connect different assignments and associated goals. This means cooperation within organisations must be promoted, with networks that transcend the own organisation and with innovative external parties. These integrated sustainability approaches at neighborhood and city level play a crucial role in the implementation of the sustainable and circular development goals and will also contribute to achieving SDG11 (sustainable cities and communities).

Although the SDGs relate to all countries in the world, the needs in the Netherlands are different than in other countries. There are still many opportunities for improvement in the Netherlands. Every year the Central Bureau of Statistics (CBS) measures how the Netherlands is doing on the seventeen goals. This produces a mixed report. For example, the Netherlands is lagging behind on climate and energy targets (CBS, 2018). In order to achieve these global and European climate goals, the Dutch government has set the goal that the Netherlands must emit 49% less CO2 by 2030 and in 2050 this must be 95% less, compared to 1990 (Rijksoverheid, 2019). This is necessary to keep the temperature on Earth from rising more than one and a half degrees. With this temperature increase, the consequences of climate change are still seemingly manageable. To achieve these and other sustainability goals, the Dutch government has agreed on measures with companies and organisations that are documented in the national Climate Agreement (Rijksoverheid, 2019a). In addition to the climate goals, this Agreement also contains the goals and requirements with regard to energy. The vision up to 2050, stated by the national government, is that the current almost 8 million homes and 1 million buildings should be transformed into well-insulated homes and buildings (CBS, 2020b). Most existing buildings are moderately insulated and almost all heated by natural gas. Well-isolated homes and buildings are heated with sustainable heat and in which clean electricity is used or even generated by itself (Rijksoverheid, 2019).

As a result of the ambitions of the Climate Agreement, the Dutch building and housing stock is required to undergo extensive renovations in the coming years (Rijksoverheid, 2019a). In 2019, the Dutch owner-occupied homes (approximately 5 million) accounted for almost 60% of the housing stock and on average 62% of this owner-occupied housing sector has an energy rating of C or higher, on a scale from A to G (Rijksdienst Ondernemend Nederland, 2020c). For more than 34% of the housing stock, action is still required to eventually achieve at least an energy label C (Rijksdienst Ondernemend Nederland, 2020c), which results in energy-saving potential of the Dutch housing sector. All homes which are currently not well enough insulated (D or lower) and are still heated by natural gas, must be renovated into well-insulated homes that are heated by means of sustainable heating systems and that use self-generated or clean electricity (Ebrahimigharehbaghi, Qian, Meijer, & Visscher, 2020).

Besides the energy and climate goals drawn up in the Climate Agreement, the Dutch government is fully committed to achieve the transition to a CE (Rijksoverheid, 2016; Rijksoverheid, 2019a). Binding agreements have been made about these goals in the government-wide program Nederland Circulair in 2050 (Rijksoverheid, 2016) and in the Raw Materials Agreement (Rijksoverheid, 2017). With the program Nederland Circulair in 2050 (Rijksoverheid, 2016), the government presented the efforts of the national government: a fully CE in 2050. This ambition was more widely endorsed in January 2017 in the Raw Materials Agreement (Rijksoverheid, 2017) by companies, trade unions, governments, nature and environmental organisations, knowledge institutes, financial institutions and many other social organisations. This document contains binding agreements to run the Dutch economy on reusable raw materials. The program Nederland Circulair in 2050 (Rijksoverheid, 2016) supports innovative pilot projects to deliver lessons and to create enthusiasm. The government is also stimulating market developments by adjusting rules, co-developing a materials passport, setting up a knowledge institute for circular construction, releasing subsidies for circular business and revenue models. Moreover, from 2023 all government requests will be circular. In addition, Dutch organisations can request support from the Netherlands Enterprise Agency (RVO) to make the switch to circular entrepreneurship. This includes subsidies, loans, tax benefits and assignments related to, among other things, research, experimental development, process and organisational innovation and chain cooperation.

In 2018, the Transition Agenda for CCE (Rijksoverheid, 2018) was drawn up. This Transition Agenda describes the strategy to achieve a CCE in 2050 and contains the Agenda for the period 2018-2021. This Agenda is based on the Raw Material Agreement (Rijksoverheid, 2017) and drawn up by a transition team of experts from science, government and market parties. The transition is aimed at the transition towards a CE and at the program Nederland Circulair in 2050 (Rijksoverheid, 2016). This Agenda ties in with The Construction Agenda (Bouwagenda, 2017), which describes a strategy and approach to strengthen the construction sector and make the Netherlands future-proof. With regard to policy implementation, the government is striving to stimulate initiatives at (inter)national, local and regional level and to ensure that they can reinforce each other. Both the government-wide program Netherlands Circular in 2050 (Rijksoverheid, 2016) and the Transition Agenda for CCE (Rijksoverheid, 2018) indicate that the circular transition is moving through different business sectors and levels of scale.

Despite the fact that the construction industry can be a fairly conservative sector, with many smaller companies, innovations are nevertheless taking place. The problem is the introduction and upscaling, because many innovations linger in the pilot phase. The Ministry of the Interior and Kingdom Relations (BZK) tries to create demand and mass through its commissioning role in order to further develop circular innovations (RVO, 2020a). This is increasingly done via the Central Government Real Estate Agency, Rijkswaterstaat and Rijksinkoop in the tendering of offices, civil engineering projects and the purchase of products and materials for the central government. This is also used to raise awareness and influence behavior among contractors and producers. BKZ also wants to take quick steps when it comes to knowledge development. A great deal of knowledge is already being developed by universities, colleges and other knowledge institutions such as TNO, whether or not in collaboration with companies. However, a distinction must be made between fundamental and practical knowledge development. BKZ considers the link with practice or the applicability of the knowledge developed to be important for both. However, it is expected that these steps in knowledge development and upscaling will be less likely to be taken by private clients and local entrepreneurs, like handymen (RVO, 2020a). This group of individuals is difficult to reach, but it is important in the long process towards a CCE. In this research I will focus on the private homeowner as a client, which will therefore contribute to the knowledge and developments that are already present.

Both international and national programs have a positive influence on the achievement of energy saving and circularity targets. In addition, these programs also contribute to the facilitation of energy efficient renovation and the removal of barriers in the energy and circularity transition processes (Ebrahimigharehbaghi et al., 2019). However, despite these programs, renovation rates have not risen enough to achieve the (inter)national energy targets (Ebrahimigharehbaghi et al., 2019). The next section will discuss the progress towards circular construction industry in the Netherlands.

3.4 Progress towards circular construction industry in the Netherlands

After drawing up the Transition Agenda for a CCE, the implementation phase started at the beginning of 2019 and will run until 2023 (Rijksoverheid, 2018). On the basis of the Transition Agenda, the implementation activities have been drawn up by means of a joint implementation program that must be undertaken by the government, industry and

knowledge institutions. The Ministry of Infrastructure and Water Management (RWS) and BZK are responsible for the progress and results of this transition.

At the end of 2018, a CCE Transition Team (CBE in Dutch) was set up, consisting of representatives from governments and the construction and civil engineering sector (GWW in Dutch). These professionals direct the Implementation Program 'Towards a circular construction economy' (Transitieteam CBE, 2019). A Transition Bureau CCE has also been set up that coordinates the daily implementation. The bureau consists of a program manager and various employees from RVO and RWS. Partly on the recommendation of the transition team, the Construction Agenda (Bouwagenda, 2017) and the ministries have agreed that the Construction Agenda will be the platform where coordination for the preparation and implementation of the 'CCE Implementation Program' will take place. Several members of the transition team will be interviewed in the next phase of the research (Chapter 5).

In order to have a base camp for circular construction set up by 2023, it is important that the market gains experience with this method of construction, according to the planning of the Transition Agenda. The report 'Circular Buildings- a measurement method for detachability' (Alba Concepts et al., 2019) is the first publication in a series of publications with indicators for circularity and demountable construction. The result of this research is a proposal for a measuring method to determine the detachability of a building. This will be worked out in concrete terms within the Dutch Green Building Council Circularity program.

Furthermore, the Dutch government sees monitoring of the transition process as an important tool for following the progress of the transition to a CE. The national government has asked the Netherlands Environmental Assessment Agency (PBL) to develop knowledge about the CE in the Netherlands together with other knowledge institutions and to report on the progress of the Dutch CE. This is how the Integrated Circular Economy Report 2021 (PBL, 2021) was established. This report builds on two transition theories used in Dutch policy contexts: the X-curve model and the innovation ecosystem model.

The X-curve model can be seen in Figure 3.5 and sees transition processes as on the one hand the emergence and institutionalisation of innovation and on the other hand as the dismantling of highly established, unsustainable existing structures and practices. In this model, a distinction is made between two phases: formative phase and growth phase (each of which is also subdivided into two phases). Typical for the formative phase of the transition is experimenting with circular products and services, developing a vision, creating new networks and relationships in product chains, and entering new parties. At this stage it is not yet expected that there will be major changes in the use of raw materials and the associated effects. This changes in the growth phase, as more and more effects of decreasing and changing use of raw materials become visible. Think of decreasing CO2 emissions and socio-economic progress, such as the growing added value of circular activities. The origin of this graph can be related back to the innovation theory of Rogers (1962), which will be explained in more detail in section 4.1.



Figure 3.5 – X-Curve model (based on PBL, 2021, p. 132).

Each phase in Figure 3.5 has some characteristic elements, as can be seen in Table 3.3. In practice, transitions rarely go through the different phases step by step. By recognising the phase, starting points for policy, as well as for other social parties, are identified with which the progress of the transition to the next phase can be promoted. It is also good to realise that the transition may differ in phase per subdomain, for example because the transition in a particular domain has already started earlier. In the transition to a CCE, the Dutch built environment is still in the formative phase, which consists of the pre-development and start-up phase. Circular new construction projects are further developed than renovation projects and are in the start-up phase. Renovation of the existing built environment is still in the pre-development at the moment is to take the step to the growth phase, where the urgency of the transition will increase and stakeholders within the SC will start working together effectively (PBL, 2021).

Pre-development Start-up Acceleration Stabilization Many knowledge questions and Entrepreneurs start with Substantial market demand Circular is the new normal development commercial activities arises Initiators work together and are Entrepreneurs start with New rules and direction are set Optimising the new normal (radical) experiments (institutionalisation) visible Innovation is aimed at incre-Urgency is increasing Strong resistance is created Resistance has decreased mental innovation Fundamental discussions about Established system functions as Contradictions and uncertain-ties Dealing with losers the future and direction usual

Table 3.3 - Characteristic elements of each transition phase of the X-curve model (based on PBL, 2021, p. 137).

The X-curve model is combined with the innovation ecosystem model for monitoring the progress of the transition to a Dutch CE, which mainly focuses on understanding innovation, see Figure 3.6 (PBL, 2021). Innovations are not developed in isolation, but in symbiosis. This system consists of organisations and rules that influence the innovation process. Its functioning can be measured by means of eight key indicators and is therefore very suitable for monitoring the progress of the transition process. When one of these indicators changes, it will affect others, which makes it valuable to monitor not only individual indicators, but also the relationship between them.



Figure 3.6 – Innovation-ecosystem model (based on PBL, 2021, p. 135).

This model is also relevant with regard to my own research, in which the role of municipalities is investigated. (Local) governments can also influence some key processes: entrepreneurship (by experimenting and scaling up innovations), facilitating and stimulating knowledge exchange, guiding the search process (by articulating goals and solutions), mobilising resources, breaking through resistances and coordinating the complex bundle of different change processes present within this transition. For this reason, some of these indicators will be used in the development of the theoretical framework in Chapter 4.

According to the report by PBL (2021), the number of Dutch companies and organisations that target the CE is increasing. In recent years, the national government has offered financial support to support these innovative and circular companies. However, compared to the total number of companies in the Netherlands, the 'circular' companies have grown less quickly. Moreover, the majority of these companies focus mainly on recycling, repair and reuse of materials, which already existed before the discussion about the necessary circular transition started. There is still insufficient attention for innovative strategies and business models that can drastically reduce the use of fossil fuels. The current Dutch economy moves and functions too much in a linear society (PBL, 2021).

Some initiatives that are taken to realise the CCE are Versnellingshuis Nederland Circulair (Versnellingshuis Circulair, 2019), Platform CB'23 (Platform CB'23, 2019a), Cirkelstad (iCircle, 2020a), City Deals (iCircle, 2020b), Dutch Green Building Council (DGBC, 2020) and the Construction and Technology Innovation Center (BTIC, 2019). All these initiatives stimulate SCC in their own way, by, among other things, inspiring entrepreneurs, informing them, bringing them into contact with other entrepreneurs and guiding them with expertise and knowledge, often by using online platforms. Cirkelstad, for example, is a cooperative association that offers the Netherlands a platform for ambitious private and public parties who want to work together on 'cities without waste' (iCircl, 2020a). They inspire municipalities, supplying industries and companies to participate in Circle Cities networks. Meetings and events are organised to provide information, connect parties and allow them to learn from each other's circular ambitions. In addition, City Deal is a thematic collaboration between national government, municipalities, private parties, knowledge institutions and other organisations that work on innovative solutions for the built environment. This stimulates knowledge exchange between the various parties involved (iCircl, 2020b). However, these initiatives are mainly designed for national government, municipalities, supplying industries and knowledge organisations, and do not yet involve private homeowners sufficiently, while in a CE they (can) be an essential part of the SC. It is assumed that the majority of this target group is also insufficiently or not aware of the development of such initiatives. To realise the transition to a CE, PBL (2021) has set up the following five recommendations, shown in Table 3.4. With this research I will mainly contribute to the latest recommendation 'division of roles', which will examine the role of local government in facilitating CSCC to realise a CCE.

The main conclusion, which follows from the report by PBL (2021), is that the current course in the field of CE is insufficient to achieve previously set goals. Only 6% of Dutch companies are circular companies (PBL, 2021). The provinces also recognise this problem and see that a fully CE in 2050 is not feasible in this way. On February 1, 2021, the day of the National Circular Economy Conference in the Netherlands, Sander de Rouwe presented the 'provincial force map' or in Dutch 'Provinciale krachtenkaart' (IPO, 2021). On behalf of the Interprovincial Consultation (IPO), De Rouwe has made an inventory of the twelve Dutch provinces and investigated where the strengths and challenges lie in the various regions. This inventory showed that provinces are making significant progress. However, in order to deliver a better result, the national government will have to work more closely with the provinces. One of the provincial core tasks is to support the regional business community, especially in the circular transition. This means that the provinces, together with the national government, want to accelerate innovation in the field of CE, indicating that their circular ambitions are anchored in their policy and implementation (IPO, 2021).

Table 3.4 – Recommendations to realize the transition to a circular economy (based on PBL, 2021, p. 16).

Recommendations

Legislation and regulations	Make sure that environmental damage is included in the prices of products and services and that legislation and regulations no longer put circular initiatives at a disadvantage compared to (established) linear practices. For example, primary raw materials are now cheaper than recycled ones, and buyers are wary of circular products because there are no quality standards (yet) for them.
Pressure and coercion	In circular economy policy, make more use of ' pressure and coercion ', such as levies and regulation, including standards. It is important to realize that the development and implementation of steering and regulatory economic and legal instruments often takes a lot of time, as is evident from the long history of the introduction of a deposit scheme for small bottles. It is therefore important to start this in good time.
Circularity requirements	Increase the circularity requirements in procurement and tendering by the government step by step, as well as those in the context of producer responsibility. Examples of this are a minimum recycling percentage that is adjusted upwards over time and setting requirements for tendering and purchasing that go beyond recycling. In this way, the quality of the recycling and high-quality reuse of raw materials become a benchmark for the design of production processes.
Detailed visions	Develop a detailed vision of the circular economy that is widely supported by companies and social organizations and develop this into concrete goals. These goals may differ per transition theme, chain or product group, which requires a differentiated approach.
Division of roles	Ensure a clear division of roles between the various parties involved in the implementation of the circular economy policy. For example, what are the responsibilities and powers of the various transition teams and what is the role of the national and local government in those teams? These questions currently play a role in practice.

Because this research is carried out in collaboration with the Municipality of Rotterdam, I will zoom in on the province of South Holland, which is the most densely populated province in the Netherlands. This province is one of the largest contributors to the Dutch economy: almost a quarter of the gross national product is earned here (IPO, 2021). This gives South Holland an important role in the major transitions that we face as a society, including the transition to a CE. In the strategy "Circulair Zuid Holland: samen versnellen" (Provincie Zuid-Holland, 2019), the province is working together on the themes of construction, green raw materials and food, manufacturing industry and plastics. In this regard, transition thinking is paramount in innovator networks, chain cooperation and innovation. In addition, various developments are in progress with the aim of scaling up and accelerating the CCE, such as the South Holland Port Industrial Complex as a strategic raw materials hub (e.g. chemical recycling plastics), the Greenports (e.g. the value of horticultural waste), manufacturing industries (e.g. SMART Industries) and the aforementioned Cirkelstad (e.g. biobased construction).

Companies must become acquainted with innovative production chains and with forms of cooperation that extend beyond the existing production chain and sector (Provincie Zuid-Holland, 2019). It is up to the province to give a boost to coalition-forming. The aim is to (re)design and (re)organise production chains to close material cycles without wastage. As a connecting government, the province must create partnerships by linking parties by means of boosting, facilitating and/or financing. However, in order to achieve this, the provincial organisation will also have to organise new cross connections internally (Provincie Zuid-Holland, 2019). In addition, the province of South Holland acts as a constructive partner for government policy and municipalities and joins initiatives such as Platform CB'23, which provides input on topics such as material passports and the measurement of circulation (Provincie Zuid-Holland, 2019). They actively collaborate with Cirkelstad and help developers with process guidance, knowledge sharing and product development. These activities come together in 'Bouwprogramma Zuid-Holland' (Provincie Zuid Holland & Cirkelstad, 2020), which was established jointly with the province.

In conclusion, circularity is an integral theme that contributes to the realisation of several national and international objectives (climate, innovation, energy transition, environment). All of this comes together in the regions. However, transition flows will not only remain within one province, but also cross international borders, which requires cooperation in implementation, regulations and further development of circularity (IPO, 2021). So, provinces have the role of midfielder: the connecting link between local and (inter)national levels (IPO, 2021). However, what is missing in the report of IPO (2021), is the viewpoint of the local government, including Dutch municipalities. With this research I will contribute to this missing link and map the perspective of the local government.

3.5 Circularity in the Rotterdam built environment

To support my empirical research, I have chosen to do an internship at the Municipality of Rotterdam. The municipality looks at its own products, services, working methods and design of the city from a circular perspective to see how the transition to a CE can be accelerated. The city of Rotterdam is ambitious and progressive in the field of sustainability and the energy transition in this city is now well underway. Rotterdam wants the entire housing stock to be CO₂ neutral by 2050. By reusing demolition waste and building materials, the city must make an important contribution to the transition to a CE and to a climate-adaptive living environment (Gemeente Rotterdam, 2019b). With its motto 'Van zooi naar mooi', Rotterdam is challenging residents, companies and the municipality itself to think in circular solutions with new circular campaigns (Gemeente Rotterdam, 2020a). Through the Municipality, I could make contacts, gather information and conduct interviews with stakeholders interested in circular construction and renovation, which can be used as input for the research. In addition, the research into collaboration opportunities for the SC in circular renovation in collaboration with the Municipality of Rotterdam can lead to the support and interest of other municipalities in the Netherlands, so that upscaling will take place. This section provides an overview of Rotterdam's current housing market, Rotterdam's Sustainability Compass, Program Rotterdam Circular 2019-2023 and the current circular instruments within Rotterdam policies.

3.5.1 Rotterdam's current housing market

The city of Rotterdam is located in the province of South Holland and is part of the partnership Rotterdam City Region and Metropolitan Region Rotterdam The Hague. As Figure 3.7 shows, on the first of January of 2020 this municipality had 650.597 inhabitants (CBS, 2020a) on an area of 319.35 km², which makes Rotterdam the second largest Dutch municipality in terms of inhabitants.

In 2020, the municipality of Rotterdam had 315,361 homes (CBS, 2020b), see Figure 3.8, which is expected to increase in the coming years. Of this housing stock, 25.5% are single-family homes (Gemeente Rotterdam, 2020c). Furthermore, Figure 3.9 shows that 60.3% of the total housing stock was built before 1970 (Gemeente Rotterdam, 2020c). Not all these houses are already well insulated or have undergone energy-efficient measures, which means that the city of Rotterdam offers many possibilities for renovation in the housing sector. Besides, for the existing building stock, which is not designed for decommissioning, it is important to prioritise renovation over demolition (Metabolic, Circle Economy, Blue City, & Spring Associates, 2018). Almost one third of the housing stock in 2020 is owned by homeowners (Gemeente Rotterdam, 2020c), as Figure 3.10 shows. So, single-family home owners represent a large part of the Rotterdam population, which makes it useful and interesting to focus the research on this group. However, (local) governments can exert little (direct) influence on private home owners, which makes it difficult to persuade this group to act in a circular manner. Municipalities can, however, encourage residents to renovate their homes in a sustainable/ circular manner by means of various actions, initiatives and financial incentives.



Figure 3.7 – Population in the municipality of Rotterdam, January 1 (Gemeente Rotterdam, 2020c, based on CBS, 2020a).







Where the national government has made a clear choice to increase sustainability by signing the Paris Agreement, homeowners do not (yet) feel the same urgency, even if (financial) incentives are given. According to BouwhulpGroep (2020), the demand from private individuals must be fed with knowledge about their home and knowledge about a suitable offer and how it benefits the resident. This facilitating role lies with municipalities, which can fulfill its role as a supporter of homeowners by organising the components and renovation solutions (BouwhulpGroep, 2020).

Examples of such (component classification) pilot projects in Rotterdam are the neighborhoods Het Lage Land and Prinsenland. These two areas were selected based on: number of owner-occupied homes, number of terraced houses, number of houses built before 1980 and the average disposable household income (Snoo & Oung, 2020). Using these selection criteria, the two neighborhoods were chosen because they contained a large number of homes suitable for the implementation of energy-saving measures and whose population was neither too rich nor poor (Snoo & Oung, 2020). The municipality has asked BouwhulpGroep (2020) to map out how the housing stock is built up for these neighborhoods (based on quality) and which steps are needed to make them more sustainable. With the results of this analysis, the municipality of Rotterdam should be able to initiate follow-up activities in the neighborhoods, for example, by initiating CSCC. By arranging the district according to a clear layout, supply and demand can be brought together before actually planning a sustainable renovation. The form of ownership can lead to a different approach, but it would be good to learn from each other how to improve the homes. After all, from a technical point of view it concerns the same houses and components, only the way they are handled differs (BouwhulpGroep, 2020).

3.5.2 Rotterdam Sustainability Compass

In December 2019, the Municipality of Rotterdam published the Sustainability Compass (Duurzaamheidskompas), in which all ambitions in the field of sustainability in Rotterdam are listed and an overview of all relevant policy documents are given (Gemeente Rotterdam, 2019a). The Sustainability Compass contains the objectives that Rotterdam is pursuing for the period 2030-2050 in the field of sustainability; how the transitions in this field can be brought closer together and how they can be integrated so that they reinforce each other and how the city will get closer to realising the ambitions (Gemeente Rotterdam, 2019a). Despite the fact that the COVID-19 crisis is a hard setback for the economy and society, Rotterdam's sustainable course remains intact. In December 2020, the municipality published a renewed compass which, shows the way to a sustainable city (Gemeente Rotterdam, 2020a). The Sustainability Compass is a living document that will have to be updated regularly.

The sustainable goals of the Municipality of Rotterdam can be divided into ambitions on four themes: energy transition, transition to a CE and the creation of a healthy and climate-proof living environment (Gemeente Rotterdam 2020a). The four ambitions have a major influence on each other and must be pursued in an integrated manner. Table 3.5 shows how the municipality has translated the national and international targets with regard to circularity into Rotterdam targets and which indicators are important for the coming period.

To achieve the goals described and regarding CSCC, Rotterdam has to work together and support circular initiatives and collaborate with partners on different policy levels. On a national scale, the Municipality of Rotterdam is affiliated with Platform CB'23 (Platform CB'23, 2019a), Beton Agreement (Betonakkoord, 2021), 'Samen Versnellen' program (Cirkelstad, 2021), Opdrachtgeversforum (Opdrachtgeversforum, 2021), BTIC (BTIC, 2019) and City Deal (iCircl, 2020b). On a provincial scale, the city is involved in Verstedelijkings alliantie Zuid-Holland (Ruimte + Wonen, 2021) and on a

Table 3.5 - Translation of (inter)national circularity targets into Rotterdam targets (based on Gemeente Rotterdam, 2020a, p. 8).

(Inter) national goals	Translation to Rotterdam goals	Main indicator for the coming period
National waste policy: 75% re-use and 100 kilograms of residual waste per person in 2020.	In 2030, circularity is very normal and we will have halved the use of primary raw materials. In addition, 3,500 to 7,000 jobs have been created that contribute directly to the circular economy.	The waste separation percentage of household waste has increased from 30.8% in 2018 to 45% in 2023.
30 kilograms of residual waste per per-son in 2025.	In 2050, Rotterdam society will be completely circular: material loops are closed.	Reduce the amount of residual waste from 296 kilograms in 2018 to 249 kilo-grams in 2022.
A fully circular economy by 2050.		At least 40 new circular initiatives will have been realized in the city by 2023.

municipal scale in Circle City Rotterdam (iCircl, 2020a). These are a number of partners within the Rotterdam network related to the circular construction sector. These mentioned initiatives and partners are explained in Appendix VI.

Collaboration with other authorities is essential in creating the right conditions. Partners within the region, within central government and internationally will therefore be involved in the ambitions. With the Rotterdam Climate Agreement, the city has taken a flying start by connecting businesses, housing corporations and governments in a network and making agreements about how they can capitalize on opportunities together, link activities intelligently and utilize economies of scale. However, this agreement focuses on the theme of climate adaptive, but such a network must also be created with regard to the circular ambitions. The municipality wants to insulate 100,000 homes, replace inefficient appliances and would like to scale up circular renovation of the existing housing stock (Gemeente Rotterdam 2020a) and wonder what role they could play in initiating (local) CSCC to achieve these goals.

3.5.3 Program Rotterdam Circular 2019-2023

Despite the fact that all four goals from the Sustainability Compass are coherent and must be tackled in an integrated manner, this study focuses on the ambition 'circularity', and in particular on circular housing renovation. Rotterdam aims to handle products and raw materials in such a way that as little waste and harmful substances as possible are emitted, whereby the benchmark is circular by 2030 (Gemeente Rotterdam, 2020b). Together they must start using more sustainable products with a longer lifespan, reusing products where possible and making new products from 'waste'. In the long run, waste should no longer exist in society, which means that Rotterdam as a city must make the switch from an LE to a CE. As one of the additions to the Sustainability Compass, the 'Rotterdam Circular Program 2019 – 2023' (Gemeente Rotterdam, 2019b) has been drawn up, which describes the circular ambitions of the municipality. This program also expresses the ambition half the use of less primary raw materials in the city by 2030. The circular ambitions of the city are divided into four key sectors: green flows, healthcare, consumer goods and construction. This research focuses on the construction sector, which is one of the least efficient sectors to date and where the greatest gains can be made when it comes to circularity (Municipality of Rotterdam, 2019b). The Municipality of Rotterdam also recognises this need and wants to stimulate circular construction and renovation, by extending the lifespan of the existing home and building stock and by efficiently recycling and re-using released (demolition) material.

Without changes in behavior, the demand for a large number of primary raw materials far exceeds the supply. The best way to accelerate the transition to a CE is being developed with the knowledge, experience and inspiration of a network of parties (Gemeente Rotterdam, 2020b). This program also mentions the importance of CSCC. You can only achieve a circular city by working together within the municipality, with companies, with organisations and residents.

3.5.4 Circular instruments within Rotterdam policies

Currently, the city of Rotterdam contributes 20% to CO₂ emissions throughout the Netherlands. (Energieswitch Rotterdamse Klimaat Alliantie, 2019b). For this reason, the city council took the initiative in early 2019 to draw up a Rotterdam Climate Agreement together with companies and civil society organisations (Energieswitch Rotterdamse Klimaat Alliantie, 2019b). Under the leadership of five independent chairmen, the participants in five Rotterdam climate tables (Port & Industry, Built Environment, Mobility, Clean Energy and Consumption) have worked out 50 'climate deals' that provide a boost for the low-carbon economy. The measures show that in ten years' time Rotterdam will halve the emissions of CO₂ and other greenhouse gases. The Rotterdam Climate Agreement contains among other things large-scale insulation of Rotterdam homes. In the report of the Climate Table for the Built Environment (Energieswitch Rotterdamse Klimaat Alliantie, 2019a), a number of goals are set, including making 15,000 homes more sustainable and

making 10,000 homes gas-free. In addition, the larger housing associations are developing a circular approach for their own property. Collaboration is required to achieve these goals. This is why the climate table Built Environment consists of a number of driven Rotterdammers from both the business community and the municipality who are engaged in formulating objectives and developing ideas. In order to make homes more sustainable and natural gas-free, it will be the real estate owner who has the task of making the necessary investment decisions. With 40% of the housing stock, housing associations play a crucial role and are also seen nationally as the 'starter' of the energy transition (Energieswitch Rotterdamse Klimaat Alliantie, 2019a). In addition to the housing associations, it is the Owners' Associations (VvE in Dutch) and the large private landlords who have been approached from the table because of their size.

In the coming years, the municipality wants to remove legal and regulatory obstacles for circular initiatives, which also concerns raw material flows in the construction industry (Gemeente Rotterdam, 2019b). As a municipality, Rotterdam is also a permit issuer and can give direction to the circular ambitions by issuing building, renovation and demolition permits. To measure the progress of more circularity in the city, Rotterdam will research the progress on the basis of the set goals. They will also look at what is going on in the city and what residents and companies require to act in a circular manner. To these interests and needs of the Municipality, this research will be relevant and could make a contribution to their research, which could lead to tightening up of the plans, more structured management of SCC and better communication between municipality and city (Gemeente Rotterdam, 2019b).

One of the most important instruments for achieving circular goals is the Municipality of Rotterdam's own purchasing and tendering policy. As a client, Rotterdam will introduce circularity as a criterion for tenders (Gemeente Rotterdam, 2019b). Circular procurement is a main part of the Socially Responsible Procurement Action Plan (Pianoo, 2016) in Rotterdam. This plan links circularity to sustainability and society, in order to also increase (social) employment.

Another important instrument for the transition to a CE is the management of the municipality's own assets. For various assets in the city, including public space, actions have been established to design circularly and experiment with the preservation of the value of objects and materials in all phases of life: the development phase, the use phase and the reuse phase (Gemeente Rotterdam, 2019b). Storage sites are needed for the 'upcycling' of promising flows such as soil, green waste and building materials. As a result, the raw and material chains will be closed and will become circular. Implementing circular principles in public spaces and municipal buildings is believed to increase awareness among private homeowners. By setting a good example as a municipality itself, this will be brought to the attention of the residents.

The municipality's vision for 'Public Space 2018 – 2028' (Gemeente Rotterdam, 2019c), in which circularity is one of the perspectives, is another strategic instrument that provides insight and direction into the relationship between all aspects that influence the physical living environment. Based on this vision, the 'Rotterdamse Stijl' (Gemeente Rotterdam, 2010), the guideline for the design of public space, has been updated and CE principles have been integrated. The Rotterdamse Stijl is intended to contribute to Rotterdam as an attractive living and working city with a well-designed outdoor space and the use of estethic materials. It provides peace, unity and recoginsability in the public space of Rotterdam. The guidelines of the Rotterdamse Stijl are described in a manual and a toolkit. The toolkit includes the products that can be recycled in a 100% high-quality manner. Ultimately, when ordering products and materials, this environmental tool should be able to measure the environmental impact, so that the most circular-proof and energy-efficient products can be chosen (Gemeente Rotterdam, 2010).

3.6 Conclusion

Research into the state-of-the-art has shown that in Europe as well as in the Netherlands, in the province of South Holland and in the city of Rotterdam, there are still many opportunities for housing renovation with the implementation of circular principles. Single-family home owners represent a large part of the Rotterdam population, which makes it useful and interesting to focus the research on this group. Governments have less influence on the actions of private homeowners, but there are various initiatives and economic incentives that encourage residents to renovate and make their homes more sustainable.

(Inter)national approaches towards the energy and circularity transitions are characterized by a broad mix of instruments and various strategies, policies and measures with which the relevant sectors are working on a low CO₂ built environment. The agreements and strategies on different policy levels discussed in this chapter are listed in Appendix VII. Most strive for a collaborative strategy to achieve reduction of CO₂ emissions, a fully CCE by 2050, in which the importance of CSCC is mentioned. However, according to PBL (2021) the current course in the field of CE is insufficient to achieve previously set goals. When we look at the Dutch context, only 6% of the companies are circular companies. Also, the provinces recognise this problem and see that a fully CE in 2050 is not feasible if we will proceed in the current manner. A circular city can only be achieved by working together with municipalities, market parties, knowledge institutions and residents.

It is assumed that these (inter)national agreements and programs will have a positive influence on the achievement of energy saving and circularity targets. In addition, these programs contribute to the facilitation of energy efficient renovation and the removal of barriers in the energy transition and circular processes. However, despite these programs, renovation rates have not risen enough to achieve the (inter)national energy and circular targets. Currently available processes and techniques are not yet sufficient or financially feasible to achieve the (inter)national goals and will not materialise as long as the society in which they are to be implemented does not accept them. In addition, for the realisation of innovative solutions like circular renovation, communication, affordability and scalability are essential.

According to the report by PBL (2021), the number of Dutch companies and organisations that target the CE is increasing. Besides, the majority of these companies focus mainly on recycling, repair and reuse of materials, which already existed before the discussion about the necessary circular transition started. There is still insufficient attention for innovative strategies and business models that can drastically reduce the use of fossil fuels. According to PBL (2021), the current Dutch economy moves and functions too much in a linear society.

As can be seen in the X-curve model (Figure 3.5, p. 45), the Netherlands is in the formative phase of the transition to a CCE. Typical characteristics for this phase are creating new actor networks and relationships in CSCs, learning and experimenting with circular products and services and developing future visions. In addition, this phase is also working on a new generation of business models: collective, cooperative, sustainable, circular and on the basis of cascading forms of value creation. Value creation in closed cycles revolves around the value retention of raw materials and products within those cycles. What is important at the moment is to take the step to the growth phase, where the urgency of the transition increases and stakeholders within the SC start working together effectively. Rogers' Innovation Theory provides important insights into how this step could be achieved and will be explained in more detail in section 4.1. Table 3.6 provides an overview of the characteristics of the formative phase of the transition (which will form the main research variables in Chapter 4) with the related state-of-the-art in the Dutch context. This table shows what is currently required to be able to take the next step towards the growth phase of the transitions towards a CCE. Based on this analysis, the next chapter will delve deeper into the aspects that are now identified as urgent for CSCC in order to scale up circular owner-occupied housing renovation. In sections 4.2- 4.5, each research variable will be theoretically substantiated and corresponding research indicators will be identified.

Table 3.6 – Overview of characteristics of the formative phase of transition with state-of-the-art in Dutch context (own table).

Research variables	State- of-the-art of each characteristic, related to CSCC for private home renovation in Dutch context
Actor networks	In the Netherlands, different initiatives are taken (discussed in section 3.4), which will stimulate CSCC in their own way, by, among other things, inspiring entrepreneurs, informing them, bringing them into contact with other entrepreneurs and guiding them with expertise and knowledge, often by using online platforms. However, these initiatives are mainly designed for national government, municipalities, supplying industries and knowledge organizations, and do not yet involve private homeowners sufficiently. In a CE, consumers, like private homeowners, could be an essential part of the SC. It is assumed that the majority of this target group is also insufficiently or not aware of the development of such actor network initiatives and that CSCC is not yet present in practice for private home renovation.
Supply chain learning	In general, learning networks are well established in the Netherlands. A great deal of knowledge is already being developed by universities and knowledge institutions, whether or not in collaboration with private parties. However, a distinction must be made between fundamental and practical knowledge development. BZK considers the link with practice or the applicability of the knowledge developed to be important for both. However, it is expected that these steps in knowledge development and upscaling will be less likely to be taken by private clients and local entrepreneurs, like handymen. This group of individuals is difficult to reach, but it is important in the long process towards a CCE and within CSCC. In this research I will focus on the private homeowner as a client, which will therefore contribute to the knowledge and developments that are already present.
Future visions	Visions regarding the realization of a Dutch CE have also been established. However, sometimes these visions are still quite abstract. One of the recommendations of PBL (2021) to realize a CE is to develop detailed visions that are supported by private parties and social organizations and to develop this into concrete ambitions. These ambitions may differ per transition, which requires a several different approaches. It is assumed that more detailed future visions, supported by (local) private parties and social organizations, will have a positive effect on (local) CSCC and the achievement of a Dutch CCE.
Circular business models	The current development of circular business models is still facing several challenges. Most of the circular business models used have been created in a linear environment. They are aimed at the company's own business operations in terms of raw material use and product design and are only aimed at the use of new revenue models to a limited extent. The consequence of this is that there is still insufficient CSCC or joint business models .

It is abundantly clear that collaboration and partnerships within CSCs are required to achieve a CCE by 2050. The entire chain, including policy makers, knowledge institutions and market parties, must work together to make subcategories in the construction sector (like housing) successful in the transition to a CE. Because this research is conducted from a management perspective, I will investigate how collaboration within SCs of circular renovation can be (better) facilitated by municipalities to achieve the desired upscaling of circular renovation of Dutch owner-occupied housing.

theories and concepts.

This research will investigate how SCs, including (local) governments, could innovate regarding the transition towards a CCE. What has become clear in the previous chapter, is that the transition to a CCE is still in the (formative) innovative phase. Therefore, the first part of this chapter (4.1) will focus on adoption of innovation in practice, including a reflection on Rogers' Innovation Theory from which the X-curve model (Figure 3.5, p. 45) has emerged. The second part of this chapter (4.2-4.5) will show which relevant (additional) theories and concepts are known in literature about the other research variables following from the analysis of the state-of-the-art: actor networks, supply chain learning, future visions and circular business models. It is assumed that these are the most important components for municipal support. Each section will end with identified research indicators that will be used in the development of the theoretical framework. This framework, shown in the conclusion (4.6), will be used as guidance for the stakeholder analysis (Chapter 5) and to reflect upon in the discussion of this research (Chapter 6).

The purpose of identifying these relevant research indicators is to address the aspects that are currently required to be able to take the next step towards the growth phase of the transition (following from Table 3.7) and to find out what the role of municipalities could be in this process. This chapter will elaborate on the aspects that are now identified as urgent for CSCC in order to scale up circular owner-occupied housing renovation and will provide an answer to the second sub-question: which factors are needed to facilitate CSCC according to literature?

4.1 Adoption of innovations in practice

4.1.1 Approaches of innovation

In conclusion from the analysis into the state-of-the-art, the transition to a Dutch CCE is still in the (formative) innovative phase. Many definitions of innovation can be found in literature. In order to arrive at a consistent framework that fits municipalities actions to facilitate CSCC, I will first compare some definitions of different authors.

The word innovation is originally derived from the Latin word 'innovare' (Gopalakrishnan & Damanpour, 1994). According to Rogers (1962, p. 12), innovation is "an idea, practice, or project that is perceived as new by an individual or other unit of adoption". Fagerberg, Mowery and Nelson (2006, p. 149) define innovation as "the creation of something qualitatively new via processes of learning and knowledge building. It involves changing competences and capabilities and producing qualitatively new performance outcomes." As cited in Mlecnik (2013, p. 104), innovation is defined by Slaughter (1998) as "the actual use of a non-trivial change and improvement in a process, product, or system that is novel to the organisation that developed it." Moreover, Mlecnik (2013) concludes from literature research that innovation is not only about the development of knowledge, but that the process of implementing this knowledge is also essential. His research shows that innovation encompasses the entire process, from knowledge development to market production. Similarly, Ziegler (2017, p. 389) says "innovation is not simply having a new idea but carrying it out in practice. As such, innovation is an inherently social process, requiring interaction with others: social processes of discussion, group formation, and networking. Thus, innovation is "the development and delivery of new ideas and solutions at different socio-structural levels that intentionally seek to change power relations and improve human capabilities, as well as the processes via which these solutions are carried out." (Nicholls and Ziegler, 2015; as cited in Ziegler, 2017, p. 391).

Defined by Ling (2003, p. 1), "innovation is a new idea that is implemented in a construction project with the intention of deriving additional benefits although there might have been associated risks and uncertainties." In comparison with Roger's definition of innovation; he argues that innovation is not only about a new idea, but that it can also be a practice or project that is perceived as new (Rogers, 1962, p. 12). Innovation should not only be seen as developing a new idea, change or improvement, but as the entire process including the implementation of these ideas, changes or improvements (Rogers, 1962; Mlecnik, 2013; Nicholls and Ziegler, 2015; Ziegler, 2017). Several authors agree on this, including West, Hirst, Richter and Shipton (2004, p. 271) who define innovation as "the development and application of ideas in practice (e.g. for new and improved products, services or ways of working)". West and Farr (1990) take a step further and look at innovation in relation to organisation and management. "Innovation is the intentional introduction and application within a job, work team or organisation of ideas, processes, products or procedures which are new to that job, work team or organisation and which are designed to benefit the job, the work team or the organisation" (West & Farr, 1990; as cited in West et al., 2004, p. 271).

The continued use of slow-dissipating resources raises concerns and increases the demand for a more sustainable society. Innovation in which a holistic view of sustainability is integrated is referred to in literature as sustainable oriented innovation (SOI) (Brown et al., 2019). For SOI, network-building and creative entrepreneurial processes are required (Allen & Potts, 2016). The difference between traditional innovation and SOI is that, within SOI, companies can be a key factor in the transition to a more sustainable society. In doing so, they will have to change their activities in a strategic way, pursuing sustainable growth through innovative solutions (Klewitz & Hansen, 2014). Because the value of companies is changed in this way; creating purposeful economic, social and environmental values, SOI goes one step further than traditional innovation. A key success factor that plays a role in achieving SOI is cooperation within and between organisations (Medeiros, Ribeiro & Cortimiglia, 2014). This is required, because larger sustainable innovations must also work at the system level. However, this cooperation will increase complexity.

Circular oriented innovation (COI) is a relatively new topic in the literature and has emerged in the field of sustainability. Research into CE has increased considerably in recent years (Brown, Bocken & Balkenende, 2019). Many authors try to define CE, to indicate its exact definition and why it is so important now. The main goal of COI is to manage product obsolescence and maximise product integrity through design. To achieve this, specific information and knowledge about

design strategies within CE is required. Innovators must design at an early stage with this necessary information and these requirements. So, a knowledge network with involved stakeholders throughout the innovation process is of great importance. Brown et al. (2019, p. 3) defines COI as "the coordinated activities that integrate CE goals, principles, and recovery strategies into technical and market-based innovations, such that the circular products and services that are brought to market purposively maintain product integrity and value capture potential across the full life-cycle." So, like innovation in construction and SCs, SOI and COI also require active leadership and diverse collaboration networks to develop sustainable business models at network level (Williams, Kennedy, Philipp & Whiteman, 2017; Lüdeke-Freund, Gold & Bocken, 2018).

It is striking that several authors agree that innovation should not only be seen as developing a new idea, change or improvement, but that the entire process (including implementation), falls within the definition of innovation. So, drawing conclusions from literature, this thesis approaches innovation as a social process from development to implementation of new ideas, knowledge and solutions at different social-structural levels.

4.1.2 Adoption of innovation

In both practical and academic terms, it is assumed that the effectiveness of an organisation requires innovation (Damanpour & Schneider, 2006). Literature research by Damanpour and Schneider (2006) shows that on the one hand the adoption of innovation by scholars is described as a multiphase process, while empirical studies show that adoption of innovation is more seen as a single phenomenon. As defined by Damanpour and Schneider (2006, p. 216), "adoption of innovation basically means that the innovation is new to the adopting unit; it intends to derive anticipated benefit from changes that the innovation may bring to the organisation."

In the famous book Diffusion of Innovation, the author Rogers (1962) discusses his theory of diffusion and adoption of innovation. Rogers (1962, p. 11) describes diffusion of innovation as "the process by which an innovation is communicated through different channels over time among the members of a social system". He describes adoption of innovations as "a decision to use and implement a new idea" (Rogers, 1962, p. xix). In his book, he mentions the adoption model, which is a marketing model of the life cycle of an innovation. Rogers (1962) distinguishes five stages, in which five different groups are subdivided that accept the product or the new idea. Figure 4.1 shows the adoption process of a new product in his adoption model. The five categories are: Innovators, Early adopters, Early Majority, Late Majority and Laggers.



Figure 4.1 - Adoption process of a new product in Rogers' adoption model (Rogers, 1962).

As mentioned in the previous chapter, the transition to a CCE, in particular the private home renovation sector, is currently in the formative phase dealing with the Innovators. When a topic, idea or plan is created, it is initially created or accepted first by this first category. Within an organization, there is often a small group of people who are the first to become enthusiastic about the idea and also want to try it out or translate it into a concrete plan with a time schedule. This small group of people is the first to try out the product or idea and are willing to take risks. This exclusive user group is therefore a 'trendsetter'. After that, the product gains increasing popularity and is purchased more. In the X-curve model (Figure 3.5, p. 45), this next phase is called the growth phase.

In contrast to Rogers (1962), who looks at innovation from a communication perspective, Moore (2014) looks at innovation from marketing and product design perspective. In his book Crossing the Chasm (1991, revised 2014), Moore focuses on marketing high-tech products during the early stages. Crossing the borders between the different stages of adoption is where the success of a product or idea lies (Rogers, 1962). However, Moore (2014) states that the transition phases from the Innovators to the Early Adopters and from the Early Adopters to the Early Majority group are two of the pitfalls in the innovation process.

The focus in this research will be on crossing the 'smaller chasm' between the Innovators and the Early Adopters (or according to the X-curve model: between the formative and growth phase). Because the group of Innovators is relatively small (2,5%), the graph of large-scale diffusion of innovation is often S-shaped (Ortt & Schoormans, 2004; Rogers, 1962). The innovation must be accepted by the Early Adopters at an early stage, because before this acceptance, the innovation will remain in its first phase (by the Innovators), in which the innovation is adopted in such a way that it no longer contains spreading of barriers on a large scale of diffusion (Ortt, Langley & Pals, 2013; Ortt & Schoormans, 2004). As the steep graph in Figure 4.2 indicates, after the Innovators start to believe in the innovation and the Early Adopters also gain confidence in it, the innovation accelerates. The actual diffusion of the innovation 'takes off' in this phase of the process. Once the innovation has passed this 'chasm', one can almost be sure that there will be a continuous spread of the innovation (Morrison, Roberts & Midgley, 2000; Larson & Meyer, 2006).



Figure 4.2 – The smaller chasm; the 'take off' of the diffusion of an innovation (Larson & Meyer, 2006, p. 81).

The reason why the accelerated diffusion 'takes off' when the Early Adopters believe in the innovation has to do with difference in thinking and doing between the Innovators and the Early Adopters. Innovators are viewed by others as individuals so different from the rest in the social system that they have difficulty exerting great influence on the rest of the social system. Innovators have more access to the mass media, which gives them the means to seize opportunities for innovative ideas. This group is also often more capable of understanding the new (complex) knowledge and applying it in practice. Furthermore, Innovators can deal more easily with uncertainty that an innovation can entail, and they make contacts outside the local social system more easily (Rogers, 1962). In contrast to Innovators, Early Adopters

are influential because this group contains a large number of opinion leaders who are respected and trusted within the system, giving them great persuasiveness. Opinion leaders are seen as advisers on which innovations should or should not be applied in practice. When there is an overlap between the opinion leaders and the Early Adopters, the acceleration of the diffusion will take off (Morrison, Roberts & Midgley, 2000; Larson & Meyer, 2006) and the 'smaller chasm' between the Innovators and the Early Adopters will be crossed.

Within this research, I will adopt Rogers's communication perspective, because, as mentioned earlier, several authors (Miozzo & Dewick, 2002; IMSA Amsterdam, 2013; Mlecnik, 2013b; ARUP, 2016; Geldermans, 2016; Adams et al., 2017) agree that networking, joint vision formation and supply chain learning are of great importance for the development of an innovation. Collaborations and building social and active actor networks will go hand in hand with internal and external communication. Rogers (1962) agrees on this and states that communication networks are of great importance in the diffusion process of innovation.

In addition to Roger's adoption model, there is the innovation-decision model (Rogers, 1983; as cited in Wani & Ali, 2015). This model states that the following stages of the decision-making process and information collection are related to adopting an innovation: **knowledge, perssuassion, decision, implementation and confirmation phase** (Rogers, 1983; as cited in Wani & Ali, 2015). "Innovation-decision process is essentially an information-seeking and information-processing activity in which the individual is motivated to reduce uncertainty about the advantages and disadvantages of the innovation" (Rogers, 1983; as cited in Wani & Ali, 2015 p. 110).

Whether or not to adopt an innovation is influenced by communication (Rogers, 1962; Morrison, Roberts & Midgley, 2000; Larson & Meyer, 2006). Communication means that a message from the sender (source) is sent through a channel to a receiver. During communication activities, a potential adopter goes through a decision-making process before the innovation is adopted and includes awareness, interest, evaluation, trial and ultimately adoption. Examples of resources used as information sources and communication channels are mass media, opinion leaders (Koebel, Papadakis, Hudson & Cavell, 2004), temporary pop-ups, permanent consultancy centers (Meijer et al., 2018) and one-stop-shops (Mahapatra et al., 2013). In the **knowledge phase**, mass media channels (e.g. flyers, websites, news messages) are of great importance, while in the **perssuasion phase**, interpersonal channels are more crucial (Morrison, Roberts & Midgley, 2000; Larson & Meyer, 2006). Interpersonal communication can be beneficial because this communication often takes place between two people, where immediate feedback can be given and received. Risks and uncertainty, which mostly accompany innovations, are more likely to be reduced through interpersonal communication than through mass media (Larson & Meyer, 2006).

According to Rogers (2003), individuals with high interpersonal influence are opinion leaders. They can informally influence the attitudes of other individuals towards innovation. Rogers (2003) sees opinion leadership as a purposeful diffusion strategy. He describes opinion leaders with the following three characteristics. First, opinion leaders gain credibility because, unlike their followers, they have more access to mass media. Second, opinion leaders are accessible to their followers, because of their many interpersonal networks and their social participation within organisations. And last, opinion leaders are often not the innovators, but the individuals who develop the innovations. In this research I regard municipalities as opinion leaders, assuming that they can play a facilitating role in supporting innovation adoption on local scale. I will investigate how SCs, including (local) governments, could innovate regarding the transition towards a CCE and which and how supporting activities from the municipality could help (local) CSCC development to achieve upscaling of circular renovation. After the stakeholder analysis, I will reflect in Chapter 6 (Discussion) on the role of the municipality and how they can contribute as an opinion leader to crossing the chasm between the Innovators and the Early Adopters.

Furthermore, effective communication is essential to increase the likelihood of innovation adoption, which includes formal and informal communication, communication between users and suppliers, communication through demonstrations of new technologies and communication between both internal and external stakeholders (Koebel et al., 2004). Indirect communicative relationships are beneficial for the diffusion of innovations. In addition, a potential adopter is more likely to invest in an innovation when information about competitors is available, as this will increase the profitability estimates of innovations (Koebel et al., 2004).

Employees in an organisation are seen as key success factors of internal communication (Borca & Baesu, 2014), which is a fundamental part of a successful organisation (Hume and Leonard, 2013). Internal communication creates a confidential

and open and trusted atmosphere within the organisation in which all employees are accepted and understood and through which the exchange of knowledge and ideas within the organisation is possible (Jacobs, Yu & Chavez, 2016).

Within an organisation, it is important to regularly inform employees about the current state-of-the-art with regard to corporate policy and organisational goals and to support and help employees understand them (Borcaa and Baesu, 2014). Organisational effectiveness is influenced by internal communication, including information transfer between different stakeholders. Through open communication, both feedback and feedforward, and making the decision-making process accessible, internal and external relationships are built and maintained (Jacobs et al., 2016). In order to contribute to the success of the organisation and to achieve the management objectives, managers must inform employees at all levels of the actions that are being taken, because effective communication with employees will positively influence the outcomes of the organisation (Borcaa & Baesu, 2014). The higher the level of internal communication within an organisation, the more efficiently problems are solved and the greater the satisfaction of the employees and engagement of consumers (Jacobs et al., 2016).

In addition to internal communication, external communication is also important for the success of an organisation and involves collaborations between a company or organisation and its downstream consumers and upstream suppliers (Jacobs et al., 2016). To manage a synchronized process, they have common goals and schedules and exchange information and knowledge strategically (Zhao et al., 2011). By entering into relationships with external trading partners, consumers and suppliers, the scope is expanded, and strategic developments can jointly benefit from market opportunities, which will result in maximum success and stakeholders' values (Zhao et al., 2011). Furthermore, effective and cooperative relationships between buyers and sellers are essential for the diffusion of innovations on a large scale (Koebel et al., 2004).

In today's dynamic market, SCs need to be effectively aligned to compete. To achieve this successfully, cross-functional integration within an organisation and external integration with consumers and suppliers are required (Zhao, Huo, Selen & Yeung, 2010). With SC integration is meant "the degree to which a firm can strategically collaborate with its trading partners and collaboratively manage intra- and inter-organisation processes to achieve effective and efficient flows of products and services, information, money, and decisions with the objective of providing maximum value to customers at low cost and high speed" (Zhao, Huo, Flynn & Yeung, 2007, p. 18). SC integration includes the sharing and transfer of knowledge, information and data across organisational levels, the collaboration between different actors and functions in the organisation and the coordination of additional logistics tasks (Zhao et al., 2011). Effective internal communication provides various benefits for the success of an organisation, such as building a trusted network, creating relational norms and exchanging knowledge (Jacobs et al., 2016). Strategic management of this communication is required for a successful organisation (Hume and Leonard, 2013).

4.1.3 Stakeholders and interactions within the construction industry

Research into innovation in construction shows that the construction industry distinguishes itself from other areas of industry by specific requirements such as collaboration, communication and inter-organisational relations (Harty, 2005). The construction industry deals with many stakeholders and interactions at various levels, which also relates to the innovation process (Bygballe & Jahre, 2009). Figure 4.3 is taken from the research by Blayse and Manley (2004) and shows the main stakeholders within the construction industry and that an active network between them is required. According to Geels and Kemp (2007), all these stakeholders have different views, goals and interests which results in complex dynamics. Previous studies have shown that skepticism and mistrust are characteristics of the construction industry, which can result in conflicts between the different stakeholders (Bygballe & Ingemansson, 2014). Based on this model, I will analyze the relations between the Municipality of Rotterdam and the different stakeholders who participated in this research in Chapter 6 (Discussion).

Furthermore, the construction industry is known as an archetypal network, in which several stakeholders work together on one project (Miozzo & Dewick, 2002). The more stakeholders are involved in a project, the more the complexity increases and the more interdependencies and different interfaces there are between these stakeholders, tasks and parts, which must be managed in an efficient way for the innovation to succeed (Bygballe & Ingemansson, 2014). An innovation is therefore not implemented in one organisation, but in a multi-actor project. This means that negotiations have to take place between several stakeholders within a project coalition (Winch, 1998). To understand and ensure the innovation succeeds in the construction industry, building a network consisting of relationships and partnering across the project and company boundaries is essential (Bygballe & Ingemansson, 2014).



Figure 4.3 – The main stakeholders within the construction industry (Blayse & Manley, 2004).

However, Adams et al. (2017) states that the structure of the construction industry faces multiple obstacles, including a fragmented context and SC. This fragmentation is partly caused by the different relationships between stakeholders and because organisations move from one project to another. This makes it difficult to discover where the motivation to innovate lies and where the resources must come from to start the innovations (Davidson, 2013). To reduce these obstacles, it is important that cooperation takes place where knowledge can be shared, that people can learn from prototypes and demonstration projects, and that suppliers connect in innovation teams (Mlecnik, 2013b).

Other characteristics within the construction industry that influence the promotion or hindrance of innovation can be divided into contextual and organisational characteristics (Bygballe & Ingemansson, 2014). Blayse and Manley (2004) have investigated the most important factors driving or hindering construction innovation. This study shows, among other things, that regulatory environment (contextual characteristic) has a lot of influence on innovation. Organisational characteristics include project organisation (Slaughter, 2000), duration of relationships between companies (Dubois & Gadde, 2000) and SC integration (Adams et al., 2017; Akintoye, McIntosh, & Fitzgerald, 2000). Miozzo and Dewick (2002) see these organisational characteristics primarily as innovation inhibitors.

4.1.4 Systemic supply chain innovation

Innovation in the construction industry is generally slower than in most other sectors (Akintoye, McIntosh & Fitzgerald, 2000). Construction projects are mostly complex, systemic and not autonomous (Dubois & Gadde, 2000). According to Davidson (2013), due to the necessary interactions between the business environments of construction and SC, SC innovation belongs to systemic innovation (i.e. involving stakeholder cooperation and coordination in innovation processes). The SC can be seen as a key player within the development and process of systemic innovation in the housing sector (Mlecnik, 2013b). According to Mlecnik (2013b, p. 104) "A shift towards more systemic innovation on the part of suppliers would help to prevent systemic failures and quality problems, amongst other things, as it would involve more adequate enterprise resource planning, service design thinking and the prefabrication of product/service component systems."

In the study by Ceschin and Gaziulusay (2016), a distinction is made between three strategies, in which the degree of sustainable transformation is increasing: innovations at product, company and system level. Within SOI, the transition to a CCE is positioned at system level (Ceschin and Gaziulusay, 2016), for which creating dynamic networks of actors, developing circular business models and active leadership are required for the innovation to succeed (Brown et al., 2019).

In addition to the distinction of the three strategies, a SOI or COI can be radical (i.e. discontinuous) or incremental (i.e. building on what exists) (Brown et al., 2019). "The key distinction is whether the innovation is a modification of a previously accepted process, product, service or technology, or whether it is wholly new and disconnected from the current context." (Brown et al., p. 4). As Figure 4.4 shows, radical innovations have more impact on sustainable development at the system level than incremental innovations. However, this also means that the potential effects of radical innovations are less predictable in advance than incremental innovations (Brown et al., 2019). According to De Medeiros, Ribeiro and Cortimiglia (2014), this is related to the need to enter into collaborations and partnerships outside the boundaries of the sector, which is seen as a success factor for SOI and COI. Furthermore, Figure 4.4 shows that COI "requires innovations at all levels (e.g., process, product, organisation, business model) to enable systemic change, but it also requires changes from the firm's strategy, engagement with society, and the way. in which value is created." (Brown et al., p. 4).



Figure 4.4 – Evolution of sustainable oriented innovation and collaboration (Brown et al., 2019, p. 4).

So, in this research, the focus will be on systemic SC innovation, where research will be conducted into collaboration opportunities within SCs of circular renovation of owner-occupied housing and into the role of the municipality to facilitate this CSCC. Arlbjørn, de Haas, & Munksgaard (2011, p. 8) defined SC innovation as "a change (radical or incremental) within the supply chain network, supply chain technology, or supply chain processes (or combinations of these) that can take place in a company function, within a company, in an industry or in a supply chain in order to enhance new value creation for the stakeholder." Because communication and learning networks are of great importance for radical innovation, they fall within the concept of systemic innovation. However, what can also have consequences for systemic innovation are social, business and technological innovations, which falls under incremental innovation, involving systematic interconnection (Mlecnik, 2013b). According to Suurs and Roelofs (2014, p. 9) "Systemic innovations may include elements or combinations of all types of innovations and are, by definition, developed and implemented by many actors. In fact, systemic innovations may even develop from (a combination of) other types of innovation."

4.1.5 Conclusion

In conclusion, this first section of the chapter was aimed at shifting towards a CCE within systemic innovation. The transition towards a CCE requires a new way of thinking; system thinking, as mentioned by the Ellen MacArthur Foundation (2017). "System thinking is the ability to understand how the parts of a system interact to produce the behavior of the whole. It is an enabling tool that can help us identify root causes and implement better solutions, and it provides the lens or frame for our conceptual understanding of it." (Ellen MacArthur Foundation, 2017).

During the current innovative phase of the transition, the key challenge is to adjust the society context; to make investments in environmental-friendly measures, energy efficient and circular renovation usual choices, also for the majority (Hauge et al., 2012). With regard to the main research question, in this research the municipality is regarded as an opinion leader, which will help facilitate the (local) innovation adoption process. Until the market has passed the first introduction phase and innovations have been accepted and adopted by the majority resulting in rapid growth and volume of energy-efficient and circular renovation, municipalities could set an example and have the responsibility to contribute to get to this point. This can be done through an economic contribution, but also through regulation or an incentive. Large organisations, companies and the media are also influential in the introduction phase of energy-efficient and circular to adopting the society context (Hauge et al., 2012).

In conclusion of this section, the identified research indicators for CSCC, resulting from the discussed theories with regard to the development and adoption of an innovation, are summarized in Table 4.1. These indicators are based on facilitating innovation development, assuming that municipalities, opinion leaders, can influence these.

Research variable	Identified research indicator for CSCC		Reference(s)
Innovation	Communication	10x	Rogers, 1962; Morrison et al., 2000; Morrison et al., 2000; Koebel et al., 2004; Larson and Meyer, 2006; Mahapatra et al., 2013; Hume and Leonard, 2013; Borcaa and Baesu, 2014; Jacobs et al., 2016; Meijer et al., 2018
	Exchange of knowledge and information	6x	Mowery and Nelson, 2006; Zhao et al., 2011; Zhao et al., 2011; Mlecnik, 2013b; Jacobs et al., 2016; Brown et al. 2019
	Coordination	5x	Zhao et al., 2011; Davidson, 2013; Williams et al., 2017; Lüdeke- Freund et al., 2018; Brown et al., 2019
	Integration	4x	Akintoye et al., 2000; Zhao et al., 2010; Bygballe and Ingemansson, 2014; Adams et al., 2017
	Trust	Зx	Rogers, 1962; Bygballe and Ingemansson, 2014; Jacobs et al., 2016
	Learning and experimentation	3x	Mowery and Nelson, 2006; Mlecnik, 2013b; Brown et al., 2019
	Openness and transparency	2x	Jacobs et al., 2016; Jacobs et al., 2016
	Alignment	1x	Zhao et al., 2010

Table 4.1 - Identified research indicators regard to the development and adoption of an innovation (own table).

In the following sections, this table will be strengthened and supplemented with indicators related to the other identified research variables (following from Chapter 3): building an active and dynamic actor network, learning between SC actors, sharing future visions and creating circular business models. In this way, the theoretical framework will be developed, assuming that the identified indicators are required in facilitating CSCC and can be influenced by municipalities (as opinion leaders).

4.2 Actor networks

As mentioned in the previous chapter, there are different (Dutch) initiatives to stimulate CSCC. However, it is assumed that CSCC is not yet present in practice for private home renovation. In order to achieve a transition to a CCE, and thus a change in thinking and acting by all stakeholder involved, it is important that the relationships between the different levels and actors are understood. Within this research, and in addition to the innovation theories, the focus will be on

some actor network theories to better understand the different relationships of stakeholders involved. At the end of this section, Table 4.1 will be strengthened and supplemented with research indicators related to actor network theories to facilitate CSCC, assuming that municipalities can influence these.

One of the theories developed to investigate innovation processes is the **Actor Network Theory** (ANT). By using the methodology offered by ANT, changes in social-technical processes can be reconstructed. Based on this, innovations are included in the market or not (Callon, Rip & Law, 1986). ANT confirms one of the earlier findings from section 4.1, namely that one of the success factors for an innovation is the inclusion of actors in a network. In addition, ANT indicates that innovations are related to a network of actors in which individual interests are aligned (Vernay, 2013). Within such an actor network, the actors themselves, their desired behaviors and roles and their size are identified (Callon et al., 1986). "A network is composed of actors and actors cannot act without a network" (Law 1992; as cited in Vernay, 2013).

Furthermore, in analysing the performance of an organisation, it is required to not only examine the characteristics of the individual organisation itself, but what relationships they have with other organisations are also taken into account (Borgatti & Ofem, 2010). "In the network perspective, relations between actors (such as individuals or firms) are the central focus" (Borgatti & Ofem, 2010, p. 18). Within the **Social Network Theory** (SNT) it is stated that interpersonal relationships within a network are based on informality and trust, which reinforces the aforementioned statements about the importance of building trusted networks (Rogers, 1962; Bygballe and Ingemansson, 2014; Jacobs et al., 2016). These confidential interpersonal interactions take place more often between actors within companies and the organisation (inter-firm relationships) than with actors outside of them (intra-firm relationships). Within SNT, 'social embeddedness' is central, which means that norms, values, assumptions and knowledge are shared between the actors within a network (Gordon & McCann, 2000). Besides, the network perspective takes into account the web of relationships that both constrain and provide opportunities (Borgatti & Ofem, 2010).

In addition to ANT and SNT, it is relevant to look at **supply chain management** (SCM) and **supply chain collaboration** (SCC), because this research focuses on the management of collaboration and partnerships within SCs of circular construction. Although there are different definitions of SCM in literature that focus on sustainability and circularity, the essence is the integration of environmental considerations in SCs (Zhu, Geng, & Lai, 2010), which has also been considered important by Akintoye et al. (2000), Zhao et al. (2010), Bygballe and Ingemansson (2014) and Adams et al. (2017) in the previous section.

SCM in this particular research field is about reducing material use and closing material loops, through collaborations between different parties (Zhu et al., 2010). SCM aims to create a SC which presents a "network of organisations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate consumer" (Christopher, 2005, p. 17). This definition of SCs includes the necessary integration between down- and up-stream linkages to optimise the value of the supply, which is required in the construction industry through improving SCs and its management. Furthermore, as the SC as a whole is now responsible for the competitiveness of its services and products for the final consumers, all efforts of the individual organisations aim to increase this capacity. Competitiveness has shifted from individual organisations to entire SCs. When an individual company joins an SC, it will result in a win-win situation in the long run (Kilger & Stadtler, 2008).

According to Lee and Ng (1998; as cited in Kigler & Stadtler, 2008), improving the competitiveness of an SC can be done in two ways: better coordination of financial, information and material flows and/or closer and more efficient cooperation between the stakeholders involved. Within these two ways of improvement, coordination of strategies, overcoming obstacles and accelerating SC flows are central. Kilger and Stadtler (2008, p. 11) define SCM as "the task of integrating organisational units along an SC and coordinating material, information and financial flows in order to fulfill (ultimate) customer demands with the aim of improving the competitiveness of a supply chain as a whole." Similarly, Christopher (2005, p. 5) states that SCM is "the management of upstream and downstream relationships with suppliers and customers to deliver superior customer value at less cost to the supply chain as a whole." So, as also mentioned in the previous chapter coordination is central to SCM (Zhao et al., 2011; Davidson, 2013; Williams et al., 2017; Lüdeke-Freund et al., 2018; Brown et al., 2019), which includes managing relationships and collaborations in order to achieve a competitive advantage and a profitable result for all parties involved. However, SCM also presents challenges, since self-interest of a particular party has to be subsumed for the benefit of the entire SC (Christopher, 2005).

To scale up sustainability and circularity in SCs, literature provides two main approaches: assessment and collaboration (Gimenez and Tachizawa, 2012). Assessment concerns the activities related to the evaluation of suppliers and collaboration focuses on working directly with these supplying parties through support, incentives, training or other activities (Gimenez and Tachizawa, 2012). Assessment is therefore not an isolated aim to increase sustainability and circularity, it also requires collaboration between stakeholders in the SC. In their research Gimenez and Tachizawa (2012) define two factors for upscaling sustainability within SCs: external and internal factors. External factors are, for example, clear objectives in the collaborations and relations between different stakeholders and internal factors include support or senior management and resource availability. Furthermore, Seuring and Müller (2008) have investigated sustainability within SCM and agree with Gimenez and Tachizawa (2012). They define sustainable SCM as "the management of material, information and capital flows as well as cooperation among companies along the supply chain while taking goals from all three dimensions of sustainable development, i.e., economic, environmental and social, into account which are derived from customer and stakeholder requirements "(Seuring & Müller, 2008, p. 1700). Moreover, according to their study, there is a need for a wider network of stakeholders than is usually discussed in SCM literature to scale up sustainability in SCs.

Furthermore, in various literature and theories, elements and indicators of SCC have been identified. Barratt (2004) has divided these elements into cultural, collaborative and strategic elements. One of the key supporting elements of collaboration within SCs is the (organizational) culture in which it takes place (Barratt, 2004). It is assumed that municipalities can influence this organizational culture by initiating an open, transparent and trusted CSC network and facilitating information and knowledge exchange.

So, in this section, several network theories and concepts are explained, which will help in understanding the relationships and collaboration opportunities within SCs. The current construction industry deals with many stakeholders and interactions at various levels, which requires an active network when aiming for systemic innovation. In order to achieve a transition to a CCE, and thus a change in thinking and acting by the stakeholders within this network, it is important that the relationships between the different levels and actors are understood, also by municipalities. They are seen as opinion leaders, where it is assumed that they can support and facilitate CSCC and the adoption of innovations on local scale. Municipalities could, for example, by coordinating and facilitating information and knowledge sharing and by creating an open and trusted communication network, bring local market parties together, which is expected to have a positive effect on local CSCC. Whether both the Municipality of Rotterdam and the local market parties agree with this will be investigated in this research. In conclusion, the identified research indicators resulting from the discussed theories regarding actor networks reinforce and supplement Table 4.1, resulting in Table 4.2. The added indicators are indicated in red.

Research variable	Identified research indicator for CSCC		Reference(s)
Actor networks	Communication	10x	Rogers, 1962; Morrison et al., 2000; Morrison et al., 2000; Koebel et al., 2004; Larson and Meyer, 2006; Mahapatra et al., 2013; Hume and Leonard, 2013; Borcaa and Baesu, 2014; Jacobs et al., 2016; Meijer et al., 2018
	Exchange of knowledge and information	7x	Gordon & McCann, 2000; Mowery and Nelson, 2006; Zhao et al., 2011; Zhao et al., 2011; Mlecnik, 2013b; Jacobs et al., 2016; Brown et al. 2019
	Coordination	7x	Lee and Ng, 1998; Kilger and Stadtler, 2008; Zhao et al., 2011; Davidson, 2013; Williams et al., 2017; Lüdeke-Freund et al., 2018; Brown et al., 2019
	Integration	7x	Akintoye et al., 2000; Christopher, 2005; Kilger and Stadtler, 2008; Zhao et al., 2010; Zhu et al., 2010; Bygballe and Ingemansson, 2014; Adams et al., 2017
	Trust	4x	Rogers, 1962; Borgatti and Ofem, 2010; Bygballe and Ingemansson, 2014; Jacobs et al., 2016
	Learning and experimentation	3x	Mowery and Nelson, 2006; Mlecnik, 2013b; Brown et al., 2019
	Openness and transparency	3x	Jacobs et al., 2016; Jacobs et al., 2016; Barratt, 2004
	Alignment	2x	Zhao et al., 2010; Vernay, 2013
	Win-win orientation	1x	Kilger & Stadtler, 2008
	Clarity	1x	Gimenez and Tachizawa, 2012

Table 4.2 - Identified research indicators regarding actor networks (own table).

4.3 Supply chain learning

In addition to actor networks, supply chain learning (SCL) between various parties and actors involved is another important element within systemic innovation. Quist (2007) assumes that learning influences the mental and cognitive framework of actors. This is especially important for the realisation of the transition to a CCE, because stakeholders are asked to think, and act differently than they are used to. As the state-of-the-art analysis in Chapter 3 has shown, various Dutch learning platforms related to the CCE are already present. However, learning, in this case about circularity and sustainability, does not always lead to change and the necessary activities (Quist, 2007).

In general, learning networks are well established in the Netherlands. A great deal of knowledge is already being developed by universities, colleges and other knowledge institutions, whether or not in collaboration with organisations. However, a distinction must be made between fundamental and practical knowledge development. It is assumed that the municipality can play a facilitating role in both forms of knowledge development. BKZ considers the link with practice and the applicability of the knowledge developed to be important for both (RVO, 2020a). It is expected that these steps in knowledge development and upscaling will be less likely to be taken by private clients and local entrepreneurs, like handymen. This group of individuals is difficult to reach, but it is important in the long process towards a CCE and within CSCC. In this research I will investigate in which ways the municipality can reach this group within the context of local CSCC. In Chapter 6 (Discussion) I will reflect on this. This section will provide a brief overview of success factors of SCL, after which the (additional) research indicators that are expected to have a positive influence on the improvement of CSCC will be given.

For organisations and its SCs it is important to acquire learning abilities in order to survive between competing organisations, at dyadic (1 on 1), firm and network level (Gosling, Jia, Gong & Brown, 2017). As previously stated by Mowery and Nelson (2006), Mlecnik (2013b) and Brown et al (2019), learning and experimentation is of great importance in the introduction phase of innovation development. According to Mariotto (2012), SCL stems from inter-organisational learning, where the focus is on creating collective knowledge through the collaboration of actors within a network. This process suggests analysis at the individual, SC and network level. Bessant and Tsekouras (2001, p. 88) describe a learning network as "a network formally set up for the primary purpose of increasing knowledge", in which learning processes can be analyzed based on reflection, feedback, experimentation and experiences. The network of actors within a SC is such a network (Bessant and Tsekouras, 2001).

According to Spekman, Spear & Kamauff (2002), learning is a key aspect of SC competency, where the SC is viewed as a means for the acquisition of learning and knowledge. They have identified six factors that influence SCL, as shown in Table 4.3: trust and commitment, communication, type of relationship, decision-making style, the ability to learn and absorb knowledge and the degree to which partners ascribe to and support a win-win situation. The study by Spekman et al. (2002) reinforces the previous findings regarding the importance of trusted behavior, communication, learning, knowledge sharing and creating win-win situations within (the facilitation) CSCC.

Furthermore, Lambrechts, Taillieu, Grieten & Poisquet (2012) researched how in-depth SCL can be successfully developed. They define in-depth SCL as "building the capacity to create new knowledge and possibilities together through a process where actors can collectively learn how to rethink and renew their supply chain frame" (Lambrechts et al., 2012, p. 628). Within this study, five aspects were summarized for developing successful SCL, shown in Table 4.4. Lambrechts et al. (2012) indicate that successful SCL can lead to improved relationships between SC actors, mutual understanding, improved innovation processes and increased overall performance of the organisation. It is assumed that municipalities can influence these five aspects, both as policy maker and non-policy maker. After the stakeholder analysis, it will be reflected in the Discussion (Chapter 6) whether the municipality is doing this effectively, according to the participants in the research.

In conclusion, literature on SCL shows that learning by actors and parties involved is a key element in systemic innovation towards circularity and sustainability. However, learning does not always lead to change and the necessary activities. Several SCL concepts were found, each with its success factors described. A distinction must be made between fundamental and practical knowledge development. It is important for both policy makers and non-policy makers to experiment and to apply the acquired knowledge in practice. In this way, lessons can be learned from mistakes and experienced obstacles in practice, after which appropriate solutions can be researched and developed. It is assumed that the municipality, as an opinion leader, could play a facilitating role by supporting and facilitating these experiments, which will be explored in this research.

Factor	Explanation
Trust and commitment	" Trust is the belief that one's partner will act in a predictable manner, will keep his/her word, and will behave in a way that will not negatively affect the other", while " commitment is simply one partner's willingness to devote time, energy, and/or resources to the alliance" (Spekman et al., 2002, p. 44).
Communication	" Communication is an essential ingredient and lies at the heart of information transfer. The frequency, depth and content of information communicated certainly affects what is known" (Spekman et al., 2002, p. 44).
Type of relationship	Learning processes and types of relationships between SC members are "integrative mechanisms that link the partners on a number of dimensions ranging from procurement related decisions regarding inventory levels and manufacturing schedules to more strategic issues related to innovative processes and joint business plans" (Spekman et al., 2002, p. 45).
Decision-making style	"A firm's decision-making processes determine the way partners interact, affect how information is processed, impact the degree of formal versus informal exchanges and interaction, and influence the readiness with which joint knowledge is created and disseminated. Flexible, adaptive, and open organizations are more conducive to highly interactive exchanges, and knowledge transfer" (Spekman et al., 2002, p. 45).
Ability to learn and absorb knowledge	"A culture supportive of trusting behavior, openness, inquiry and experimentation is likely to reap more benefit from these alliances than will a culture that avoids learning alliances because of the potential risks associated with knowledge transfer. Such cultures are open to continuous learning, encourage questioning behavior, and reward working hard to improve the quality and transparency of the information acquired through partnerships and created internally" (Spekman et al., 2002, p. 45).
The degree to which partners ascribe to and support a win-win situation	"A win-win orientation captures the notion that trading parties will hold the tendency to act opportunistically in check and will work hard for the common good" (Spekman et al., 2002, p. 45).

Table 4.4 – Aspects for developing successful supply chain learning (based on Lambrechts et al., 2012).

What?	How?
Interdependent system optimisation and development	Product and quality improvements , a greater market share, a faster 'time to market', product innovations , increased flexibility or strategy development on the level of the supply chain.
Joint competence development	How to improve collaboration and in-depth joint learning in order to keep the system healthy and highly adaptable in the face of an increasing rate of change and complexity?
Creation of unique mutual knowledge and expertise	Sharing knowledge and experiences among different actors within the suply chain and organisation.
Whole system awareness	How the parts of the chain are interwoven and contribute to each other fostering more mutual understanding .
Transforming the essence or identity of the chain	New goals, policies, business models and norms.

The identified research indicators resulting from the discussed theories with regard to SCL reinforce and supplement Table 4.2, resulting in Table 4.5. The added indicators are indicated in red.

Research variable	Identified research indicator for CSCC		Reference(s)
Supply chain learning	Communication	11x	Rogers, 1962; Morrison et al., 2000; Morrison et al., 2000; Spekman et al., 2002; Koebel et al., 2004; Larson and Meyer, 2006; Mahapatra et al., 2013; Hume and Leonard, 2013; Borcaa and Baesu, 2014; Jacobs et al., 2016; Meijer et al., 2018
	Exchange of knowledge and information	10x	Gordon & McCann, 2000; Spekman et al., 2002; Mowery and Nelson, 2006; Zhao et al., 2011; Zhao et al., 2011; Mariotto, 2012; Lambrechts et al., 2012; Mlecnik, 2013b; Jacobs et al., 2016; Brown et al. 2019
	Coordination	7x	Lee and Ng, 1998; Kilger and Stadtler, 2008; Zhao et al., 2011; Davidson, 2013; Williams et al., 2017; Lüdeke-Freund et al., 2018; Brown et al., 2019
	Integration	7x	Akintoye et al., 2000; Christopher, 2005; Kilger and Stadtler, 2008; Zhao et al., 2010; Zhu et al., 2010; Bygballe and Ingemansson, 2014; Adams et al., 2017
	Trust	5x	Rogers, 1962; Spekman et al., 2002; Borgatti and Ofem, 2010; Bygballe and Ingemansson, 2014; Jacobs et al., 2016
	Learning and experimentation	7x	Bessant and Tsekouras, 2001; Spekman et al., 2002; Mowery and Nelson, 2006; Lambrechts et al. 2012; Mlecnik, 2013b; Gosling et al., 2017; Brown et al., 2019
	Openness and transparency	3x	Barratt, 2004; Jacobs et al., 2016; Jacobs et al., 2016
	Alignment	2x	Zhao et al., 2010; Vernay, 2013
	Win-win orientation	2x	Spekman et al., 2002; Kilger & Stadtler, 2008
	Clarity	2x	Gimenez and Tachizawa, 2012; Lambrechts et al., 2012
	Awareness	1x	Lambrechts et al., 2012

4.4 Future visions

In literature on systemic innovation, future visions are also considered one of the key elements (Quist, 2007). "The basic assumption is that future visions can be seen as shared multi-actor constructions that may have the potential to guide actor behaviour, especially if generated in a participatory or collective process" (Quist, 2007, p. 33). Because municipalities, as local authorities, have the role as vision and policy makers, understanding the necessary changes in the technological and scientific field, such as the transition to a CCE, requires analysing these visions and their dynamics.

Future visions exist on different scales and in different forms in our society. For example, the concept of sustainability (mentioned in section 1.1), as defined by the World Commission on Environment and Development (1987), can be seen as a vision of the future providing guidance and direction on global scale. According to Quist (2007), two major types of visions can be distinguished: desirable positive and undesirable negative visions of the future. Both types of visions can be accepted or disputed in society, as they evoke discussions and debates between different stakeholders with similar or opposite visions of the future. The visions within the development of the transition towards a CE are generally seen as desirable and gain acceptance at macro level, which can be traced back to the aim of the Ellen MacArthur Foundation (2013, p. 96), "inspiring a generation to re-think, re-design and build a positive future through the vision of a regenerative, circular economy". This statement mentions the CE as a desirable vision of the future, which provides direction and guidance in creating a closed-loop and circular system. Furthermore, according to SDG17 (United Nations, 2015a), shared principles, goals and future visions are needed at global, regional, national and local levels, to achieve a CE.

Following from the analysis into the state-of-the-art, visions regarding the realisation of a Dutch CE have been reasonably established. However, sometimes these visions, including municipal visions, are still quite abstract (PBL, 2021). One of the recommendations of PBL (2021) to realise a CE is to develop detailed visions of the CE that are widely supported by companies and social organisations and to develop this into concrete goals. It is assumed that more detailed future

visions, supported by (local) companies and social organisations, will have a positive effect on (local) CSCC and the achievement of a Dutch CCE. For this research, it is useful to analyze different scientific concepts regarding future visions and to see what is useful in developing the theoretical framework.

In the study of Van der Helm (2009, p. 100), future vision is defined as "the more or less explicit claim or expression of a future that is idealised in order to mobilise present potential to move into the direction of this future". Van der Helm (2009) identified four key elements that will help to understand the purpose and function of future visions, which are summarized in Table 4.6. Some elements confirm previous findings and some can be added to the theoretical framework, such as motivating, inspiring and giving guidance and direction.

Table 4.6 – Elements that will help by understanding the functioning of visions (based on van der Helm, 2009, p. 101-102).

Elements	Explanation
Metaphors	A future vision can be seen as: a magnet that through its attractive force pulls the present towards an envisioned future; a compass : while the ship is riding the waves of transformational change; a platform : the vision holding all actors together and giving them a possibility to speak and listen to each-others desires; a crowbar : the vision converging all energy to break open some future otherwise unattainable.
Vision statements	There is a need to make a vision explicit , and to use words, metaphors and images to describe and share the idealized future. A future vision can be seen as that which is created between the actor and the audience. A vision, that is, its transformational tension, does only really originate in the encounter between what is emitted and what is perceived.
Motivation, inspiration, and direction	A vision makes a statement for a transformation, which can motivate, inspire and direct people. Motivation will relate to some kind of appropriation of the future, of being part of the project that will (partly) design the future. Inspiration refers to the central message of any vision, i.e., that transformation is potentially possible. Whether inspiration comes like a sudden impulse, or whether it grows gradually will very much depend on personality. Direction will refer both to giving a direction where to go and givingdirection on what to do.
Leadership and authority	The vision is not only the idealised future, but an idealised future carried by or attributed to some leader . As a consequence, the transformational tension of a vision must always be complemented with authoritative tension . This may go so far as to expect from any leader to have and pronounce a vision of the future.

Furthermore, a future vision concept that considers guidance as one of the main elements of a vision is the concept of Leitbild (Dierkes, Hoffmann & Marz, 1996; as cited in Quist, 2007). Guidance relates to leading and guiding shared innovative goals and visions. The aim is to connect and coordinate learning processes and interactions between different actors within a network. In addition, guidance aims to provide scope for the development of the network around innovation, by means of regulations and management. Besides guidance, image is also one of the main elements of the Leitbild concept (Dierkes et al., 1996; as cited in Quist, 2007). Image relates to the key challenge to gather information and knowledge that is necessary for the development of the vision and obtaining the necessary resources and actors. In addition, image provides coordination of independence and communication between different network actors.

In conclusion, this section has outlined the relevance of future vision concepts. Future visions are key elements within systemic innovations towards a CCE. Most concepts will deal with bottom-up approaches that are difficult to influence through top-down perspectives. However, it is assumed that more detailed municipal future visions, supported by (local) companies and social organisations, will have a positive effect on (local) CSCC and the achievement of a Dutch CCE. The transition towards a CE is seen as a future vision at macro level. At lower levels different expectations and promises are developed to implement CE principles in society. Examples of promises within this transition include becoming independent from fossil fuels and contributing to limiting (the consequences of) climate change (Ellen MacArthur Foundation, 2013).

The concept of Van der Helm (2009) and the Leitbild concept of Dierkes et al., 1996 (as cited in Quist, 2007) are useful for analyzing visions of the future in this research, because these concepts focus on understanding the purpose and function of future visions and on the mutual influences of relationships between network actors and on dynamic vision developments. The identified research indicators resulting from literature with regard to future visions reinforce and supplement Table 4.5, resulting in Table 4.7. The added indicators are indicated in red.

Research variable	Identified research indicator for CSCC		Reference(s)
Future visions	Communication	12x	Rogers, 1962; Dierkes et al., 1996; Morrison et al., 2000; Morrison et al., 2000; Spekman et al., 2002; Koebel et al., 2004; Larson and Meyer, 2006; Mahapatra et al., 2013; Hume and Leonard, 2013; Borcaa and Baesu, 2014; Jacobs et al., 2016; Meijer et al., 2018
	Exchange of knowledge and information	11x	Dierkes et al., 1996; Gordon & McCann, 2000; Spekman et al., 2002; Mowery and Nelson, 2006; Zhao et al., 2011; Zhao et al., 2011; Mariotto, 2012; Lambrechts et al., 2012; Mlecnik, 2013b; Jacobs et al., 2016; Brown et al. 2019
	Coordination	9x	Dierkes et al., 1996; Lee and Ng, 1998; Kilger and Stadtler, 2008; Van der Helm, 2009; Zhao et al., 2011; Davidson, 2013; Williams et al., 2017; Lüdeke-Freund et al., 2018; Brown et al., 2019
	Integration	7x	Akintoye et al., 2000; Christopher, 2005; Kilger and Stadtler, 2008; Zhao et al., 2010; Zhu et al., 2010; Bygballe and Ingemansson, 2014; Adams et al., 2017
	Trust	5x	Rogers, 1962; Spekman et al., 2002; Borgatti and Ofem, 2010; Bygballe and Ingemansson, 2014; Jacobs et al., 2016
	Learning and experimentation	7x	Bessant and Tsekouras, 2001; Spekman et al., 2002; Mowery and Nelson, 2006; Lambrechts et al. 2012; Mlecnik, 2013b; Gosling et al., 2017; Brown et al., 2019
	Openness and transparency	Зx	Barratt, 2004; Jacobs et al., 2016; Jacobs et al., 2016
	Alignment	2x	Zhao et al., 2010; Vernay, 2013
	Win-win orientation	2x	Spekman et al., 2002; Kilger & Stadtler, 2008
	Clarity	1x	Gimenez and Tachizawa, 2012; Lambrechts et al., 2012
	Awareness	1x	Lambrechts et al., 2012
	Guidance and direction	2x	Van der Helm, 2009; Ellen MacArthur Foundation, 2013
	Motivation	1x	Van der Helm, 2009
	Inspiration	1x	Van der Helm, 2009

Table 4.7 - Identified research indicators regarding future visions (own table).

4.5 (Circular) business models

The systemic innovation that accompanies the transition to a CCE requires a redesign of current business models (BMs). According to Osterwalder et al. (2005, p. 3), a business model (BM) is defined as "a conceptual tool to help understand how a firm does business and can be used for analysis, comparison and performance assessment, management, communication, and innovation". Besides, a BM also "describes the rationale of how an organisation creates, delivers, and captures economic, social, and other forms of values" (Osterwalder & Pigneur, 2010, p. 14). Sustainable business models (SBMs) and circular business models (CBMs) are essential for delivering economic sustainability and for enhancing social and environmental values (Bocken, Short, Rana & Evans, 2013). "The value of business models lies in their ability to frame action and reveal connexions between those actions, across multiple levels of analysis." (Mason & Spring, 2011, p. 1039). These actions, in the context of the transition towards a CE, are based in CBMs, where systemic innovations are related to value creation (Boons, Montalvo, Quist, & Wagner, 2013). CBMs can provide guidance, inspiration and motivation to organisations in the implementation of circular principles.

The current development of CBMs is still facing several challenges. Most of the CBMs used in the Netherlands have been created in a linear environment. They are aimed at the organization's own business operations in terms of raw material use and product design and are only aimed at the use of new revenue models to a limited extent. The consequence of this is that there are still insufficient CSCC or joint business models and that should change.

With regard to the main question of this research, it is assumed that municipalities only have an indirect facilitating role in CBM development. For example, they can inform, stimulate, inspire and motivate the market to switch to CBMs. By sharing the necessary information and knowledge about CBMs and offering help (as a facilitating municipality), local market parties may be able to make this switch more easily. In this section, an overview will be given of various SBMs and CBMs that have recently been developed and how these models can contribute to the analysis within this research.

(Local) governments, including municipalities, around the world are increasingly seeing the urgency of business activities to find solutions for major environmental and sustainable challenges. They can contribute to this by "creating the framework conditions that will assist companies to operate according to a business model through which they can meet their business objectives and make profits" (Beltramello et al., 2013, p. 19). In response to climate change, depletion of resources, stricter regulations and a shift in social pressure, interest in BMs is growing in both literature and practice (Bocken, Short, Rana & Evans, 2014). Organisations are increasingly looking for opportunities to gain competitive advantage. BMs are useful tools in sustainable business development (Bocken et al., 2014). BM innovations for sustainability is defined as "innovations that create significant positive and/or significantly reduced negative impacts for the environment and/or society, through changes in the way the organisation and its value-network create, deliver value and capture value (i.e. create economic value) or change their value propositions" (Bocken et al., 2014, p. 44).

One of the main challenges is the development of a BM which enables the organisation to create economic value for itself by means of ecological and social benefits. Lüdeke-Freund (2010, p. 23) defined an SBM as "a business model that creates competitive advantage through superior customer value and contributes to a sustainable development of the company and society". According to Garetti and Taisch (2012), SBMs protect the environment and are a means to improve human qualities. Furthermore, Stubbs and Cocklin (2008) state that SBMs will align the interests of all actors within a network, conceiving society and the environment as two main stakeholders. Similarly, according to Bocken et al. (2013), SBMs capture social, environmental and economic value for a network of different actors.

However, one of the main obstacles for organisations with a large ecological footprint, is that they may not have sufficient capacity to cover facilities for sustainable innovations (Stubbs & Cocklin, 2008). In such a case it is more economically effective if the costs associated with these facilities are shared among the stakeholders. For example, to develop a sustainable and circular innovation such as a recycling process, organisations will benefit from partnering with competing organisations, as collecting and returning materials can be a major challenge (Stubbs & Cocklin, 2008). "This implies a collaborative approach where stakeholders develop sustainability solutions for the whole system, rather than for individual components (organisations) within the system" (Stubbs & Cocklin, 2008, p. 16). By replacing traditional BMs with SBMs, organisations are able to re-organise their SCs and develop new producer-consumer relationships. Furthermore, this BM perspective is also required to understand and run systemic business innovations (Beltramello, Haie-Fayle & Pilat, 2013). BMs enable sustainable innovation because they force organisations to look at the larger system in which they operate, with especially the focus on shared value creations with positive effects on the organisation, society and the environment (Boons et al., 2013; Bocken et al., 2013).

Recently, many different principles and elements of CBMs have been developed, which created a need for a balanced and simple categorization of the various developed circular strategies and BMs (Achterberg, Hinfelaar, & Bocken, 2016). CBMs could be developed in several ways. For instance, Bocken et al. (2014) have categorized archetypes of SBMs into three groups (technological, social and organisational). Combining this categorization with the CE principles developed by the Ellen MacArthur Foundation (2013) leads to the following framework (Figure 4.5) that can serve as a basis for developing CBMs. This categorization with associated archetypes can be used as a means to identify and analyse circular opportunities within a company or organisation (Bocken et al., 2014). It should be noted that some archetypes in this model are placed within a main category, but they often overlap with other categories. After the stakeholder analysis (Chapter 5), I will reflect in the discussion (Chapter 6) on the role and possible actions that the municipality could take within these eight categories in the framework of CSCC.

In conclusion, this section described why BMs are important for sustainability and circularity. With regard to the main focus of this research, it is assumed that municipalities only have an indirect facilitating role in CBM development. For example, they can inform, stimulate, inspire and motivate the market to switch to CBMs. By sharing the necessary information and knowledge about CBMs and offering help (as a facilitating municipality), local market parties may be able to make this switch more easily. The categorization with associated archetypes, as the framework of Bocken et al. (2014) has outlined, can be used as a means to identify and analyze circular opportunities within an organization and what the role of municipalities could be in these processes.


Figure 4.5 – Development of a circular busines model (based on Ellen MacArthur Foundation, 2013; Bocken et al., 2014).

Concluding this section, the identified research indicators resulting from literature with regard to sustainable and circular business models reinforce and supplement Table 4.7, resulting in Table 4.8. The added indicators are indicated in red.

Table 4.8 - Identified research indicators regarding business models (own table).

Research variable	Identified research indicator for CSCC		Reference(s)
(Circular) business models	Communication	13x	Rogers, 1962; Dierkes et al., 1996; Morrison et al., 2000; Morrison et al., 2000; Spekman et al., 2002; Koebel et al., 2004; Osterwalder et al., 2005; Larson and Meyer, 2006; Mahapatra et al., 2013; Hume and Leonard, 2013; Borcaa and Baesu, 2014; Jacobs et al., 2016; Meijer et al., 2018
	Exchange of knowledge and information	11x	Dierkes et al., 1996; Gordon & McCann, 2000; Spekman et al., 2002; Mowery and Nelson, 2006; Zhao et al., 2011; Zhao et al., 2011; Mariotto, 2012; Lambrechts et al., 2012; Mlecnik, 2013b; Jacobs et al., 2016; Brown et al. 2019
	Coordination	9x	Dierkes et al., 1996; Lee and Ng, 1998; Kilger and Stadtler, 2008; Van der Helm, 2009; Zhao et al., 2011; Davidson, 2013; Williams et al., 2017; Lüdeke-Freund et al., 2018; Brown et al., 2019
	Integration	7x	Akintoye et al., 2000; Christopher, 2005; Kilger and Stadtler, 2008; Zhao et al., 2010; Zhu et al., 2010; Bygballe and Ingemansson, 2014; Adams et al., 2017
	Trust	5x	Rogers, 1962; Spekman et al., 2002; Borgatti and Ofem, 2010; Bygballe and Ingemansson, 2014; Jacobs et al., 2016
	Learning and experimentation	7x	Bessant and Tsekouras, 2001; Spekman et al., 2002; Mowery and Nelson, 2006; Lambrechts et al. 2012; Mlecnik, 2013b; Gosling et al., 2017; Brown et al., 2019
	Openness and transparency	3x	Barratt, 2004; Jacobs et al., 2016; Jacobs et al., 2016
	Alignment	Зx	Zhao et al., 2010; Vernay, 2013; Stubbs and Cocklin, 2008
	Win-win orientation	4x	Spekman et al., 2002; Kilger & Stadtler, 2008; Stubbs and Cocklin, 2008; Bocken et al., 2014
	Clarity	1x	Gimenez and Tachizawa, 2012; Lambrechts et al., 2012
	Awareness	1x	Lambrechts et al., 2012
	Guidance and direction	Зx	Van der Helm, 2009; Boons et al., 2013; Ellen MacArthur Foundation, 2013
	Motivation	2x	Van der Helm, 2009; Boons et al., 2013
	Inspiration	2x	Van der Helm, 2009; Boons et al., 2013

4.6 Conclusion and theoretical framework

The purpose of this chapter was to answer the second sub-question: which factors are needed to facilitate CSCC according to literature? and has provided an overview of different theories and concepts based on the five research variables: development and implementation of innovations, building an active and dynamic actor network, learning between SC actors, sharing future visions and creating circular business models. During the literature review, it became clear that a CSC network is needed to accelerate the transition to a CCE. The following definition of a CSC network has been formulated for this research:

A network of supply chain actors in which individual circular interests are aligned, where there will be learned from each other through the exchange of knowledge and experience, where action is taken towards shared visions of the future and where circular business models are developed.

Table 4.9 summarizes the literature review and identifies the research variables and associated indicators related to (the facilitation of) CSCC. This table will form the theoretical framework, the scientific justification for this study, and will be used as guidance for the stakeholder analysis (Chapter 5) and to reflect upon in the discussion (Chapter 6) of this research. The purpose of identifying these relevant research indicators was to address the aspects that are currently required to be able to take the next step towards the growth phase of the transitions towards a CCE (following from Table 3.7). This chapter has elaborated on the aspects that are now identified as urgent for CSCC in order to scale up circular owner-occupied housing renovation, in which it is assumed that the municipality can influence. The indicators are ordered by importance according to this literature study.

This theoretical framework can be seen as an important element that establishes the links between previous research into the state-of-the-art and relevant theories and concepts related to this research field. The X's within this table shows the cross-connections between the research variables and associated identified indicators related to (the facilitation of) CSCC. What this table clearly shows is that different indicators emerge in various theories. Table 4.10 is a translation of this theoretical framework and describes how the indicators will be tested during the interview phases.

Research indicator related to CSCC	Research variable						Reference(s)
	Innovation	Actor networks	Supply chain learning	Future visions	(Circular) business models		
(1) Communication	Х		X	X	X	13x	Rogers, 1962; Dierkes et al., 1996; Morrison et al., 2000; Morrison et al., 2000; Spekman et al., 2002; Koebel et al., 2004; Osterwalder et al., 2005; Larson and Meyer, 2006; Mahapatra et al., 2013; Hume and Leonard, 2013; Borcaa and Baesu, 2014; Jacobs et al., 2016; Meijer et al., 2018
(2) Exchange of knowledge and information	Х	X	X	X		11x	Dierkes et al., 1996; Gordon & McCann, 2000; Spekman et al., 2002; Mowery and Nelson, 2006; Zhao et al., 2011; Zhao et al., 2011; Mariotto, 2012; Lambrechts et al., 2012; Mlecnik, 2013b; Jacobs et al., 2016; Brown et al. 2019
(3) Coordination	Х	Х		X		9x	Dierkes et al., 1996; Lee and Ng, 1998; Kilger and Stadtler, 2008; Van der Helm, 2009; Zhao et al., 2011; Davidson, 2013; Williams et al., 2017; Lüdeke-Freund et al., 2018; Brown et al., 2019
(4) Integration	Х	Х				7x	Akintoye et al., 2000; Christopher, 2005; Kilger and Stadtler, 2008; Zhao et al., 2010; Zhu et al., 2010; Bygballe and Ingemansson, 2014; Adams et al., 2017
(5) Trust	Х	Х	X			5x	Rogers, 1962; Spekman et al., 2002; Borgatti and Ofem, 2010; Bygballe and Ingemansson, 2014; Jacobs et al., 2016
(6) Learning and experimentation	Х		X			7x	Bessant and Tsekouras, 2001; Spekman et al., 2002; Mowery and Nelson, 2006; Lambrechts et al. 2012; Mlecnik, 2013b; Gosling et al., 2017; Brown et al., 2019
(7) Win-win orientation		Х	Х		Х	4x	Spekman et al., 2002; Kilger & Stadtler, 2008; Stubbs and Cocklin, 2008; Bocken et al., 2014
(8) Alignment	х	Х			х	3x	Zhao et al., 2010; Vernay, 2013; Stubbs and Cocklin, 2008
(9) Guidance and direction				Х	Х	3x	Van der Helm, 2009; Boons et al., 2013; Ellen MacArthur Foundation, 2013
(10) Openness and transparency	Х		Х			Зx	Barratt, 2004; Jacobs et al., 2016; Jacobs et al., 2016
(11) Motivation				Х	Х	2x	Van der Helm, 2009; Boons et al., 2013
(12) Inspiration				Х	Х	2x	Van der Helm, 2009; Boons et al., 2013
(13) Clarity		Х	Х			1x	Gimenez and Tachizawa, 2012; Lambrechts et al., 2012
(14) Awareness			Х			1x	Lambrechts et al., 2012

Table 4.10 – How the identified research indicators will be tested during the interview phases (own table).

Research indicator related to CSCC	How to investigate in the interviewphases?
(1) communication	Ask the stakeholder about experiences with regard to (sufficient) communication within and between organization(s), including local governments.
(2) exchange of knowledge- and information	Investigate whether the stakeholder agrees that sufficient knowledge and information is exchanged within and between organization(s), including the role of local governments therein.
(3) coordination	Ask the stakeholder whether coordination is required/desired for (stimulating/facilitating) CSCC, including the role of local governments therein.
(4) integration	Investigate whether the stakeholder agrees that there is sufficient integration within and between organisation(s)/visions/ambitions, including the role of local governments therein.
(5) trust	Ask the stakeholder about experiences with regard to trust and mutuality within and between organization(s), including local governments.
(6) learning and experimentation	Investigate whether the stakeholder agrees that there are sufficient learning and experimentation opportunities, including the role of local governments therein.
(7) win-win orientation	Investigate whether the stakeholder agrees that there is a win-win orientation within and between organisation(s), including the role of local governments therein.
(8) alignment	Investigate whether the stakeholder agrees that there are sufficient alignment within and between organisation(s)/visions/ambitions, including the role of local governments therein.
(9) guidance and direction	Investigate whether the stakeholder agrees that there is sufficient guidance within and between organisation(s), including the role of local governments therein.
(10) openess and transparancy	Ask the stakeholder about experiences with regard to openess and transparency within and between organization(s), including local governments.
(11) motivation	Investigate what motivates the stakeholder to undertake circular (renovation) actions and what motivates them for CSCC.
(12) inspiration	Investigate what inspires the stakeholder to undertake circular (renovation) actions and what inspirates them for CSCC.
(13) clarity	Investigate whether the stakeholder agrees that there are sufficient clarity within and between organisation(s)/visions/ambitions, including the role of local governments therein.
(14) awareness	Ask the stakeholder about experiences with regard to awareness of CSC actors (including private homeowners) and the role of local governments therein.



stakeholder analysis.

The purpose of this chapter is to answer SQ3: **How do different actors of CSC networks experience the role of the municipality within CSCC to achieve upscaling of circular renovation of owner-occupied homes?** This is done through a stakeholder analysis, consisting of two phases of semi-structured interviews, an additional internal survey and a discussion in a focus group.

In the first interviewphase, SQ3 is discussed by means of interviews with public parties, including actors from different municipalities, universities and knowledge institutions. In the second interviewphase, the question is discussed by means of interviews with private parties and civil society organisations, including actors from different (local) market parties, branch organisations within the building sector and interest groups for homeowners. In this way, I have collected insights from both policy makers and non-policy makers, which has resulted in four main barriers of CSCC for private home renovation: insufficient internal integration, communication, realization and facilitation. Based on the interviews held, the pre-identified research indicators can be clustered within four main barriers (insufficient internal integration, communication, realization and facilitation), with some indicators overlapping and belonging to more than one factor as shown in Table 5.1. This categorization is based on the assumption that local authorities could influence these four CSCC factors and will be used by the development of the final advice towards the Municipality of Rotterdam.

Insufficient iternal integration	Insufficient communication	Insufficient realisation	Insufficient facilitation
Alignment	Alignment	Communication	Awareness
Awareness	Awareness	Knowledge/information exchange	Knowledge/information exchange
Integration	Communication	Learning and experimentation	Openess and transparancy
Knowledge/information exchange	Coordination	Win-win situation	
Openess and transparancy	Clarity	Motivation	
Learning and experimentation	Knowledge/information exchange	Inspiration	
	Openess and transparancy		
	Learning and experimentation		
	Trust		
	Win-win situation		
	Motivation		
	Inspiration		
	Guidance and direction		

Table 5.1 – Indicators grouped in four categories of CSCC barriers, where it is assumed that local authorities have influence (own table).

On the basis of these four main barriers, results will be given of the current presence and importance of the pre-identified research indicators related to (initiation of) CSCC from different stakeholder's perspectives in section 5.1 (indicators are **bold**). Table 5.2 lists all interviewees and how they are referenced in this section. In addition, by means of this table the results can be found in corresponding transcripts which have been merged in the separate appendix document of this thesis.

In section 5.2, results of the internal survey will be presented where the insufficient internal integration will be discussed in more detail to clarify how this barrier could be overcome. In section 5.3, the other three main barriers will be discussed within a focus group (full transcript can be found in Appendix W), where I will investigate from a management perspective whether the suggested opportunities, in terms of (more) concrete strategies mentioned by different stakeholders, will work or not to solve the identified barriers and mismatches. In the conclusion (5.4), an answer will be given to SQ3.

Table 5.2 - All interviewees, including their reference in the document and the corresponding transcripts (own table).

Interviewee	Reference in document	Transcript
Phase 1		
Alliance Manager Next Generation Residential Areas, Municipality of Rotterdam	А	Appendix A
Program Manager Circularity, Municipality of Rotterdam	В	Appendix B
Consultant Circular & Climate adaptive, Municipality of Rotterdam	С	Appendix C
Resident coach (home maintenance and sustainability), Municipality of Rotterdam	D	Appendix D
Senior Advisor Energy and Circular Development, Municipality of Amsterdam	E	Appendix E
Doctoral Researcher Housing Management, TU Delft	F	Appendix F
Consultant and lecturer Sustainable Renovation, BouwhulpGroep	G	Appendix G
Scientist Integrator Sustainable and Circular Construction Concepts, TNO	Н	Appendix H
Project Leader Sustainability, Circular Society and Upscaling, Platform31	1	Appendix I
Circular Construction Specialist, C-Creators	J	Appendix J
Phase 2		
Secretary, VERAS	К	Appendix K
Director and member of the CCE transition team, BRBS	L	Appendix L
Director and member of the CCE transition team, NVTB	Μ	Appendix M
Team leader Technology Netherlands Advice, Technology NL	Ν	Appendix N
Founder and Architect, Architect Maken	0	Appendix O
Circular demolition specialist, A van Liempd	Ρ	Appendix P
Consultant, Copper8	Q	Appendix Q
Director Transformation, Renovation & Maintenance, van Omme en de Groot	R	Appendix R
Deputy Director of Greenworks, Raab Karcher	S	Appendix S
Consultant, Stichting !WOON	Т	Appendix T
Construction Specialist at the Knowledge Center, VEH	U	Appendix U
Entrepreneur and private homeowner, Het Groene Bureau	V	Appendix V

5.1 Results of the interview phases

5.1.1 Insufficient internal integration

To achieve **alignment** between (national and local) circularity ambitions and Dutch legislation, integration of different challenges, such as the energy transition, climate crisis, housing shortage and the transition to a CE, is crucial. Different departments within municipalities are working on these challenges, but often separately. As mentioned by 13 out of 22 respondents (A, C, F-I, L, M, P, Q, S-U), creating an integrated project and organisational quality is required for the circular transition. They also mentioned the importance of integrating various themes for the success of both internal and external collaborations.

However, it soon became clear that there is insufficient internal **integration** between different departments within the municipality at the moment. This was mentioned by people working at municipalities as well as parties who have collaborated with municipalities. The word 'island culture' has been mentioned by several employees working at the

"The integration of themes is certainly a key to solutions" – TNO, Scientist Integrator Sustainable and Circular Construction Concepts (appendix H) municipality, meaning that the different departments are too busy with their own tasks and ambitions. It became clear, that there is a lack of shared visions, which will result in insufficient internal collaboration (mentioned by C, D, L, M, Q, S-U). This lack of integrated visions is one of the biggest obstacles highlighted during the interviews. Departments such as Sustainability (energy saving, natural gas-free, etc.), Building and Housing Supervision (home maintenance) and Circularity have to discuss together to see how the various goals could be integrated and be achieved. At a later stage, regulations may help with this, but it should start with the internal collective motivations and ambitions. This lack of shared visions will result in fragmented collaboration between different departments that are involved. It often remains with separate assignments that are being worked on, which is related to the lack of insufficient **information and knowledge sharing** internally (mentioned by A-D, G, H, I). This lack of integration of the various departments of the municipality is also noticeable in the 'Duurzaamheidswinkel' in the Keizerswaard shopping center. However, attempts are being made to introduce collaboration deals, in which other departments, such as Circularity, will also be represented in the store. It has not yet come about, but the first steps of the desired integration has been taken.

Furthermore, the insufficient **knowledge and information sharing** among colleagues within the municipality resulted in insufficient internal cooperation due the lack of **awareness** and knowledge of each other's tasks and assignments. This means that it will sometimes be difficult to find (the right) colleagues to achieve the desired integration of themes, which could lead to unnecessary hiring of external parties, as colleagues do not really know what someone else is doing and what someone's expertise and tasks are (mentioned by C). When an external party is hired, it must first be sure that that knowledge is not already available. Certainly, when there is talk of cutbacks within the municipality, money must be spent in the right way (mentioned by C, D).

In order to reduce the unfamiliarity with colleagues about each other's themes and tasks, more internal **sharing of knowledge and information** is needed. This could be achieved by, for example, internally scheduling different theme sessions, mini-lectures, webinars or workshops (proposed by A, B, D). Within these types of activities, it is required that there is an **open and transparent** atmosphere with a common goal to inform each other about the information and knowledge that is available. It is important that not only the successful projects are highlighted, but also the mistakes in practice that need to be **learned** from (mentioned by P, Q). In this way, you not only gain more knowledge about the various themes within the municipality, but you also get to know colleagues better personally (mentioned by A, B, D).

The internal scheduling of various theme sessions, lectures, webinars and workshops sounds like an effective means of increasing internal **information and knowledge sharing**. However, employees of the Municipality of Rotterdam indicated that practical examples within the municipality show that these types of activities have not always been successful to date, which is mainly due to full agendas. Initially, people are willing to participate in these types of internal activities. Only what emerged from interviews with both employees of the municipality and knowledge institutions, is that these knowledge sessions are often considered 'non-committal', making it difficult to prioritise them in addition to any other important tasks to be completed (mentioned by B, F, I). People often see the added value in the long term, but the added value in the short term is still lacking. It is necessary to take action now to achieve the national goals of 2030 and 2050. Due to the fact that insufficient priority has been given to the internal development of **information and knowledge sharing** to date, various departments within the municipality continue to run into this internal barrier. What was mentioned by the

Program Manager Circularity of the Municipality of Rotterdam (B), was when there is a concrete reason with a clear goal to learn with and from each other, for example within a certain (pilot) project, a combination will arise between knowledge development and a teambuilding. It is assumed that in addition to sharing knowledge, the (informal) connection between colleagues will also have a positive effect on the internal collaboration between different departments.

"If there is a clear result or team feeling, then you make a combination between knowledge development and a 'we factor'; we are doing something together and we want to achieve something together. Then, we are not only talking about knowledge development, but the purpose in what we want to deliver." - Municipality of Rotterdam, Program Manager Circularity (appendix B) As indicated by employees of the municipality, it will be a major challenge to bring the different ambitions of the different departments and projects together in order to achieve integral, internal cooperation. Because this has not yet been successful, a director could be appointed who will take on this task: **integrating** the various tasks and ambitions of several departments within the municipality regarding circular (building and) renovation of the private housing stock of (in this case) Rotterdam (proposed by D, I, N).

Furthermore, when these kinds of integrated collaborations arise, the different departments within the municipality could also consider joint (horizontal) budgeting and accountability for certain shared goals (proposed by D, H, I). Consideration could be given to creating a budget, which together is enough to finance the necessary subsidies for certain measures, like circular renovation. However, then you also have to deal with several councilors who have to decide on this, which could sometimes become a challenge. Besides, the project Leader Sustainability Circular Society and Upscaling of Platform31 (I) indicated that if a municipality does realise an integrated way of working, but the budget is still released from one policy domain, it can be assumed that the way in which the project in question is viewed is aligned with that policy domain and the associated priorities. For these reasons, some stakeholders (D, H, I) also argue for horizontal budgeting and accountability.

So, to achieve an effective CSCC, the first step to be taken is the invisible barrier internally. It is important that internal cooperation within an organization is in order before entering into partnerships with external parties. Currently, the different departments within the municipality still have different priorities and cultures. It is important for the municipality that circularity becomes an integral part of the construction and renovation tasks and different departments must be sufficiently informed and **aligned**. This means that sufficient **information and knowledge must be shared** among themselves, so that colleagues become more familiar with each other's themes and tasks that are being worked on, which will also result in more internal **integration**. To achieve this, there must be more internal **integration** between colleagues from different departments as well as between visions, ambitions and transition challenges of the different departments. This internal **alignment** and **integration** must first be worked on before publicizing new applications and entering into partnerships with external parties with regard to the upscaling of circular renovation of the private housing stock in Rotterdam. So, it is not only about **alignment** and collaboration between different parties involved, but also between different departments and clusters within organisations. If the collaboration is in order internally, the step to external transparent CSCC will be smaller.

5.1.2 Insufficient communication

Most people in the Netherlands are not (yet) **aware** of the concept CE. In the construction sector, the transition is developing, but many parties still do not know exactly what it entails. Besides, circular construction and renovation are also still unknown to colleagues within the municipality itself. However, it is assumed that it already helps when it is mentioned in the **communication** between different organisations and departments, as a suggestion, so that people start thinking about it. In this initial, phase of the transition, people must become **aware** of the existence and the possibilities of circularity, which is (according to 21 out of 22 interviewees) currently insufficiently the case in practice.

Private homeowners usually renovate their home with the aim of improving comfort or for repair. This often concerns, for example, kitchens, bathrooms, toilets or extensions to the house. Other types of adjustments to the house have to do with reasons such as family expansion, wheelchair-friendliness or inability to climb stairs properly. Larger home renovations, such as renovating entire facades or roofs, are less common in private homes. The theme of sustainability is fairly present among residents in both smaller and larger home renovations (mentioned by D, F, G, I, J, T, U, V). However, when you talk about sustainability, it should be about both energy and material use; material choices should be taken into account in the decision (mentioned by G). Currently, residents are not (yet) **aware** of circular home renovation. The municipality could activate and stimulate this **awareness** through multiple means of **communication**, such as the existing 'Duurzaamheidswinkel', pop-up stores, one-stop shops, demo homes or demo districts, digital platforms and social media.

What is important with private home renovation is that the owner must be well **aware** that it is a long-term investment in his or her own home (mentioned by J). When the home is made sustainable (in a circular manner), this not only

"You have to place the incentive in such a way that you drive the innovation you want." - Municipality of Rotterdam, Alliance Manager Next Generation Residential Areas (appendix A) has a positive effect on the environment, but the home will also increase in value. When informing and encouraging private homeowners, this must be clearly **communicated**, because then people might start thinking differently about renovation; beyond just the benefits such as comfort and repair (mentioned by A, D, F, J, T, U, V).

Furthermore, the way of **communicating** is closely related to **giving guidance** and **coordination**. Within this research, **coordination** is interpreted differently from steering. After all, major system transitions, like the transition towards a CE, are difficult to push in one direction from above according to a (strict) plan. In the context of the role of (local) governments within CSCC, **coordination** means, among other things, connecting relevant parties, continuously facilitating **communication** and providing feedback on actions taken. It will **align** activities of different actors in the innovation system and thus accelerate the transition. To achieve this, features rely on efforts from both public and private organisations. However, what results from this research is, collaborations on circular initiatives are slow to come about. Only a few initiatives are visible where parties enter into new collaborations beyond the boundaries of their own organisation or their existing partners.

As experienced by 17 out of 22 respondents (B-D, G, I-U), insufficient **coordination** and control is an important obstacle regarding the creation of collaborations. Collaboration is an active process that requires harmonizing expectations, capacities and interests. Sometimes adjustments in production processes at one organisation lead to savings for another organissation. A form of cooperation must then be sought that offers added value for all parties, resulting in a **win-win situation**. This does not happen automatically and requires some form of **direction** in the chain, in the region and within other networks. This directing role could, for example, be taken by trade organisations within the building sector or (local) governments.

Coordination is closely related to the way of **communicating** and **giving guidance**. Within this research, a distinction is made between **communication** between (local) government and market and between (local) government and residents. What emerged from the interviews is that both forms of **communication** are currently not sufficient present in practice.

'In these kinds of developments, I see the role of he municipality as a director in bringing together supply and demand."- Municipality of Rotterdam, Program Manager Circularity (appendix B)

First, the **communication** between local government and market parties is mainly related to the municipal (circular) visions for the future. The municipality could include innovations from the market when drawing up municipal vision and policy documents (proposed by I, J, M, N, R). Certainly, because a major task has to be approached in a relatively short period of time, cooperation between governments and market parties is also important in the field of visions and policy making. According to 6 out of 22 respondents (B, E, N, O, R, S), public and private parties could enter into a dialogue together, because some initiatives originating from market parties or housing associations could serve as input for renewal of municipal policy. Showing (more) confidence (trust) in the market also plays a crucial role in this.

The need for a cultural change within organisations is related to the lack of urgency and motivation to act in a circular way. What emerged remarkably during 21 out of 22 interviews (all, excepts S), was that they notice that the urgency and

"Necessity creates innovation." - Platform31, Project Leader Sustainability, Circular Society and Upscaling (appendix I) motivation is not yet sufficiently present in the majority of the market. However, if one does not act quickly enough now, the 'real' crisis will come at some point and then it is too late. Because people do not feel the need enough yet, it slows down innovation. The consequences are not yet severe enough to justify the intervention now. The drawbacks will soon be there, but we have to intervene for those drawbacks at this moment in time. In order to get parties more motivated to switch to circular business models, the municipality could challenge the market to come up with circular solutions (proposed by A, J, M, Q). (Local) governments are seen as major launching customers (clients and purchasers), which could therefore play meaningful roles in the development of the innovation (proposed by A, L, N, Q). The (local) government plays not only a role by informing and inspiring the market with opportunities and successful projects, but also by offering the market space and putting them to work in. However, it is important that a win-win situation is created in this respect as well. The government wants something from the market, but the market must get something in return.

In addition, it must also be ensured that municipal visions of the future are **transparent** and accessible to everyone. Visions must be clearly articulated and **communicated** to both the market operators and residents, which is, according to 12 out of 22 respondents (A, D-G, I-K, M, N, Q, R), not yet sufficiently the case. Making visions concrete is also important in order to be able to make a clear request. When visions of the future are linked to concrete strategies, standard requirements could be included in the building envelope regarding circularity and CSCC, which are based on these strategies (mentioned by T). Requirements that could be set with regard to CSCC are, for example, that the collaboration must lead to a reduction in waste of materials and that it must ensure a shared innovation so that the parties share and develop knowledge together (proposed by T).

The main goals of municipal visions are to **motivate, inspire** and **give direction** to the market. According to Platform31 (I), in drawing up these visions, it is important that governments remain in the so called 'adjacent possible'. Visions must be feasible and realistic, otherwise nothing will come of it. Most importantly, visions have to provide **clarity** to the market in a timeframe where they could properly prepare for the future with the assurance that there will be no 'free-riders', meaning that there will be no distortions of competition (mentioned by M). If that is in order, then market parties think that setting higher requirements for sustainability and circularity is fine and also very logical (M).

So, municipal visions of the future are generally perceived as still too abstract and noncommittal for many stakeholders involved in CSC networks. To concretize these visions, municipalities could enter into dialogues with knowledge institutions and private parties. They could together provide tools and strategies for how they think the visions could be realised. However, it must be realistic and feasible, otherwise it will not work. In addition, NVTB (M), Van Ommen & de Groot (R) and Stichting !WOON (T) mentioned the importance of supervision and enforcement in the implementation and realisation of future visions, in order to prevent distortion of competition and to make sustainability and circularity possible. This is the responsibility of municipalities and environmental services.

Second, in order to activate and stimulate **awareness** among private homeowners, it is important that they are well informed and that there is clear and accessible **communication** from the (local) government. Various means of communication could be used for this to make communication between the municipality and residents more accessible, such as the existing 'Duurzaamheidswinkel' (Sustainability Shop), pop-up stores, one-stop shops, demo homes or demo districts, digital platforms and social media. The results from the interviews show that both physical and digital service points are highly desirable for local population. Here, private homeowners could be **informed, inspired** and **motivated** to think about circularity and circular possibilities for home renovations. Existing initiatives such as pop-up stores and one-stop-shops are mainly aimed at making the home more energy efficient. However, such concepts could perhaps also be used to raise **awareness** of circular construction and renovation (proposed by D, F). The Duurzaamheidswinkel in Rotterdam is also such a service point where people can go with questions about making their homes more sustainable. The experience of several parties, including municipalities, consultancies and interest groups for homeowners, also shows that a physical meeting place can stimulate **communication** between municipalities and citizens, such as the Duurzaamheidswinkel in Keizerswaard shopping center.

However, linking consumers to market parties is not yet being done in the current service points for residents, aimed at sustainability and energy efficiency. This is very difficult from the perspective of the government. But in order to unburden private homeowners in this area, and certainly the step towards circular renovation of the home, consideration could be given to how this could be achieved. The municipality could, for example, be a meeting point for parties that offer circular housing concepts (proposed by B, D, F, G, U). In that case, the municipality will not be able to refer the consumer directly to a specific party, but it will, for example, be able to inform and advise on circular options. For larger renovations, homeowners must often apply for a building permit from the municipality. At such a time, the municipality

could, make the private homeowner **aware** that there are also circular possibilities for that renovation. For example, by means of the municipal website(s), show examples and experiences of such circular renovations of homes with associated parties that have been involved in this (proposed by D, O). Improving the municipal website(s) in this way, would help unburden private homeowners as well as **inform, inspire** and advise on circular renovation options. When people want to have a renovation done, they could, for example, offer it on a kind of platform on the municipal website after which market parties could respond with an offer of what they could mean for that private person or that a list of parties is proposed that meets the choices. For example, the private individual could tick off wishes and choices, such as material, color, sustainability, energy efficiency, circularity, time and costs (proposed by D).

Besides bringing private homeowners and market parties together, municipal websites could also offer the possibility to **share experiences** and reviews (proposed by B, C, D, G, N). This means that (especially in the beginning) not only examples of private home renovations need to be shared, but also circular renovations of the municipality's own real estate, for example. Furthermore, 7 of the 22 respondents (A, F-H, M, N, R) indicated that they would like to see the municipal visions more in relation to concrete actions. One way to do this, is to show what is possible, which could happen slightly more often (mentioned by A, C, P-S). The municipality could show the people who have the right experience in which ways circular renovation is possible. Just as with **sharing knowledge**, by means of workshops, webinars and lectures, on a platform/website not only the successful projects must be shown, but also the barriers that have been encountered in practice (proposed by P, Q). In this way, people could **learn** and research can be done into solutions and improvements.

So, such a platform could be beneficial for every party; knowledge is developed and shared by and with knowledge institutes, market parties can show what they have to offer, residents can see what is offered on the market and municipalities could stimulate (local) CSCC. Through such a platform, supply and demand are brought closer together. However, what is important here is that the affiliated parties are as **open and transparent** as possible to each other. That is one of the requirements for an innovative collaboration to run smoothly.

Municipalities could also provide more **guidance** to the market, through such a platform and/or in collaboration with knowledge institutes and industry organisations. We are currently still in the innovative phase of the transition. Many different parties and organisations develop knowledge, conduct research, write reports and come up with initiatives. However, this is perceived by the market as 'chaotic' and 'unclear', so more **guidance** for the market would be desirable.

As indicated by 8 out of 22 interviews (F, G, I, K, Q, T, U, V), demo homes and/or experimental areas could also be used as a means of **communication**, showing possible circular renovation solutions. Such a concept could be interesting for the municipality as well as for market parties and residents, which will result in a **win-win situation**. The municipality wants to show what is possible to (local) market parties and its residents, the market parties could show what they have to offer, and the residents will become more aware of circularity and can see and **experience** what is possible. Demo houses and/or areas have proven to be good **communication** tools for entering into a dialogue with people, which can help in involving residents in the transition to a CCE. It is assumed that this citizen participation will also activate **awareness** among people and stimulates them to consider alternatives when the home is due for renovation.

Another possible means of **communicatio**n from the municipality is to set up a campaign (proposed by B). In addition to stimulating demand among residents, the current supply with which they are stimulated must also be considered. Can the private homeowners make the 'right' choice? Ways must be found to create a collective message for residents that will initiate the desired change and that will make it easier for the end user to make the 'right' choices. For example, local market parties, such as GAMMA or Praxis, could participate in joint actions or strategies, in which information is provided about a circular insulation material that consumers receive a discount on (proposed by B). It is expected that this will stimulate **awareness** among the various participating parties as well as the upscaling of the purchase of circular renovation material by private individuals.

What is most important for any form of **communication** with private homeowners is that this **communication** remains **clear** and accessible. Practical experiences of the resident advisor (home maintenance and sustainability) of the Municipality of Rotterdam (D) and interest groups for homeowners (T, U) have shown that most residents are not enthusiastic about, for example, CO₂, nitrogen or circularity, but more about aspects such as accessibility, health, affordability, comfort and lower bills etc. So, the way of **communicating** as a municipality to residents is very important.

And that includes naming the benefits people are susceptible to. Municipalities must be able to properly explain to residents that certain products and materials are not harmful, neither for the environment nor for their own health (mentioned by C, D, F).

Moreover, it must become apparent that residents have a great need to be informed and facilitated (mentioned by D, T). The Municipality of Rotterdam is already informing its residents through, for example, the websites www.duurzaam010. nl or www.woonwijzerwinkel.nl. However, it should be taken into account that people will end up here if they want information on their own initiative about subsidies when they want to make their homes more sustainable. In order to activate and stimulate **awareness** among people, especially with regard to circular renovation solutions and to achieve the circular objectives based on the needs of residents, consideration could be given to reaching residents in a more accessible way (mentioned by D, F, G, O, Q, T, U, V)

The Residents Coach of the Municipality of Rotterdam (D) and a consultant of Stichting !WOON (T) experienced that the most promising way to reach people is during their daily activities. For example, social media could be used, with the aim of making people less averse to sustainability/circularity and giving them more insight into what it entails (proposed by D). Instead of having to look up information on a website on their own initiative, residents can easily encounter

messages, blogs, informative videos, etc. via social media, which may attract their attention. It will be assumed that this will also stimulates **awareness** among people. If circularity is seen often enough during daily activities, for example by scrolling on Facebook, it is expected that the subject will automatically come to the attention of this target group.

"Keep it simple and close, then it will be fine." -Municipality of Rotterdam, Resident Coach, advisor home maintenance and sustainability (appendix D)

Furthermore, what is related to clear and accessible **communication** is **openness and transparency** within a CSC network. In order to contribute to the CE through joint initiatives, the added value of collaboration must first be clear for all parties involved. For this, organizations need insight into each other's activities and capacities. For example, companies must be **aware** of each other's production processes or have information about each other's residual flows. However, it turns out that organisations have very limited insight into this, and sometimes even have an interest in not sharing the necessary information. For example, NVTB (M) and A van Liempd (P) indicated that organisations are reluctant to disclose their information regarding residual flows due to the sensitivity to competition. This lack of **transparency** hinders identifying and exploiting the potential added value of a CSCC. Finding the right partners requires a lot of time and money, which is often not profitable, in particular for smaller parties, or is considered unprofitable due to the high costs.

It is understandable that organisations are not always equally **transparent**. Mainly the employees of the Municipality of Rotterdam (B, C) and NVTB (M) see the current market democracy and market functioning as a basis for sustainability rather than a problem. However, for an effective CSCC it is important to be as open as possible to each other. To indicate an example from one of the market parties, Architect Maken (O), it is more common that when a tender from the municipality is won by a particular developer in collaboration with an architect, the architect is subsequently kept away from the consultations between the developer and the municipality. In most cases, an architect has different interests in a plan than a developer. For example, architects are often more in line with the municipalities when it comes to sustainability and circularity requirements. When architects are kept away from these types of consultations, the underlying story for certain (sustainable and circular) choices may not be sufficiently conveyed to the client. Experience

"They sometimes say knowledge is power, but knowledge is not power; withheld knowledge is power. So, we have to share that knowledge with each other much more and ensure that we develop together, because then better and more suitable products will be created." – Stichting !WOON, Consultant and member of the Natural Gas Free project team in Amsterdam (appendix T) of Architect Maken (O) has shown that at the moment, circular choices are the first to be dropped (often due to time or costs), which should be avoided. Municipalities could ensure that important parties, such as architects, are also invited to this type of consultation, which is expected to have a positive effect on CSCC and the upscaling of circular renovation (mentioned by O, T).

Furthermore, what is experienced by 8 out of 22 respondents (B, H, I, K, Q, R, U, V) is a lack of confidence (**trust**) in the market by (local) government. What emerged from these interviews

was that in practice clients, including municipalities, are often still too hierarchical towards the market. Instead of asking for assignments in a functional and innovative way, showing confidence that the market will come up with the best solutions, clients are often still very used to technical specifications (mentioned by B). This hierarchy does not help to accelerate the circular transition and achieve common goals. One must first enter into the conversation before acting, as in the traditional way, with the attitude of 'I have to get this from you.' Particularly within this transition, it has become apparent that cooperation and having an **open and transparent** attitude towards each other are of great importance. Both public and private parties do not yet know exactly how the CCE works, because no unambiguous definitions and frameworks have been established from the (national) government and because the Dutch built environment is still in

the innovation and knowledge development phase. In this phase it is necessary to enter into a dialogue with each other and to **exchange information and knowledge**. It is therefore important for the transition to a CCE that mutual trust, and in particular the trust of the government in the market, will be stimulated and increased.

"Very often there is an attitude of distrust towards each other, which is not always stimulative to innovation." - Municipality of Rotterdam, Program Manager Circularity (appendix B)

Municipalities could influence this mutual **trust** in different ways. According to 6 out of 22 interviewees (I, K, Q, R, U, V), (local) authorities could ensure that the market is given (more) freedom and room for **experimentation**, through their role as landowners or licensing authorities, for example. Municipalities could not set too many requirements in advance and could not fully frame the plans. Municipalities must start to **trust** in the process with external parties who are like-

"I think you will have to enter into a kind of partnership with parties who are likeminded and who can offer suitable solutions." – Bouwhulpgroep, Consultant and lecturer Sustainable Renovation (appendix G) minded (mentioned by G). This is expected to take time, but ultimately yields much more than is currently the case. In combination with a more liberal approach to certain permits, municipalities could also designate specific areas, where the market is set to work and offer them the opportunity to build **experimentally** (proposed by C, I, J, K, O, Q, T) and, for example, in a modular way (mentioned by F, G, H).

Another barrier that has become clear from the interviews, is that there is insufficient **alignment** between (national and local) circularity ambitions and Dutch legislation. Almost every interviewee, 19 out of 22 (A-I, K-O, Q-U), mentioned the current Dutch laws and regulations, which are considered to be an obstacle to creating the right conditions for the transition to a CCE. Due to these obstructing laws and regulations of the current Dutch system, development is slowed down. However, because municipalities are one of the implementers of this type of national legislation, they could address these obstacles towards the national government. They could indicate what is encountered in practice and what should be tackled at a higher level (regional and/or national) government. Especially in this innovative phase that we are currently in, there could perhaps be some more flexible options for developing in a circular way.

Branch organisations within the building sector could also influence these legislations and regulations. In addition to putting circularity on the agenda, explaining, **inspiring** and sharing examples with their members, they could enter into a

discussion with the national government about the obstacles they and their members encounter in practice. Ultimately, it comes down to the fact that the current regulations are not **in line** with the circular ambitions. There is a lack of **alignment** and unambiguity for both municipalities and market parties.

"Ultimately it just has to become an ongoing model and that requires regulation; clarity in tendering and request." - Techniek Nederland, Team leader Advice (appendix N)

So, compared to the traditional LE, a CE requires a 'richer' and more advanced way of thinking and acting. Current regulations are not sufficiently **in line** with the circular ambitions in the Netherlands. Implementers of these regulations could pass on these obstacles to the national government as points of attention, because in order to further develop the circular transition, adjustments to the current legislation and regulation system are required. The Netherlands wants to achieve the agreed goals, but this must be properly facilitated from regional and central government.

Furthermore, the interview results showed that circular ambitions are expressed by both public and private parties. Many circular initiatives are currently under development. However, if clients request assignments with high circular "All those initiatives and ambitions are wonderful, but it does not make it clear anymore." – VERAS, Secretary (appendix K) ambitions, **clear** frameworks must be provided in advance in order to be able to assess this circularity or to reach a decision about it. However, in practice that is still usually lacking. This is often due to the lack of knowledge within organisations, or the excessive costs involved. And these high costs may not even be so much for the products that are used, but mainly for the risks in the implementation; use of unknown products, processes need to be adjusted, operation is still unknown, etc.

In addition, the national government has not yet set **clear** frameworks for the definition of circularity in the construction sector. Initiatives such as Platform CB'23 try to take this step by creating an unambiguous language for the whole Dutch construction industry. However, this is not yet sufficiently addressed in practice, so that many parties are still **unclear** on what circularity entails.

If a municipality want to convey the circular ambitions to (local) market parties and residents, it is important that they set a good example themselves. What has emerged from 7 out of 22 interviews (A, C, H, P-S) is that this is still insufficiently done in practice, with regard to the sustainable and circular ambitions. Under the motto 'practice what you preach', the

municipality could first approach its own buildings and public space in a circular manner and, above all, show this clearly to the city. In addition to an informing, motivating and facilitating role, the municipality could also play an inspiring role. It is assumed that this will also result in activation and stimulation of awareness among people.

"Practice what you preach. If we don't take it seriously ourselves, we can't blame residents for not taking it seriously." - Municipality of Rotterdam, Consultant Circular and Climate adaptive (appendix C)

Furthermore, the interview results have shown that the municipality could exert influence on a local scale on chain collaboration with and between market parties. The municipality, as client and licensing authority, could assume a director's role in this respect (proposed by B, K). To initiate (local) chain cooperation, the municipality, as 'director', could bring (like-minded) parties together (proposed by A, B, E, J, M, N, P, R, S, V). They could invite market parties and discuss

"Market and government need each other to shape circular innovation." - Platform31, Project Leader Sustainability, Circular Society and Upscaling (appendix I)

their ambitions and ideas with them (proposed by B, E, N, O, R, S). What is important here is that the municipality takes an equal position (not hierarchically) and will also listen to the input from the market itself (mentioned by B, H, I, K, Q, R, U, V). It has previously been shown that public and private parties need each other to achieve the goals for 2030 and 2050.

So, in order to stimulate **awareness** among people and to scale up circular home renovation, people must first become **aware** of what circularity is. It is important that **communication** is accessible. People must be informed, **inspired** and **motivated** to actually renovate their homes in this way. Municipalities are already doing this in the field of sustainability, when it comes to making homes more energy-efficient, but this is not yet happening for circular renovation, because there is not yet a good framework for thinking and regulation. Currently, circular renovation is secondary to the living comfort of private owners. People need to realise and understand that the majority of them are actually already working in a circular manner on a small scale, for example by separating waste. Once they are **aware** of this, they could be increasingly informed, and more tips and tricks could be given to think and act in a circular manner. The municipality could play a stimulating role in scaling up this demand, because she is a party that is generally **trusted** by (future) residents in the advice they give. It is important that municipalities set good examples and continue to **communicate** with residents and private parties.

5.1.3 Insufficient realisation

Learning and experimentation is closely related to **information and knowledge exchange**. Example projects and the realization of circular home renovation are still scarce in the Netherlands. Some methods and elements are tried out on a small scale, which also appear to work and seen as good solutions, but in fact follow-up steps must also be considered. We need to investigate how these solutions could be facilitated, so that it will be possible to apply these small-scale methods and elements on a larger scale.

As indicated by 7 out of 22 respondents (C, I, J, K, O, Q, T), an experimental area is more desirable than a specific demo house as an example project. Demo houses usually incorporate as many innovative solutions as possible, which can serve as a means of **communication** towards residents (mentioned by F, G, T). However, it turns out that in the end most people do not want or cannot live in such a house, because so much has been combined or because it becomes too expensive to afford the total package. It would be better to take smaller steps each time that one can experience and see (mentioned by F, G). In an experimental area or demo district, not all innovative circular solutions need to be incorporated in one home, but different solutions could be implemented at different times in different homes. As mentioned by 7 out of 22 interviewees (G, I, K, Q, R, U, V), by being more flexible with certain permits and area destinations, the municipality, as a real estate developer and/or manager, could challenge the market more to come up with circular innovative solutions.

In addition to drawing up circular ambitions, municipalities could **motivate**, **inspire** and stimulate the market to tackle the transition and to innovate and develop, so that enough support is created to implement the visions. However, both governments and market parties must start small. Realistic and achievable goals must be set, otherwise innovation will not be possible.

"Much more flexibility is needed. Give the market room to experiment." – Association Eigen Huis, Construction Specialist (appendix U)

In addition to designating specific areas to challenge the market, the municipality could also use its own real estate as good examples and show what is possible, including circular home renovation methods. The municipality could challenge the market to imitate these kinds of projects and to stimulate CSCC. This way, the argument is taken away that it is difficult and cannot be done. As a municipality you could show that not only the large market parties, but also the smaller local parties, have already gained experience with this, which requires more mutual **trust**.

"Everyone can emphasize the importance of the development towards complete chain circularity from their own position in the chain. Each chain partner must have its own drive to become circular. But in the first instance there is of course a considerable amount of idealism in it, fed by the fact that this is the way to make the world more sustainable." - Municipality of Rotterdam, Alliance Manager Next Generation Residential Areas (appendix A) Furthermore, almost all of the interviewees confirmed that one of the main success factors of CSCC is the creation of a **win-win situation**. Many organizations and parties are very used to work in a certain (traditional) way. If they are suddenly expected to work in a different (innovative) way, resistance will arise in practice that will slow down the transition. Those resistances will actually have to be tackled. Indicated by the Alliance Manager Next Generation Residential Areas of the Municipality of Rotterdam (A), joining a CSC should be beneficial for every chain partner in order to achieve effective CSCC, which will result in common interest, instead of an individual interest that accumulates. However, it has turned out that this is still insufficiently the case in practice.

As mentioned by the Senior Advisor Energy and Circular Development of the Municipality of Amsterdam (E), it also appears that the government often believes that the market should do it. However, the market will not do it if the risk remains too high. In fact, the government itself could take the lead until the risks are so low that they know for sure that the development will go well. Until then, the market could be helped by broadening knowledge, developing pilots, arranging subsidies, with the government taking a leading role (proposed by E). In this way the cooperation is beneficial for both parties, which will result in a **win-win situation**.

However, by starting small, circular principles are applied in the market. It is precisely the parties that have been using certain materials or processes for some time that are convinced of this. They also see that the risk they attribute is actually no longer necessary. It becomes normal to do their business that way. And that is the level that have to be reached. However, it is expected that it will still take a lot of time. Until then, like-minded parties will have to work together, maybe in a kind of public-private partnership (PPP), to find appropriate solutions, as mentioned by the Consultant and lecturer Sustainable Renovation of BouwhulpGroep (G).

5.1.4 Insufficient facilitation

Due to all the emerging innovative initiatives to achieve a CE, quite a lot of **information and knowledge is exchanged.** However, sometimes it may be a little too much. The branch organisations (K, L, M, N) in particular indicated that they noticed that their members no longer had an overview of the knowledge, information and initiatives. Market parties need these organisations to become familiar with this fragmentation. In reducing this fragmentation of **knowledge and information (exchange)**, municipalities could, in collaboration with knowledge institutions, play a facilitating role, particularly in the sense of collecting and sharing the required knowledge. This was a proposal from both the knowledge institutions and employees of the municipality (A, D, F, I). For the sake of circular design, construction, renovation and demolition, municipalities could, for example, develop a series of themed/knowledge sessions, for both the market and the government (proposed by A). The interviews have shown that the involvement of knowledge institutions is desirable here in order to disseminate the required knowledge to local, medium and high levels of government and to support

"What I notice is that we, as a knowledge institution, have a very crucial role in this transition. Certainly, in the beginning I am involved in the dissemination of knowledge. It is my role to show what is already there and how they can make choices." - TU Delft, Doctoral Researcher Housing Management (appendix F) them so that the necessary knowledge is sufficiently available in order to cooperate with the market (mentioned by E, F, G, H, I). In addition, knowledge institutes play a stimulating role. A project leader Sustainability, Circular Society and Upscaling indicated that Platform31 (I) try very hard to focus on integration and cooperation between both public and private parties. Because knowledge institutes are 'neutral' within these processes and collaborations, they could create an even-playing field, in which it is assumed that an **open and transparent** atmosphere will arise (mentioned by F).

Another way to **share information and knowledge** and to activate the necessary **awareness** among residents, which was mentioned by Architect Maken (O) and Copper8 (Q), is by integrating the theme more into curricula in primary and secondary education. Children and young people should be able to acquire knowledge about circularity in an accessible way from an early age. It is expected that children will tell about this at home, which will result in more **awareness** among parents. Besides, theme afternoons/evenings at schools could also be organised for both children and parents, where various (local) initiators could **share knowledge** about circularity in an accessible way (proposed by Q).

People often do not reason from energy savings or a reduction of the environmental impact, but from certain complaints or wishes. In order to scale up circular home renovation, it is therefore important that the responsibility not only rests with the end user, but that this is also taken into account prior to the process; throughout the supply chain (mentioned by A, D, E, F, G, H, U). The chain could unburden the private homeowner in this area, because we are still in the innovation phase of the transition. The end users are not yet (sufficiently) aware of circularity and are less interested in the entire process prior to a home renovation. For private homeowners who do have some interest in circularity, the currently offered solutions are still too fragmented in the market, making it 'too much hassle' for them to find out how they could renovate their homes in a circular way. If the private homeowner were to buy a product for a renovation, then he or she should not have to think about whether that product is circular, because it should be organised in the chain.

One way to unburden the homeowner is prefabrication of home components, in which circularity is already taken into account in the chain (mentioned by A, D, F, H, U). The consumer no longer has to think about whether the renovation is circular or not, or whether the job is done by the right companies, but then that choice has already been made in the chain. If the house is divided into different components, renovations also remain more affordable for private homeowners. The house does not have to become 100% circular immediately, but if small steps are taken, they could slowly continue to become more circular (mentioned by F, G).

Prefabricated construction is not only beneficial for circular component development, because the product can be disassembled, but also for the mass production required to realise large numbers of affordable homes. If homes are divided into different components, such as a kitchen, dormer window or an extension to the house, then you have a scale with which you could offer the (circular) solutions to multiple consumers. The government could also play an important role in this, such as setting sustainability and circularity requirements for materials and the ability to dismantle components in a modular way (proposed by F, G, H, T). (Local) governments have to start researching how these types

of requirements could be included in regulations (proposed by T). However, it is important that within these standard solutions there is customization, both in the design and in the cycles of the renovation and the form of financing, because in the case of private housing, it would be necessary to renovate in series of one (mentioned by F, G).

Scientist Integrator Sustainable and Circular Construction Concepts of TNO (H) mentioned that in order to arrive at such component solutions, it would help if the chain would work together at element level. The municipality could take an initiating and facilitating role in stimulating this CSCC at element level, making it possible for market parties to get to know each other and to **exchange knowledge** (proposed by F, G, H). The front runners, namely the parties that are already working on circular component development, could, by means of such an online platform or website (as mentioned in section 4.1.2), disseminate experiences and information to other market parties as well as housing associations, VVEs and private homeowners (mentioned by D, O). For example, private homeowners could be informed about various possible solutions with associated underlying thoughts and differences in costs, etc. (proposed by C, D, O).

So, it is important that the responsibility for circular renovation not only rests with the end user, but that this is also taken into account prior to the process; throughout the chain. The chain could unburden the private homeowner, whereby the municipality could take an initiating and facilitating role; making it possible for market parties and residents to get to know each other and to **exchange knowledge and experiences**.

What also emerged several times during the interviews is that project-based work is not always beneficial, certainly not for private homeowners (mentioned by C, D, F, G). For example, when packages are offered in a certain neighborhood, which is now also done with energy-saving packages, one always has to deal with different wishes of residents. A preliminary study could first be done to see what could be offered and what meets the needs of the residents in that specific neighborhood (proposed by D, F, G).

Moreover, 6 out of 22 respondents (A, D, I, K, L, M) assume that shifting taxes will activate and stimulate **awareness** among people about circular home renovation, for example by significantly lower the tax rate for recycled material or for circular demolition. When these kinds of tax shifts start to take place, people automatically start looking for alternatives, purely because of the costs. According to these six interviewees, this type of system intervention have to take place in order to further develop the circular transition. If a private homeowner notices that it is currently much more expensive to build/demolish/renovate in a circular way, then it depends on that person whether or not he or she wants to realise a circular renovation. And then it could help if circular renovation of the home is also stimulated by the local government. Municipalities could challenge residents to renovate their homes in a circular manner by providing certain subsidies, for example when a certain percentage of reusable material is used in the renovation. As a result, the resident is rewarded for 'good' behavior (proposed by T).

Another way in which the necessary collaborations could be initiated is the development of a local circular construction hub: a logistics hub where demolition is linked to new and renovation construction. When a building is demolished, releasing materials and products that could be reused at product level (toilets, wash basins, washing machine taps, etc.), they could be taken to such a 'construction hub' where they would then be thoroughly cleaned and stored. The municipality could again take on a director's role, making a location available for such a construction hub and starting up the collaboration, bringing parties together and organising it concretely. This will be a good starting point on a local scale.

However, such an initiative already exists on a national scale. The circular demolition company A van Liempd is the owner of 'www.gebruiktebouwmaterialen.com', which can be seen as an online material bank. On this site, demolition material is offered to both private individuals and business companies. They would like to enter into more collaborations with housing corporations and municipalities, including Rotterdam, in order to realise the national (and local) circular ambitions. For the Municipality of Rotterdam, a combination of local physical construction hubs and cooperation with a nationally operating organisation such as A van Liempd could be of great benefit. The urban development department of the Municipality of Rotterdam is already working with this organisation, which is going well, because both parties have the same mentality. Only with regard to the demolition of municipal real estate, A van Liempd is of the opinion that circularity steps can still be taken here. When the Municipality of Rotterdam has its own real estate demolished by this company, they can see per project what has arrived at A van Liempd. These materials are then either sold on the

open market or the municipality can indicate that they want to reuse the materials themselves in subsequent projects. When the materials are and can also be reused within the organisation, you achieve the maximum value, which results in double profit: no waste and no new products to buy. If this is not the case, the demolition materials will be sold by A van Liempd and the municipality will receive a certain percentage of the proceeds from the sale. This is an example of a possible public-private partnership, which could be contractually agreed.

So, municipalities could enter into cooperation with (local) market parties and knowledge organisations and could bring parties together by means of, for example, an innovative platform/website where knowledge, experiences and examples are mutually exchanged or by means of a construction hub where demolition and construction are brought together. In its role as director, the municipality could organise more concrete activities than is currently being done.

5.1.5 Conclusion

In conclusion, during the interviews it became clear that almost all parties involved agree that there is a great need for CSCC, to realise the circularity goals and ambitions set by national and local governments. Chain collaboration has been a concept that has been around for decades in the construction sector, but to date a lot is still being built without effective collaboration with various chain partners. Public and private parties need each other to realise the transition to a CCE. The need for this was not only mentioned by public parties, but also by private parties and civil organisations. However, it became clear that the pre-identified CSCC factors, following from the theoretical framework, are not always sufficient reflected in practice. Table 5.3 provides a summary overview showing the presence of each indicator in practice related to (initiation of) CSCC, from different stakeholders' perspectives. This table is also useful for the Municipality of Rotterdam. They can see here which factors should receive more or less attention within (local) CSCC in order to be able to scale up circular housing renovation of private homes. Which factors are sufficiently present in practice and which factors hinder the transition to a CCE?

Appendix VIII gives another summary overview of the four main barriers (insufficient internal integration, communication, realisation and facilitation) and associated suggested opportunities mentioned by the different stakeholders. These opportunities are related to different and overlapping factors (as discussed in this section) and are aimed at desired/ needed roles and actions of the municipality related to (the initiation of) CSCC.

The following section will discuss the results of the internal survey related to the first main barrier (insufficient internal integration) to clarify how this barrier could be overcome. In section 5.3, the other three barriers (insufficient communication, realisation and facilitation) will be discussed within a focus group, where I will investigate from a management perspective whether the suggested opportunities, in terms of (more) concrete strategies mentioned by different stakeholders, will work or not to solve the identified barriers and mismatches.

Table 5.3 - Comparison of different stakeholders' perspectives, related to CSCC indicators (own table).

Presence of indicator related to (initiation of) CSCC from different stakeholders' perspectives

,		, , -	,			/	-,								
		(1) communication	(2) exchange of knowledge and information	(3) coordination	(4) integration	(5) trust	(6) learning and experimentation	(7) win-win orientation	(8) alignment	(9) guidance and direction	(10) openess and transparancy	(11) motivation	(12) inspiration	(13) clarity	(14) awareness
Public parties	Rotterdam - Alliance Manager Next Generation Residential Areas														
	Rotterdam - Program Manager Circularity														
	Rotterdam - Consultant Circular and Climate adaptive														
	Rotterdam - Residents advisor home maintenance and sustainability														
	Amsterdam - Senior Advisor Energy and Circular Development														
Intermediaries	TU Delft - Doctoral Researcher Housing Management														
	Bouwhulpgroep - Consultant and lecturer Sustainable Renovation														
	TNO - Scientist Integrator Sustainable and Circular Construction Concepts														
	Platform31 - Project Leader Sustainability, Circular Society and Upscaling														
	C-Creators - Circular Construction Specialist														
Private parties	VERAS - Secretary														
	BRBS - Director and member of the CCE transition team														
	NVTB - Director and member of the CCE transition team														
	Technology NL - Team leader Technology Netherlands Advice														
	Architect MAKEN - Founder and Architect														
	A van Liempd - Circular demolition specialist														
	Copper8 - Consultant														
	Van Omme en de Groot - Director Renovation & Maintenance														
	Raab Karcher - Greenworks- Deputy Director of Greenworks														
Civil organizations	Stichting WOON! - Consultant and member of the Natural Gas Free project														
	VEH - Construction Specialist at the Knowledge Center of VEH														
Home owner	Het Groene Bureau - private homeowner who has renovated his house (circular)														

Sufficiently present

Partly, but insufficiently available

Not sufficiently present

Undefined

5.2 Internal survey

In addition to the related interview data, and to find more clarity with regard to the first main barrier 'insufficient internal integration', an internal survey was circulated within the municipality, consisting of four questions and four statements. These questions and statements were based on the insufficient internal cooperation and the unfamiliarity among colleagues, resulting from the interviews. Through various means of communication, such as the internal platform RIO, groups in Microsoft Teams and multiple group WhatsApp's from different departments, the internal survey was distributed with the question whether people involved in the topic would like to complete it. The survey was completed by 35 colleagues from various departments and clusters within the Municipality of Rotterdam, including: Sustainability, Urban Development and City Management, Construction and Housing Supervision, Research and Business Intelligence and the Engineering Office (including the Buildings and Steel Structures, Soil Quality and Demolition Asbestos clusters). The purpose of this survey was to gain more clarity about the main internal bottlenecks mentioned by the interviewees. In this section, relevant results from the survey will be discussed in more detail. The complete survey can be found in Appendix III.

First, the participant was asked to what extent he/she was familiar with circularity in the construction and renovation sector. 17% of the participants were very well-know about this subject, more than half of the participants were reasonably familiar (57%) and a quarter (26%) not very well known. Familiarity with the subject differs greatly both within and between different departments. These results shows that more attention should still be paid internally to the subject of circular construction and renovation, so that it will become more known among colleagues.

Next, four statements were given, where the participants had to indicate to what extent they agreed. The first two statements were about **insufficient internal cooperation**. A large majority is of the opinion that more cooperation between different departments within the municipality is needed for the upscaling of the sustainable (and circular) renovation of the private housing stock in Rotterdam (Figure 5.1). In addition, almost 90% of the participants are actually willing to collaborate more with colleagues from other departments (Figure 5.2). This willingness is positive and will hopefully be continued in the future when cooperation strategies are actually set up.

The next two statements were about **unfamiliarity among colleagues**. One third of the participants strongly agree that (more) sharing of knowledge, experiences and ambitions between different clusters/departments within the municipality is necessary for the upscaling of the sustainable (and circular) renovation of the private housing stock in Rotterdam (Figure 5.3). The majority (60%) say they agree with this statement and 6% have a neutral opinion. However, what is striking, the willingness of participants to actually share (more) knowledge, experiences and ambitions with other departments/clusters is less strong (Figure 5.4). Where more than a third of the participants strongly agree with the statement that this knowledge sharing is necessary, less than a quarter strongly agree with the statement that they are actually prepared to do this. The neutral option has also more than doubled in the statement about willingness.

After the four statements, two last questions followed. The first question was about the (current) threats: 'are you experiencing bottlenecks with regard to internal cooperation within the municipality?' Only 4 of the 35 participants did not experience any bottlenecks with regard to internal collaboration within the municipality. The most common bottlenecks related to internal collaboration that were mentioned by the other participants are:

- Conflicting interests between different departments/clusters
- Insufficient communication between different departments/clusters
- Lack of internal coordination and control between different departments/clusters
- Unfamiliarity with each other's assignments
- Uncertainty about responsibilities
- People are working on own work/assignments/interests ('island-culture')



Figure 5.3 – Results of statement 3 of the internal survey (own figure).

Figure 5.4 – Results of statement 4 of the internal survey (own figure).

The last question of the survey was about the (future) possibilities: 'how would you like to envision the internal collaboration between different clusters/departments within the municipality?' All participants came up with suggestions to improve internal cooperation, with the aim of scaling up sustainable and circular renovation of the private housing stock. The most common suggestions, related to stimulating internal collaboration, mentioned by participants are:

- Appoint director(s) for the connection of clusters/departments/assignments
- Create shared visions
- Create integral working groups that share knowledge and develop input for policy/processes
- Create an open, transparent, accessible/informal communication network
- Create space and clarity about (linkage) opportunities that go beyond cluster.

In conclusion, the answers from the internal survey partly confirm the findings from the interview phases, related to insufficient internal cooperation and the unfamiliarly among colleagues within the municipality. In addition, the responses also added new insights to the lack of sufficient internal integration, as summarized in Table 5.4.

Barrier	Discussed themes	Suggested opportunities followed from interviews	(Additional) suggested opportunities followed from internal survey
Insufficient internal I integration	Insufficient internal cooperation	Open transparent atmosphere Shared goals, visions, ambitions Integration of various themes Joint budgeting and accountability Director who integrates several tasks	Internal coordination and control Certainty about responsibilities Integral working groups Clarity about (linkage) opportunities
	Unfamiliarity among colleagues	Sharing information and knowledge Concrete reason to learn together Theme-sessions, lectures, workshops Informal sessions	Accessible/informal communication Integral working groups

Table 5.4 – Main barrier, discusses themes and (additional) suggested opportunities followed from the interviews and internal survey (own table).

5.3 Focus group discussion

The overage three barriers are discussed within a focus group (full transcript can be found in Appendix W), where I have investigate from a management perspective whether the suggested opportunities, in terms of (more) concrete strategies mentioned by different stakeholders, will work or not to solve the identified barriers and mismatches. This focus group consisted of five participants from different departments within the municipality of Rotterdam. Before the discussion started, I clearly presented the perspectives of the different parties interviewed to the participants (based on the interview results), in order to avoid that the predetermined topics and questions were only discussed from the point of view of the municipality.

The themes and questions discussed followed from the results of the previous interview phases. The main purpose of the focus group discussion was to further discuss three recurring barriers from the interview results: insufficient communication, realization and facilitation. Based on these barriers, three questions were presented on which the participants could share their views and opinions. Table 5.5 shows these barriers and associated questions, including the suggested opportunities mentioned by different stakeholders in the previous research phase (Tables 5.1, p. 93 and 5.3, p. 95).

Table 5.5 - Barriers with associated questions and suggested opportunities that will be discussed in the focus group (own table).

Barrier	Discussed question	Suggested opportunities
Insufficient communication	How could the municipality reach, inform and enthuse its residents about circular renovation	Set good examples with own real estate and public space
	options?	Facilitate circular (renovation) platform for both supply and demand
Insufficient realisation	How could cooperation between policymakers and non-policy makers be organized in order	Draw up visions together (policy and non-policy makers)
	to realize future visions?	Designate experimental areas in the city
Insufficient facilitation How could (local) chain cooperation be facilitated and stimulated?		Organize workshops and knowledge sessions for market, residents and municipality
		Make location available for local construction hub and link to existing initiative(s)

In the following sections, each barrier will be discussed, and it will become clear how the municipality views the suggested possible strategies and actions that they could take to initiate CSCC to scale up circular private home renovation. Due to time constraints, it was decided to start with realization, as I had assumed that this was one of the most debatable topics.

5.3.1 Insufficient realisation

The first part of the discussion focused on 'insufficient realization', discussing the following question: How can cooperation between policymakers and non-policymakers be organized and stimulated by municipalities to concretize and realize future visions? The discussion started with the first suggestion from the market '**draw up visions together**'. It soon became clear that all participants agreed with this suggestion. It should not be the case that only the municipality draws up visions and policy documents, but that they discuss with the market what they can do and how they could be supported by the (local) government to actually make this possible. This is currently insufficiently the case in practice.

In addition, it is good to realise that the municipality is not only the policymaker, but also an implementer of its own policy. Municipalities also have the role of client and in this way could set good examples to the city and its residents. The municipality could therefore first test the formulated policy for its own implementation and see what is and is not feasible. This is because it does not appear credible on the market if the municipality prescribes a policy for them but does not implement it itself (which sometimes still occurs in practice). In addition, it is believed these kind of pilot projects will also stimulate the awareness of homeowners. When they see examples in their living environment, they can also think about possibilities for renovation of their own home. One of the participants indicated that after such a 'sample project', in which policy will be tested, a joint evaluation meeting have to be conducted to see whether the own policy is correct, after which these documents may have to be adjusted. External parties who have contributed to these types of projects could also attend these evaluation meetings in order to be able to share their knowledge and experiences with regard to the realisation and feasibility of municipal visions and policy making. Ultimately, what matters is the cooperation between policy and non-policy makers (including municipalities that can take up both roles), whereby feasible solutions must be looked at together.

"That should be the main goal. Not so much that we as a municipality make and implement the program, but that we ask other parties what they can do and what they need to do so." – Sustainability Advisor Urban Development In addition, it is also important in vision development and policy making that homeowners are listened to. There could be more listening to the experiences of residents. What is the situation like and what needs and obstacles are there at the moment? So, also when drawing up vision and policy documents, the municipality could listen to its residents, because they may also be able to share a lot of experiences and relevant input.

The second proposed opportunity, resulting from the interviews, was 'designate experimental areas in the city'. The participants in the discussion also agreed on this statement, but also provided additional insights. In addition to designating experimental areas, the municipality could also designate so-called experimental buildings. By making

the municipality's own real estate (and public space) available for experimenting space, both market parties and (local) authorities could gain experience and share knowledge. In the longer term, this could also be beneficial for private homeowners, because in this way (by seeing circular (renovation) examples in the built environment and public spaces) they become more aware of circularity and its possibilities.

"When we talk about sharing experiences, I think that 'experimenting buildings' can also be beneficial for private individuals later on. What materials do you have? What do you need? Where is too short?"- Consultant Building Physics, Circularity and Integrated Sustainability

5.3.2 Insufficient facilitation

The second part of the discussion was related to 'insufficient facilitation', discussing the question: How can the municipality play a meaningful role in initiating and facilitating local circular chain cooperation in order to scale up circular renovation of owner-occupied homes?

The first suggestion from the private parties was 'organize workshops and knowledge sessions for the market, residents and municipality itself'. Most participants mentioned that agreed and considered training to be an important aspect in particular. For example, the municipality could facilitate (in collaboration with knowledge institutions) comprehensive courses on certain material uses or ways of CSCC that are given to people already working in the construction industry, such as architects or contractors, but who want to learn more about other construction activities. However, the municipality is not (yet) equipped for this. Until now, only people are supported and trained who have social assistance or unemployment benefits. Since September 2020, jobseekers from Rotterdam can apply for a training voucher of up to 2,500 euros from the municipality, which reimburses training up to and including MBO 4 level. With this voucher they can pay for their studies and increase their chances of long-term paid work in sectors where there are sufficient jobs, including the construction and engineering sector. In this way, the municipality invests in its residents and in the resilience of the Rotterdam economy. However, these vouchers are not (yet) intended for people who are already working in construction and want to learn or retrain related to, for example, circular material use or CSCC, which could be very useful to achieve the desired upscaling of circular construction and renovation. In addition, there is currently a shortage of labor for renovation work. Rotterdam is looking for people who can give meaning to making the private housing stock more sustainable. Perhaps they can attract these people by facilitating training through such vouchers. The application of certain (circular) materials sometimes requires different expertise than that of traditional organizations. The municipality is actually looking for how they can support smaller (local) companies so that these parties get more opportunities regarding developments related to (circular) sustainability of the built environment. How can they make themselves more visible and profile themselves? Municipalities should not only work with certified companies, but also look at the smaller organizations and the quality they want to achieve.

In addition, it became clear from the discussion that the municipality and many construction companies are still quite conservative. That have to be broken first. If everyone continues to do their job according to the standard way, nothing will change. For example, Bouwmaat is one of the largest suppliers to construction companies, and they could be addressed. Until now you can hardly get any bio-based materials from this company. First the big parties have to be educated, then the smaller parties will follow. There are smaller providers in the bio, eco and circular sector, but they often run into the problem that they do not have enough work, which is partly because they do not (yet) earn enough to be a member of, for example, the Woonwijzerwinkel and to be able to profile themselves in this way. Many are also not yet certified as construction companies. (Local) governments are currently bypassing these smaller organizations, which sometimes makes it difficult for them to develop further and profile themselves.

What was mentioned as a suggestion during the discussion was cooperation between the municipality and construction markets. For example, many Gamma's are franchises and can mean a lot to municipalities. For example, municipalities can provide stickers or stamps with 'better/circular/healthier choice' or the like to these types of large construction markets. In addition, these companies can also organize energy or circular fairs and open days for sustainable and circular renovation of homes in collaboration with municipalities, whereby the construction companies then ensured that during those days/weeks the shelves were filled with products and materials with those particular stickers or labels, which will also result in more awareness among people. Gradually, the products and materials without labels could be phased out at the construction market level. In principle, a start has been made with regard to healthier materials, by means of MPG and LCA calculations, but this development is still very slow.

The next suggestion was **'make location available for a local construction hub and link to existing initiative(s)'.** Due to time, this point was not discussed extensively. However, all attendees mentioned that they agreed whit this statement. In the past, attempts were made to realize such local construction hubs, but it turned out that at the time it was sometimes incomplete and/or not financially feasible. Nevertheless, it is certainly worthwhile to facilitate such a hub locally or regionally, because then (secondary) material does not have to be hauled throughout the country.

5.3.3 Insufficient communication

In the last part of the discussion, 'insufficient communication' was discussed, focusing on the following question: How could the municipality reach, inform and enthuse its residents about circular renovation options?

First discussed was the suggestion 'set good examples with own real estate and public space', which was in part

related to the designation of experimental buildings, as discussed in section 5.1. Good examples can contribute to activating and stimulating awareness among residents. For some, intrinsic motivation plays a major role in renovating the home in a sustainable/circular way. However, for the vast majority of private homeowners this plays no role at all and they are not aware of circularity. They simply have a problem in the home and therefore want to rebuild or renovate. The monthly lower energy bill could be the incentive for making the home more sustainable, but for circular applications there is not (yet) such a motive that stimulates people. In the discussion it emerged that this is perhaps the biggest barrier to enthausiasmating residents, that the residents do not see what they are getting in return. In response to this, another participant indicated that as a resident you certainly get something in return when you renovate your home in a circular manner. "In general, the resident gets a healthier home with a better quality of life in return" (Consultant Circular and Climate adaptive). For example, bio-based materials can often be clamped more easily in different sizes of the existing structures during renovations. While the more common products often have standard sizes, where (dis) assembly is more difficult. However, the resident must be able to see and understand that value. So, the municipality could play an informative role in this respect, for example by showing how things can be done differently, by giving the right examples with its own property.

On the one hand, it could be said that it is precisely on the private housing stock that the municipality cannot exert any influence, because it does not fall under its own ownership. But on the other hand, the municipality can influence the immediate environment and public outdoor spaces around these homes. For example, when residents themselves start taking initiatives and activities with regard to making the home or neighborhood more sustainable (perhaps with circular interventions), the municipality could always take action on 'its' side (the surrounding environment). This also applies to the role as client, which the municipality has.

"If we set high standards for developers, then we have to do it also ourselves in a high-quality way." – Sustainability Advisor Urban Development

In tenders from the municipality, it could be considered how 'old' buildings will be handled when they are to be demolished. The discussion showed that this must also be communicated very clearly between different departments and parties. For example, the re-use of materials from an old building has been proposed for the redevelopment of the library in Rotterdam. There, the municipality proposed the materials passport to be used as a means of communication, for example an information board in the entrance hall: "these are the materials that are present in the building and this is how we deal with them ...". At first everyone was enthusiastic about this idea, but when it became known that it would entail more costs, the plan was quickly lost. It was not given priority by the project management office (PMB), which was probably also due to a lack of sufficient internal integration and communication. It is important that it is clearly communicated what the incentives are for certain (sustainable/circular) choices that are made within such (municipal) projects.

Residents often reason in this way too. Certain choices must pay off. The experience of the participants in the discussion shows that people often do not reason from a long-term perspective. If, for example, bio-based materials are chosen instead of materials that are difficult to degrade, the value is not immediately visible, but only later when the home or building is demolished. Most people do not or insufficiently understand that certain choices are only sustainable / circular during the demolition process. According to those present, the municipality could play a pioneering role in this. Colleagues (including the people of PMB) must become more aware that action is needed now, whereby the value will only become visible in the future. This have to be completely permeated by the entire organization.

"I think that for all successes you always need enthusiastic and good people. And in the case of the library, I thought that was actually the most important barrier. That the right people in the projectmanagement were not selected. Then nothing will come of it." – Sustainability Advisor Urban Development However, to refer back to the insufficient integration of themes, ambitions and departments within the municipality, with such a materials passport (as was proposed at the library) you also have to deal with benefits and investments of various departments. A materials passport for a well-documented building is useful to both the real estate department and the library foundation. But the social development department (MO) is the client and the paying party for the investment of the building. And there is the separation and the (internal) barrier, which contradicts the motto "practice what you preach". There are currently no or insufficient incentives for residents to renovate their homes in a circular manner. However, it appears that a healthy living and housing climate is becoming increasingly important to people. Furthermore, for now it actually only costs more money, time and effort to renovate the house in a circular manner. However, what emerged clearly during the discussion is that action is now needed. In practice, this is not (yet) done sufficiently by the residents, so it is the task of the municipality to inspire and motivate them with information and examples of possibilities. What is of great importance here is the way of communicating with residents. As an example, what emerged from one of the

"The municipality still fails to do that too often and then you get all kinds of prejudices that are not easily conveyed by residents." -Residents Coach (Advisor Home Maintenance and Sustainability) interviews is that the residents in the New West district of Rotterdam are very active and enthusiastic about sustainability. However, in the park, in the middle of this district, the municipality has replaced a lot of greenery with asphalt, which was not understood by the residents. For the municipality it is important that there is clear communication about the motives and perspectives for this type of interventions, which will result in more understanding by residents.

The second suggestion **'facilitate a circular (renovation) platform for both supply and demand'** that resulted from the interviews actually falls under the theme of both facilitation and communication. Some participants in the discussion certainly agreed, others were a little more skeptical.

First of all, everyone agreed that a lot of information about circularity is scattered on the internet, which also makes it difficult for residents to find the right information. However, within this fragmented information there are also good initiatives and websites that both private parties and residents can turn to, although these are not sufficiently known and visible. In addition, everyone agreed during the discussion that the municipal website www.duurzaam010.nl contains insufficient information and is not accessible enough for residents.

"The needs of residents (the users of the website) were not considered at all. And I think that the municipality should pay much more attention to this: make a website in such a way that it is really suitable for the user and, above all, should be an entrance page, so that you then end up with the right parties". – Residents Coach (Advisor Home Maintenance and Sustainability)

Several participants did not consider it necessary to facilitate a (new) circular platform. However, it was indicated that the municipal website could be more accessible and better structured, with more references to existing initiatives, information and examples. The municipality could actually play a very passive role in this, facilitating and being present in the background.

"If you want to encourage collaboration, you shouldn't start thinking that you know best how everything should be done. In fact, the municipality should not design such a site itself, but should work together with the people who are already doing it. And give them the opportunity to work that out." – Sustainability Advisor Urban Development There was also talk about the accessibility of such a website. An online platform should be accessible to different target groups: what can I do as a do-it-yourselfer? What can I engage as a contractor? As a landlord, what can I do about circularity? In order to optimize the user-friendliness of such a website, a user, for example a private resident, should also be able to select certain criteria, such as the type of material, the color and the distance where the material is available. For example, the difference in CO_2 impact could become transparent from bio-based materials vs. fossil materials. When residents make certain choices, they should also be able to see what kind

of impact this will have on the environment, for example. By developing something that gives people the choice for circular renovation options, awareness will also be stimulated.

So, the main purpose of the focus group discussion was to investigate from a management perspective whether the suggested opportunities, in terms of (more) concrete strategies mentioned by different stakeholders, will work or not to solve the identified barriers and mismatches. The additional insight resulting from this focus group discussion partly confirm the findings from the interview phases, related to insufficient realization, facilitation and communication. In addition, this discussion also added new insights, as summarized in Table 5.6 (p. 101).

Barrier	Discussed questions	Suggested opportunities followed from interviews	(Additional) suggested opportunities followed from focus group discussion
Insufficient realisation	How could cooperation between policymakers and non-policymakers be organised in order to realise future visions?	Draw up visions together (policy and non-policymakers)	Test formulated policy for own implementation Conduct evaluation meetings during and after 'test' projects
		Designate experimental areas in city	Also designate experimental buildings (owned by the municipality)
Insufficient facilitation	How could (local) chain cooperation be facilitated and stimulated?	Organize workshops and knowledge sessions for market, residents and municipality	Facilitate comprehensive courses Integrate vouchers for retraining Make sure smaller companies are seen and can profile themselves Cooperate with construction markets
		Make location available for local construction hub and link to existing initiative(s)	Participants agreed, no additions
Insufficient communication	How could the municipality reach, inform and enthuse its residents about circular renovation options?	Set good examples with own real estate and public space	Make clear what people get in return Make sure people can see and understand the (added) value, through example projects Tackle the immediate environment and public outdoor spaces around the homes Communicate very clearly what the incentives are for certain choices Listen to homeowners input and experiences
		Facilitate circular (renovation) platform for both supply and demand	Improve www.duurzaam010.nl: more accessible and better structured Refer to existing initiatives, information and examples Make site/platform accesible to different target groups

Table 5.6 – Main barriers, discusses questions and (additional) suggested opportunities followed from the interviews and focus group discussion (own table).

5.4 Conclusion

In conclusion, this chapter intended to provide an answer to SQ3: How do different actors of CSC networks see and experience the role of the municipality in CSCC to achieve upscaling of circular renovation of owner-occupied homes? This has been done by means of a stakeholder analysis, consisting of two phases of semi-structured interviews, an internal survey and a discussion in a focus group. First, results are given of the current presence and importance of the identified research indicators related to (initiation of) CSCC from different stakeholders' perspectives and whether and how municipalities could and should steer these indicators to scale up circular private home renovation. This analysis has resulted in four main barriers of CSCC in which the municipality could and should exert influence: insufficient internal integration, communication, realization, facilitation. To find more clarity on how the first barrier could be overcome, an internal survey was circulated within the municipality. This has resulted in an overview of proposed possibilities from employees of different departments within the municipality to reduce the insufficient internal cooperation and the unfamiliarity among colleagues (Table 5.4, p. 96). The overage three identified barriers are discussed within a focus group, where I have investigated whether the suggested opportunities mentioned by different stakeholders, will work or not to solve the identified barriers and mismatches. This discussion has resulted in an overview of additional insights and contradictions, mentioned by employees working in different departments within the municipality, regarding the proposed possibilities and strategies resulting from the interviews (Table 5.6). In the next chapter, I will reflect on the concepts and theories described (Chapter 4) on the basis of the results of this research, after which the final advice will follow.

discussion.

To strengthen the conclusion of this research (Chapter 7), the results following from the previous chapter will be compared to the state-of-the-art and relevant theories and concepts, examining the importance of obtained solutions for the identified mismatches in more detail (6.1). Additionally, the research validity (6.2), limitations (6.3) and possible practical recommendations for further research (6.4) will be discussed.

6.1 Interpretation of the results

This section will reflect and highlight the results that add new insights to the preliminary analysis of the state-of-the-art (6.1.1) and of relevant theories and concepts (6.1.2). From a management perspective, it will be described what this research contributes to existing knowledge development.

6.1.1 Reflection on the-state-of-the-art

Research on the state-of-the-art (Chapter 3) has shown that in the Netherlands, including the city of Rotterdam, there are still many potential opportunities for private housing renovation with the implementation of circular principles. However, in practice, private homeowners appear to be hardly aware of circular renovation. As can be seen in Figure 3.5 (p. 45), the Dutch built environment is still in the formative phase of the transition towards a CCE. What is important at the moment is to take the step to the growth phase, where the urgency of the transition will increase and stakeholders within the SC will start working together effectively.

Typical for the formative phase of the transition is experimenting with circular products and services, developing a vision, creating new networks and relationships in supply chains and entering in new partnerships. At this stage it is not yet expected that there will be major changes in the use of raw materials. This will change in the growth phase, as more effects of decreasing and changing use of raw materials become visible. Think of decreasing CO2 emissions and socio-economic progress, such as the growing added value of circular activities.

Table 3.1 (p. 40) gives an overview of several circular design principles that are minimally applied in practice in the Netherlands. Some of these principles were also discussed during the interviews and focus group, in which it has turned out that the design principle **modular building and renovation** is most promising to support by local authorities. Stimulating modular building will help to take the next step towards the growth phase, to achieve better CSCC and to scale up circular renovation of private homes.

Modular building and renovation are ways to unburden the homeowner: prefabrication of home components, whereby circularity is already taken into account in the chain. The consumer no longer has to think about whether the renovation is circular or not, or whether he or she has the job done by the right companies. That choice has already been made in the chain. If the house is divided into different components, then renovations also remain more affordable for the private homeowner. The house does not have to become 100% circular immediately, but if small steps are taken, you can slowly continue to grow. Prefabricated construction and renovation are not only beneficial for circular component development, because the product can be disassembled, but also for the mass production required to realise large numbers of affordable homes.

Resulting from the stakeholder analysis, the local government could also play an important role in supporting **modular building and renovation**, such as setting sustainability requirements for materials and the ability to dismantle components in a modular way. Local governments have to start researching how these types of requirements could be included in laws and regulations. However, it is important that within these standard solutions there is customization, both in the design and in the cycles of the renovation and the form of financing, because in the case of private housing stock, it would be necessary to renovate in series of one. The results of the interviews have shown that in order to arrive at such component solutions, it would help if the chain works together at element level. The municipality could take an initiating and facilitating role in stimulating this cooperation at element level, making it possible for market parties to get to know each other and to exchange knowledge. The front runners, the parties that are already working on circular component development, could, for example by means of an online platform at the municipal website, disseminate experiences and information to other market parties as well as housing associations, VVEs and private homeowners. For example, private homeowners could be informed about various possible solutions with associated underlying thoughts and differences in materials, time, costs and impact on the environment etc. If local governments will stimulate, support and facilitate **modular building and renovation** more, it is expected from this research that the route to the growth phase of the transition will be accelerated, that CSCC will be stimulated and that circular private home renovation will be scaled up.

Another circular design strategy what was mentioned in the analysis into the state-of-the-art (p. 39), is the **multiple reuse scenario strategy** developed by Steward Brand (Brand, 1995). By means of this strategy, it is assumed that a building can retain its value, even if there is a need for a function other than that for which the building was made after the first use phase (Brand, 1995). What was striking during the stakeholder analysis is that no participant mentioned the transformation of municipal buildings into homes. However, thinking of repurposing the existing stock and adaptive reuse is actually a good example in which municipalities could play a significant role. When municipalities have their own (vacant) buildings circularly transformed into homes, they set a good example to the city ('practice what you preach'). In this way, it is assumed that (future) residents will become more aware of what circularity means in the construction sector. So, based on the **multiple reuse scenario strategy** (Brand, 1995), I would recommend the Municipality of Rotterdam to also consider the transformation of their own (vacant) buildings into homes.

Furthermore, the conclusion of the analysis into the state-of-the-art (section 3.6, p. 52) has provided an overview of the characteristics of the formative phase of the transition with the related state-of-the-art in Dutch context (Table 3.7, p. 54). This table has shown what is (further) currently required to be able to take the next step towards the growth phase of the transition towards a CCE. Based on this analysis, the literature review has delved deeper into the aspects that are now identified as urgent for CSCC in order to scale up circular owner-occupied housing renovation, where each research variable was theoretically substantiated and corresponding research indicators were identified. Based on these indicators, the empirical part of the research was carried out, after which a column can be added to Table 3.7 (p. 54), indicating per aspect how the municipality could act to contribute to the acceleration to the growth phase of the transition and to stimulate (local) CSCC (resulting in Table 6.1). Some of the proposed tasks for the municipality are related to several aspects.

In addition to these possible tasks for the municipality regarding the four aspects that are now identified as urgent for CSCC (resulting from Chapter 3) and based on the results (described in Chapter 5), four additional requirements have been identified that are required for CSCC: sufficient internal integration, communication, realisation and facilitation. These aspects are explained in more detail in the next section, reflecting on the relevant theories and concepts (described in Chapter 4).

Table 6.1 – Overview of characteristics of formative phase, indicating possible role of municipalities to the acceleration of the transition (own table).

Research variables	State- of-the-art of each characteristic, related to CSCC for private home renovation in Dutch context	Suggested tasks for municipality, resulting from interviews, survey, focus group
Actor networks	In the Netherlands, different initiatives are taken (discussed in section 3.4), which will stimulate CSCC in their own way, by, among other things, inspiring entrepreneurs, informing them, bringing them into contact with other entrepreneurs and guiding them with expertise and knowledge, often by using online platforms. However, these initiatives are mainly designed for national government, municipalities, supplying industries and knowledge organizations, and do not yet involve private homeowners sufficiently. In a CE, consumers, like private homeowners, could be an essential part of the SC. It is assumed that the majority of this target group is also insufficiently or not aware of the development of such actor network initiatives and that CSCC is not yet present in practice for private home renovation.	 Make existing (online) networks visible, like Platform CB'23, Platform31, BTIC, City Deal, Cirkelstad Rotterdam, VIBO-vereniging, Holland Houtland, Bouwprof, Kern. Try to involve residents in (online) knowledge networks related to circular home renovation. Give (local) initiatives a (online) platform, so that residents become more aware of circular renovation (through social media posts with links to the website). Challenge private parties and encourage them to collaborate in experimental areas focused on circular private home renovation. Organize (online) theme sessions for public and private parties (including interested residents).
Supply chain learning	In general, learning networks are well established in the Netherlands. A great deal of knowledge is already being developed by universities and knowledge institutions, whether or not in collaboration with private parties. However, a distinction must be made between fundamental and practical knowledge development. BZK considers the link with practice or the applicability of the knowledge developed to be important for both. However, it is expected that these steps in knowledge development and upscaling will be less likely to be taken by private clients and local entrepreneurs, like handymen. This group of individuals is difficult to reach, but it is important in the long process towards a CCE and within CSCC.	Circular request: test own policy with own implementation (real estate, public space etc.). Challenge private parties and encourage them to collaborate in experimental areas focused on circular private home renovation. Organize regular (learning) evaluation moments with all parties involved in project(s). Organize (online) theme sessions for public and private parties (including interested residents). Facilitate comprehensive courses for stakeholders already working in the construction industry. Integrate vouchers for retraining.
Future visions	Visions regarding the realization of a Dutch CE have also been established. However, sometimes these visions are still quite abstract. One of the recommendations of PBL (2021) to realize a CE is to develop detailed visions that are widely supported by private parties and social organizations and to develop this into concrete goals. These goals may differ per transition theme, chain or product group, which requires a differentiated approach. It is assumed that more detailed future visions, supported by (local) private parties and social organizations, will have a positive effect on (local) CSCC and the achievement of a Dutch CCE.	Enter into dialogues with private parties and civil organizations and try to give (together) a more concrete interpretation to municipal vision and policy documents. Circular request: test own policy with own implementation (real estate, public space etc.).
(Circular) business models	The current development of circular business models is still facing several challenges. Most of the circular business models used have been created in a linear environment. They are aimed at the company's own business operations in terms of raw material use and product design and are only aimed at the use of new revenue models to a limited extent. The consequence of this is that there is still insufficient CSCC or joint business models.	Organize, together with knowledge institutions, (online) theme sessions related to the development of circular business models for private parties. Challenge private parties and encourage them to collaborate in experimental areas focused on circular private home renovation.

6.1.2 Reflection on relevant theories and concepts

This section will reflect on the literature review given in Chapter 4. First, I will reflect on the previously explored theories and concepts and will describe how my research contributes to them. Table 6.2 provides an overview of the discussed theories and concepts, including additional insights resulting from this research.

Table 6.2 - Overview of the discussed theories and concepts and additional insights resulting from this research (own table).

Variable	Theory/concept	Additional insights resulting from this research
Innovation	Innovation Theory (Rogers, 1962)	Both public and private parties are still in the early innovation phase of the transition to a CCE. Heading back to Rogers' (1962) innovation theory, the 'chasm' must now be crossed towards the Early Adopters. In contrast to Innovators, Early Adopters are influential because this group contains a large number of opinion leaders who are respected and trusted within the system, giving them great persuasiveness. Opinion leaders are seen as advisers on which innovations should or should not be applied in practice. When there is an overlap between the opinion leaders and the Early Adopters, the acceleration of the diffusion will take off and the 'chasm' between the Innovators and the Early Adopters, will be crossed (Figure 4.2, p. 59). Within this research, I regard municipalities as opinion leaders . They could, as launching customer , help the innovation curve overcome this certain point due to its mass. Partly because, in addition to its regulatory and legislative function, the municipality also has market opportunities. As long as clients do not ask for it, the market will not offer it and as long as suppliers do not ask for secondary material, there will be little supply. So, supply and demand must be triggered. And municipalities, could play a major role in here. On the one hand by making policy, rules, tax benefits, etc. And on the other hand, as a client and purchaser.
Actor networks	Actor Network Theory (Callon, 1987)	According to ANT (p. 65), one of the success factors for an innovation to succeed is the inclusion of actors in a network. What this research has shown is that in the reconstruction of such a network formation, local authorities can play a facilitating and stimulating role by entering into dialogues with both public and private parties and bringing them together.
	Social Network Theory (Gordon and McCann, 2000)	In SNT (p. 65), three main characteristics of a social network were identified: "firms within the social network are willing to undertake risky cooperative and joint ventures without fear of opportunism; firms are willing to reorganize their relationships without fear of reprisals; and firms are willing to act as a group in support of common mutually beneficial goals" (Gordon & McCann, 2000, p. 520). This research has shown that the government often believes that the market should reshape their (traditional) business models into circular business models. However, the market will not do that if the risks remain too high. In practice, most of the Dutch (construction) organizations are not (yet) willing to undertake risky cooperative and joint ventures. In fact, the (local) government itself should take the lead until the risks are so low that they know for sure that things will go well. Until then, the market should be helped by broadening knowledge, developing pilots and arranging subsidies, with the government taking a leading role.
	Concept of SCC (Barratt, 2004)	In various literature and theories, elements and indicators of SCC have been identified. Barratt (2004) has divided these elements into cultural, collaborative and strategic elements (p. 66). Based on this research, I think that Barratts (2004) model could be strengthened by adding the factors coordination and control to the collaborative elements. It has become clear that these two factors are desirable for cross-functional activities, process alignment and joint decision making, especially within organizations. Within this research, coordination and control means, among other things, connecting relevant parties, continuously facilitating communication and providing feedback on actions taken. It will align activities of different actors in the innovation system and thus accelerates the transition.
Supply chain learning	Concept of SCL (Spekman et al., 2002)	According to Spekman et al. (2002), learning is a key aspect of SC competency, where the SC is viewed as a means for the acquisition of learning and knowledge. They have identified six factors that influence SCL (Table 4.3, p. 68). As a result of this research, one more factor could be added to this list, which is the incentive to learn and develop knowledge . When there is a concrete reason with a clear goal to learn with and from each other, for example within a certain (pilot) project, a combination will arise between knowledge development and teambuilding. It is assumed that such an incentive to learn will have a positive influence on SCL.
	Concept of SCL (Lambrechts et al., 2012)	Within the study of Lambrechts et al. (2012), five aspects were summarized for developing successful SCL, shown in Table 4.4 (p. 68). They indicate that successful SCL can lead to improved relationships between SC actors, mutual understanding, improved innovation processes and increased overall performance of the organisation. It was assumed that municipalities can influence these five aspects, both as policy maker and non-policy maker. According to the participants of this study, the municipality could act more effectively with regard to these five aspects. With regard to the first aspect (interdependent system optimization and development) and following from the stakeholder analysis, municipalities can offer the market more room to experiment, whereby legislation and regulations can be dealt with more flexibly. For the second aspect (joint competence development), municipalities can bring market parties together to facilitate CSCC. For example, by putting the market to work and letting them work together on construction projects for municipal buildings. The municipality, in collaboration with knowledge institutes, can also be a source of information and knowledge sharing. They can play a facilitating role in organizing knowledge sessions, webinars, workshops and comprehensive courses for interested market parties and residents. With regard to the third aspect (creation of unique mutual knowledge and expertise), municipalities can, in addition to gathering and sharing information and knowledge.

		for example via a platform on the municipal website. It is important here that both the success stories and less good experiences are shared, to show what is possible, to arouse interest in people and so that learning can take place. For the fourth aspect (whole system awareness), municipalities could make more use of social media. Both market parties and residents are not yet sufficiently aware of circular housing renovations. Awareness among residents could be stimulated through posts on social media, during daily activities, in order to bring it more to the attention. Awareness among private market parties can be stimulated by, for example, circular questions or by facilitating knowledge sessions and comprehensive courses. With regard to the last aspect (transforming the essence or identity of the chain), municipalities, as policymakers, can sharpen their goals, visions, policies and standards in the field of circularity. It was also recommended by participants in the study to flesh out vision and policy documents together with market parties, because initiatives from the market can provide good input.
Future visions	Concept future visions (Van der Helm, 2009)	Van der Helm (2009) had identified four key elements that will help to understand the purpose and function of future visions (Table 4.6, p. 70). What has emerged from this research, and which could be added to these identified elements, is remaining in the adjacent possible . Visions must be clear and realistic, otherwise it will be at the expense of the functions to inspire, motivate and provide guidance to the implementers of these visions.
(Circular) business models	Categorisation CE principles (Ellen MacArthur Foundation, 2013; Bocken et al., 2014)	Reflecting on the overview of circular strategies (Figure 4.5, p. 73) developed by Ellen MacArthur Foundation (2013) and Bocken et al. (2014) and based on the outcomes of this research, the role of the municipality within local CSCC falls mainly within the organizational category . Municipalities, as opinion leaders, can stimulate, facilitate and organize local CSCC in order to scale up circular housing renovation. They could bring like-minded SC actors, including knowledge institutes and residents, together by inviting them to knowledge sessions, workshops, consultations and theme days, for example. In addition, the municipality could facilitate an open innovation platform on (or linked to) the municipal website, which is referenced in social media posts. On such a platform, examples can be shown, information can be provided, success stories can be shared and interest and awareness can be stimulated among both private market parties and residents.

Besides these additional insight for the described theories and concepts, I made some assumptions about the possible role of municipalities with regard to relevant aspects of the theories in Chapter 5. These assumptions are confirmed in Table 6.3 based on the results of the stakeholder analysis.

Table 6.3 - Assumptions about the role of the municipality with regard to relevant aspects of the theorieso (own table).

Research variable	Assumption	Conformation
Actor networks	In order to achieve a transition to a CCE, and thus a change in thinking and acting by the stakehold- ers within this network, it is important that the relationships between the different levels and actors are understood, also by municipalities. Municipalities are seen as opinion leaders, where it is assumed that they could support and facilitate CSCC and the adoption of innovations on local scale. (p. 66)	This assumption is confirmed by this research. According to the participants of this study, municipalities could by coordinating and facilitating information and knowledge sharing and by creating an open and trusted communication network, bring local market parties together, which is expected to have a positive effect on local CSCC. Furthermore, municipalities could, as launching customers, help the innovation curve overcome the 'chasm' due to its mass. Partly because, in addition to its regulatory and legislative function, the municipality also has market opportunities. As long as clients do not ask for it, the market will not offer it and as long as suppliers do not ask for secondary material, there will be little supply. So, supply and demand must be triggered. And municipalities, could play a major role in here. On the one hand by making policy, rules, tax benefits, etc. And on the other hand, as a client and purchaser.
Supply chain learning	BKZ considers the link with practice and the applicability of the knowledge developed to be important for both (RVO, 2020a). It is expected that these steps in knowledge development and upscaling will be less likely to be taken by private clients and local entrepreneurs, like handymen. This group of individuals is difficult to reach, but it is important in the long process towards a CCE and within CSCC. In this research, I will investigate in which ways the municipality can reach this group within the context of local CSCC. (p. 67)	How the municipality can reach private clients and local entrepreneurs and stimulate them to take steps in knowledge development related to circular renovation, is by facilitating knowledge sessions, webinars and workshops in which they can participate. In order to stimulate this target group to actually participate in these activities, the municipality can activate awareness through posts on social media and the municipal website(s). Showing success stories and clearly indicating the urgency of the transition may help to increase interest in circular renovation. Besides, the municipality could also facilitate comprehensive courses for actors who are already working in the construction industry, but who want to retrain and develop in the circular area, for example.
	A distinction must be made between fundamental and practical knowledge development. It is important for both policy makers and non-policy makers to experiment and to apply the acquired knowledge in practice. In this way, lessons can be learned from mistakes and experienced obstacles in practice, after which appropriate solutions can be researched and developed. It is assumed that the municipality, as an opinion leader, could play a facilitating role by supporting and facilitating these experiments. (p. 67)	This research confirms that the municipality, as an opinion leader, could play a facilitating role by supporting and facilitating experiments. In order to get parties more motivated to switch to circular business models, the municipality could challenge the market to come up with circular and modular building and renovation solutions. Not only by informing and inspiring the market with opportunities and successful projects, but also by offering the market space and putting them to work in, for example, designated experimental areas where there will be (more) flexible handling of current legislation and regulations. By making the municipality's own real estate (and public space) available for experimenting space, both market parties and (local) authorities could gain experience and share knowledge. In the longer term, this could also be beneficial for private homeowners, because in this way (by seeing circular (renovation) examples in the built environment and public spaces)

		seeing circular (renovation) examples in the built environment and public spaces) they become more aware of circularity and its possibilities. (Local) governments could designate experimental areas and buildings and challenge private parties and encourage them to collaborate in these experiments (with for example focusing on circular private home renovation).
Future visions	It is assumed that more detailed future visions, supported by (local) companies and social organisations, will have a positive effect on (local) CSCC and the achievement of a Dutch CCE. For this research, it is useful to analyze different scientific concepts regarding future visions and to see what is useful in developing the theoretical framework. (p. 69)	Following this research, public and private parties should enter into dialogues together, because initiatives originating from market parties or housing associations could serve as input for renewal of municipal policy. To initiate local CSCC, the municipality, as 'director', could bring (like-minded) parties together. They could invite market parties and discuss their ambitions and ideas with them. What is important here is that the municipality takes an equal position and will show (more) confidence in the market. It should not be the case that only the municipality draws up visions and policy documents, but that they discuss with the market what they can do and how they should be supported by municipalities to actually make this possible. As a recommendation to the municipality, try to give together with private parties a more concrete interpretation to municipal vision and policy documents. Start by finding shared ambitions, both within organizations and with potential public and private partners. Innovative market parties and socially engaged entrepreneurs play an important role in boosting circularity and tackling social challenges. Involve these parties early in the process.
Business models	With regard to the main focus of this research, it is assumed that municipalities only have an indirect facilitating role in CBM development. For example, they can inform, stimulate, inspire and motivate the market to switch to CBMs. By sharing the necessary information and knowledge about CBMs and offering help (as a facilitating municipality), local market parties may be able to make this switch more easily. (p. 72)	See conformation third assumption: In order to get parties more motivated to switch to circular business models, the municipality could challenge the market to come up with circular and modular building and renovation solutions. Not only by informing and inspiring the market with opportunities and successful projects, but also by offering the market space and putting them to work in, for example, designated experimental areas where there will be (more) flexible handling of current legislation and regulations. So, municipalities indeed only have an indirect facilitating role in CBM development.

In addition, the stakeholder model (Figure 4.3, p. 62) developed by Blayse and Manley (2004) can be used to reflect on Rotterdam's CSC network. Figure 6.1 is based on this model, showing the relationships between the Municipality of Rotterdam and the stakeholder groups involved in this research.



Figure 6.1 - Relationships between the Municipality of Rotterdam and the stakeholders involved in this research (own figure).

What follows from this research is that the municipality could take more actions to strengthen relations with other authorities, branch organizations in the construction sector, knowledge institutions, local market parties and (interest groups of) homeowners. For each mentioned municipal relationship (green arrows), it will be briefly explained how the municipality could act with regard to facilitating CSCC to scale up circular renovation of private homes.

What follows from this research is that the municipality could take more actions to strengthen relations with other authorities, branch organizations in the construction sector, knowledge institutions, local market parties and (interest groups of) homeowners. For each mentioned municipal relationship (green arrows), it will be briefly explained how the municipality could act with regard to facilitating CSCC to scale up circular renovation of private homes.
Arrow 1: Compared to the traditional LE, a CE requires a 'richer' and more advanced way of thinking and acting. Current national regulations are not sufficiently in line with the circular ambitions in the Netherlands. Implementers of these regulations, like municipalities and branch organisations in the building sector, could pass on these obstacles to the national government as points of attention, because in order to further develop the circular transition, adjustments to the current legislation and regulation system are required. The Netherlands wants to achieve the agreed goals, but this must be properly facilitated from regional and central government.

Arrow 2: In reducing the current fragmentation of knowledge and information regarding circularity in the construction industry, municipalities could, in collaboration with knowledge institutions, play a facilitating role, particularly in the sense of collecting and sharing the required knowledge. For the sake of circular design, construction, renovation and demolition, municipalities could, for example, develop a series of themed/knowledge sessions, for both the market and the government. The interviews have shown that the involvement of knowledge institutions is desirable here in order to disseminate the required knowledge to local, medium and high levels of government and to support them so that the necessary knowledge is sufficiently available in order to cooperate with the market. In addition, knowledge institutes play a stimulating role. For example, Platform31 focuses on integration and cooperation between both public and private parties. Because knowledge institutes are 'neutral' within these processes and collaborations, they could create an even-playing field, in which it is assumed that an open and transparent atmosphere will arise.

Arrow 3: Currently, there is a lack of confidence in the market by (local) governments. What emerged from the interviews was that in practice clients, including municipalities, are often still too hierarchical towards the market. Instead of asking for assignments in a functional and innovative way, showing confidence that the market will come up with the best solutions, municipalities are often still very used to technical specifications. This hierarchy does not help to accelerate the circular transition and achieve common goals. One must first enter into the conversation before acting, as in the traditional way, with the attitude of 'I have to get this from you.' Particularly within this transition, it has become apparent that cooperation and having an open and transparent attitude towards each other are of great importance. Both public and private parties do not yet know exactly how the CCE works, because no unambiguous definitions and frameworks have been established from the (national) government and because the Dutch built environment is still in the innovation and knowledge development phase. In this phase it is necessary to enter into a dialogue with each other and to exchange information and knowledge. It is therefore important for the transition to a CCE that mutual trust, and in particular the trust of the government in the market, will be stimulated and increased.

Arrow 4: It must become apparent that residents have a great need to be informed and facilitated by municipalities. The Municipality of Rotterdam is already informing its residents through, for example, the municipal websites. However, it should be taken into account that people will end up here if they want information on their own initiative about subsidies when they want to make their homes more sustainable. In order to activate and stimulate awareness among people, especially with regard to circular renovation solutions and to achieve the circular objectives based on the needs of residents, consideration could be given to reaching residents in a more accessible way. Various means of communication could be used for this to make communication between the municipality and residents more accessible, such as the existing 'Duurzaamheidswinkel' (Sustainability Shop), pop-up stores, one-stop shops, demo homes or demo districts, digital platforms and social media. The results from the interviews show that both physical and digital service points are highly desirable for local population. Here, private homeowners could be informed, inspired and motivated to think about circularity and circular possibilities for home renovations. Practical experiences of the resident advisor (home maintenance and sustainability) of the Municipality of Rotterdam and interest groups for homeowners have shown that most residents are not enthusiastic about, for example, CO₂, nitrogen or circularity, but more about aspects such as accessibility, health, affordability, comfort and lower bills etc. So, the way of communicating as a municipality to residents is very important. And that includes naming the benefits people are susceptible to. Municipalities must be able to properly explain to residents that certain products and materials are not harmful, neither for the environment nor for their own health.

The Residents Coach of the Municipality of Rotterdam and a consultant of Stichting !WOON experienced that the most promising way to reach people is during their daily activities. For example, the municipality could use social media more, with the aim of making people less averse to sustainability/circularity and giving them more insight into what it entails. Instead of having to look up information on a website on their own initiative, residents can easily encounter messages,

blogs, informative videos, etc. via social media, which may attract their attention. It will be assumed that this will also stimulates awareness among people. If circularity is seen often enough during daily activities, for example by scrolling on Facebook, it is expected that the subject will automatically come to the attention of this target group.

Moreover, it is also important for municipalities in vision development and policy making that homeowners are listened to. There could be more listening to the experiences of residents. What is the situation like and what needs and obstacles are there at the moment? So, also when drawing up vision and policy documents, the municipality could listen to its residents, because they may also be able to share a lot of experiences and relevant input.

So, it is assumed by the participants in this study that when these four forms of relationships improve and strengthen, this will have a positive influence on local CSCC in order to scale up circular home renovation.

Furthermore, Chapter 5 has provided results on the current importance of the identified research indicators related to CSCC (derived from the described theories and concepts) from different stakeholders' perspectives and whether and how municipalities could steer these indicators to scale up circular private home renovation. This analysis has resulted in four main barriers of CSCC in which the municipality could exert influence: insufficient internal integration, communication, realisation and facilitation. Within this section, I will examine the importance of the suggested solutions and opportunities for the identified barriers in practice (mentioned by research participants) in more detail. I will do this in order to be able to describe the most suitable role of the municipality within the transition to a CCE, with the specific focus on circular private home renovation in the next chapter (Conclusion/Advice). All proposed roles and tasks for the municipality, following the results of this study, have been merged and reduced to a number of crucial actions that are expected to contribute to the development of CSCC and to the upscaling of circular private home renovation. Table 6.4 provides an overview of the four main barriers to support CSCC identified in this research, the related main suggested tasks for the municipality along with the importance to address these tasks, substantiated by existing literature.

Table 6.4 - Overview of the main barriers, along with the importance to address the suggested opportunities (own table).

Main barrier to support CSCC	Suggested task for municipality	Importance of addressing suggested task according to existing literature
Insufficient integration	Introduce an internal coordinator who integrates several themes and tasks of different departments and clusters within the municipality.	Circular oriented innovation requires active leadership and diverse collaboration networks (Williams et al., 2017; Lüdeke-Freund et al., 2018). Within an organization, it is important to regularly inform employees about the current state-of-the-art with regard to corporate policy and organizational goals and to support and help employees understand them (Borcaa & Baesu, 2014). In order to contribute to the success of the organization and to achieve the management objectives, managers must inform employees at all levels of the actions that are being taken, because effective communication with employees will positively influence the outcomes of the organization (Borca & Baesu, 2014). The higher the level of internal communication within an organization, the more productively problems are solved and the greater the satisfaction of the employees and engagement of consumers (Jacobs et al., 2016). Strategic management of this communication is required for a successful organization (Hume & Leonard, 2013).
		coordination of different organizations and explicit coordination of the actors and their relationships in the innovation process. Active leadership is required in order for the innovation to succeed (Brown et al., 2019).
	Create internal integrated working groups, consisting of employees from different departments and clusters within the municipality.	A key success factor that plays a role in achieving sustainable oriented innovation is cooperation within organizations (Medeiros et al., 2014). Employees in an organization are seen as key success factors of internal communication (Borca & Baesu, 2014), which is a fundamental part of a successful organization (Hume & Leonard, 2013). Internal communication creates a confidential, open and trusted atmosphere within the organization in which all employees are accepted and understood (Jacobs et al., 2016). What is important here is the exchange of knowledge and information between the project, organizational and industry levels. However, research shows that it is difficult to transfer knowledge gained in individual projects to the organizations, so that the knowledge can be applied to other projects. Organizations must be able to learn from new ideas and knowledge and then implement them and transfer the results to other organizational levels (Bygballe & Ingemansson, 2014). This could be achieved by means of internal integrated working groups.

	Organize regular internal informal discussions, knowledge sessions and teambuilding workshops.	Knowledge networks with involved stakeholders throughout the innovation process is of great importance (Brown et al., 2019). Effective communication is essential to increase the likelihood of innovation adoption, which also includes formal and informal communication between internal stakeholders (Koebel et al., 2004).
Insufficient communication	Enter into dialogues with private parties and civil organizations and try to give (together) a more concrete interpretation to municipal vision and policy documents.	Whether or not to adopt an innovation is influenced by communication (Rogers, 1962; Morrison et al., 2000; Larson et al., 2006). Effective communication is essential to increase the likelihood of innovation adoption, which includes formal and informal communication, communication between users and suppliers, communication through demonstrations of new technologies and communication between both internal and external stakeholders (Koebel et al., 2004).
	Use example projects as means of (accessible) communication to activate and stimulate awareness among people and to stimulate, inspire and motivate people.	Until the market has passed the first introduction phase, and innovations have been accepted and adopted by the majority resulting in rapid growth and volume of circular renovation, (local) authorities must set an example and have the responsibility to contribute to get to this point. This can be done through an economic contribution, but also through regulation or an incentive (Hauge et al., 2012).
	Use of social media as means of (accessible) communication to activate and stimulate awareness among people and to stimulate, inspire and motivate people.	During communication activities, a potential adopter goes through a decision-making process before the innovation is adopted and includes awareness, interest, evaluation, trial and ultimately adoption. An example resources used as information source and communication channel is mass media (Koebel et al., 2004).
	Use of circular renovation platform as means of (accessible) communication to stimulate, inspire and motivate people and to bring together demand and supply.	Previous research has shown that an potential adopter is more likely to invest in an innovation when information about competitors is available, as this will increase the profitability estimates of innovations (Koebel et al., 2004).
Insufficient realization	Circular requests: test own policy with own implementation (real estate, public space etc.).	Governments around the world are increasingly seeing the urgency of business activities to find solutions for major environmental and sustainable challenges. They can contribute to this by "creating the framework conditions that will assist companies to operate according to a business model through which they can meet their business objectives and make profits" (Beltramello et al., 2013, p. 19).
	Organize regular evaluation moments with all parties involved during (pilot) projects.	To scale up circularity in SCs, literature provides two main approaches: assessment and collaboration (Gimenez and Tachizawa, 2012). Assessment concerns the activities related to the evaluation of stakeholders involved and collaboration focuses on working directly with these involved parties through support, incentives, training or other activities (Gimenez and Tachizawa, 2012). Assessment is therefore not an isolated aim to increase sustainability and circularity, it also requires collaboration between stakeholders in the SC.
	Designate experimental areas and buildings and challenge private parties and encourage them to collaborate in these experiments (with for example focus on circular private home renovation).	Innovation should not only be seen as developing a new idea, change or improvement, but as the entire process including the implementation of these ideas, changes or improvements (Rogers, 1962; Mlecnik, 2013; Nicholls and Ziegler, 2015; Ziegler, 2017). So, the developed circular renovation ideas and concepts must also be implemented, starting with experiments . Adams et al. (2017) states that the structure of the construction industry faces multiple obstacles, including a fragmented context and SC. This fragmentation is partly caused by the different relationships between companies and because companies move from one project to another. This makes it difficult to discover where the motivation to innovate lies and where the resources must come from to start the innovations (Davidson, 2013). To reduce these obstacles, it is important that cooperation takes place where knowledge can be shared , that people can learn from prototypes and demonstration projects , and that suppliers connect in innovation teams (Mlecnik, 2013b).
Insufficient facilitation	Organize (online) theme sessions for public and private parties (including interested residents).	Knowledge networks with involved stakeholders throughout the innovation process is of great importance (Brown et al., 2019). This will also influence the awareness among people.
	Facilitate comprehensive courses for private parties.	For organizations it is important to acquire learning abilities in order to survive between competing organizations, firms and network levels (Gosling et al., 2017).
	Facilitate teaching programs and organize workshops for (local) primary and secondary schools to activate and stimulate awareness among children.	Effective communication is essential to increase the likelihood of innovation adoption, which includes informal communication and activating awareness (Koebel et al., 2004). This research has shown that awareness among people can also be activated and stimulated through education and communication through children.
	Facilitate location for storage of building materials used (linking to existing initiatives/parties).	(Local) authorities have the responsibility to contribute to the acceleration of the CE transition. This can be done through an economic contribution, but also through regulation or an incentive (Hauge et al., 2012). Also helping private parties , for example by facilitating locations for storage of materials, could contribute to the acceleration of the CE transition.

Because the importance of the necessary tasks that the municipality could undertake according to this research has now been theoretically substantiated, Table 6.4 will serve as a basis for the advice to the Municipality of Rotterdam that will be formulated in Chapter 7.

6.2 Validity of the research

Because this is a qualitative research, the interpretation of the results plays a major role, because results are more subjective than within a quantitative research. Within this research, not all interview questions were fixed and respondents were allowed to answer as they wanted. As a researcher, I questioned the respondents on the basis of previously identified indicators. After, I analyzed the answers, whereby there was the possibility that the results were interpreted differently. However, this does not mean that this research is not valid, because the following factors have been taken into account:

- **Representative:** within this study, 22 stakeholders were interviewed from public, private and civil sectors. This is a representative and diverse number of respondents. The main purpose of the interviews was to gather different insights from different groups of stakeholders, both policy makers and non-policy makers, within CCSC of private home renovation.

- **Objective:** during the interviews I have been as objective as possible. I have tried not to direct the questions and to show my own opinions and insights as little as possible.

- **Critical:** after a completed interview, I immediately started transcribing and analyzing. Certainly, after the first few interviews it became clear to me what is going well and where there was still room for improvement. Which questions work and which do not? Where should more questions be asked? In this way, I learned from advancing insights during the research.

- **Archivable:** prior to the interviews, participants' approval had been requested before recording the interview, so that afterwards I had the opportunity to listen back and transcribe the conversations. After transcribing the interviews, the transcripts were analyzed using the coding process of Williams and Moser (2019), as explained in Chapter 2. The purpose of this method of analysis was to reduce the many pages of interview data to a number of themes (main barriers and opportunities) that provided answers to the research questions and could contribute to the theory. All recordings, transcripts and analyses (including coding) are neatly stored in different folders on my computer, hard drive and Project Drive. During the entire research process, I handled the data with care. I will continue to do this even after the research is complete (as explained in Chapter 2). The attached document to this thesis contains all anonymized transcripts of the interviews and focus group discussion, so that other researchers/students have the opportunity to use them.

- **Reliable:** to increase the reliability of this research, I presented the main results from the interview phases in an additional internal survey (completed by employees from different departments and clusters) and within a focus group with specialists from different departments and clusters within the municipality. One of the goals of the internal survey and focus group discussion was to find out how different specialists interpreted the results.

6.3 Limitations of the research

During (and after) the research process I encountered the following limitations, which should be taken into account when using the research results for follow-up research:

- **Limitation of switching research method:** initially, my plan was to collect data using the case study method. The intention was that I would investigate three private homes that had been renovated in a circular manner. However, during the search for suitable cases, this turned out to be a very difficult task. There are hardly any examples of circular private home renovations. And the few that have been done are either not documented or not known, because we are still in the innovative phase of this transition. As a result, halfway through the research process I decided to organise my empirical part differently, as explained in Chapter 2 (two phases of interviews, internal survey and focus group discussion). By organising my research in this way, I expected to collect more relevant information than I could have gathered with the case study method, because I could investigate more different perspectives of stakeholders within

the SC of circular renovation, which will strengthen my substantiation of the final advice towards the Municipality of Rotterdam. However, this has resulted in the fact that I only interviewed one private homeowner who had renovated his home in a circular manner. Because in this research the focus is on the upscaling of circular renovation of private homes, it would have been interesting if I could have spoken to more homeowners who had gained this experience and could therefore provide me with input for the research. As an alternative, I have interviewed people who represent private homeowners such as the Sustainability Coach of the Municipality of Rotterdam, Vereniging Eigen Huis (VEH) and Stichting !WOON.

- **Limitation of sampling method:** one sampling technique that is used is snowball sampling, where one participant recommended another, until the range of stakeholders will 'snowball' to a large number of participants. All interviews ended with the question of whether there were any specific stakeholders that I (also) should include in the research. A selection criterion was that the (potential) participant understood my research area and could reflect on it. In addition, the (potential) participant also had to understand my role as a researcher and should be able to offer different perspectives by sharing opinions, thoughts, feelings and insights from their point of view. Using this sampling method resulted in a wide range of stakeholders, including those that were (still) unknown to me. However, a limitation of this method was that these stakeholders may have the same social or professional background and interest in the CCE, which will result in limiting the perceptions and range of data collected. In this research, I tried to prevent this by questioning a wide diversity of participants, based on another sampling method, which was theoretical sampling.

- **Limitation of (online) focus group discussion**: The focus group consisted of five participants from different departments within the Municipality of Rotterdam, which can result in that the predetermined topics and statements will only be discussed from the viewpoint of the Municipality. In order to avoid that, before the discussion starts, I clearly showed the viewpoints from the market parties, branch organisations within the building sector, interest groups of homeowners and knowledge institutions (based on the interview results). In retrospect, the discussion might have yielded more results if more different participants/parties were present. However, due to the online setting, this might have resulted in a discussion that is more difficult to guide. In addition, partly because the timeframe of the research process and because I had to conduct and supervise the discussion online, it was difficult to schedule an appointment where several colleagues and parties could be present. If I had more time, perhaps a longer or second discussion would have been interesting to delve deeper into certain insights.

- **Underexposing (circular) business models:** five research variables were involved in the pre-developed theoretical framework: (adoption of) innovation, actor networks, supply chain learning, future visions and (circular) business models. However, (circular) business models were underexposed during the interview phases. This was mainly due to the fact that many private parties themselves did not yet see clearly what a circular business model should look like. In addition, during the interviews more attention was paid to the role of the municipality within CSCC, whereby the other research variables and indicators were discussed more.

- **Reflection on SDGs:** In the introduction of this thesis, I indicated that this research will contribute to the following three SDGs: SDG9 Industry, innovation and infrastructure, SDG11 Sustainable cities and communities and SDG17 Partnerships for the goals. However, the aspects of infrastructure and communities have not been investigated in this study. For example, while the municipality has strong possibility to act on infrastructure, this is underexplored in this research. In addition, no communities were included in the stakeholder analysis, because the research then became too broad in the given time frame. The scope of this study was the role of municipalities within local CSCC for circular renovation of private homes. So, this research does contribute to industry, innovation, sustainable cities and partnerships. Further (additional) research could focus on the two missing aspects (infrastructure and communities).

- **Results not entirely generalizable:** this research falls within the broad concept of CE, which has received worldwide attention. However, this research has only focused on the Dutch built environment and construction industry. In addition, the conclusions have been formulated and addressed specifically to the Municipality of Rotterdam. This must be taken into account for (inter)national use of the results of this study. Not all results can be generalized for other municipalities within and outside the Netherlands. It should be taken into account that there may be several similarities and differences at regional, national and international level.

- **Time restriction:** What would strengthen this research is if I could have (partly) implemented the proposed advice to the Municipality of Rotterdam and tested it in practice. For example, if I could have worked on the research for a few weeks/months longer, I could have started organising knowledge sessions, workshop and working groups internally in order to first tackle the internal barrier and test the best ways of internal collaboration.

6.4 Recommendations for follow-up research

The main goal of this research was to make a contribution to the theory on how CSCC within circular renovation of owner-occupied housing could be better managed and facilitated, to achieve the desired upscaling at a rapid pace and to advise the Municipality of Rotterdam on what role they should play in this process. In order to achieve this, and to give an answer to the main question of this research, the next chapter will provide practical recommendations that the municipality could undertake in the coming period, in the form of an advisory action plan. Besides, based on the collected results and formulated limitations of this research, the following recommendations for follow-up studies have been formulated:

- **In-depth research:** because this research is exploratory in nature, it makes sense to conduct more in-depth research into the various insights that follow from this research. For example, how the role of an internal director should be fulfilled and how comprehensive courses related to circular renovation could be facilitated by the municipality for private parties.

- Research into public-private partnerships (PPP): As mentioned in Chapter 5, the circular demolition company A van Liempd is the owner of 'www.gebruiktebouwmaterialen.com', which can be seen as an online material bank. On this site, demolition material is offered to both private individuals and business companies. They would like to enter into more collaborations with municipalities, including Rotterdam, in order to realise the national (and local) circular ambitions. For the Municipality of Rotterdam, cooperation with a nationally operating organisation such as A van Liempd could be of great benefit. The urban development department of the Municipality of Rotterdam is already working with this organisation, which is going well, because both parties have the same mentality. Only with regard to the demolition of municipal real estate, A van Liempd is of the opinion that circularity steps can still be taken here. When the Municipality of Rotterdam has its own real estate demolished by this company, they can see per project what has arrived at A van Liempd. These materials are then either sold on the open market or the municipality can indicate that they want to reuse the materials themselves in subsequent projects. When the materials are and can also be reused within the organisation, you achieve the maximum value, which results in double profit: no waste and no new products to buy. If this is not the case, the demolition materials will be sold by A van Liempd and the municipality will receive a certain percentage of the proceeds from the sale. This is an example of a possible public-private partnership, which could be contractually agreed. Further research is needed to investigate how local authorities can enter into other public-private-partnerships with (local) circular construction and demolition companies, such as A van Liempd or Buurman (participants within this research).

- **Research into laws and regulations:** (local) governments could play an important role in stimulating component and modular building methods, such as setting sustainability/circularity requirements for materials and the ability to dismantle components in a modular way. Research is needed on how these types of requirements could be included in (national) laws and regulations. Besides, it is important to look at the regulations related to the energy transition in combination with the (national) circular goals. This research has shown that these are not (yet) sufficiently aligned, which means that some circular-related developments are delayed in practice.

- **Research into building materials:** this research focused on upscaling circular private home renovation. However, because the circular transition is still in the innovation phase, a lot of research is still needed in the field of building materials. Governments want residents to make the 'best' choice for renovating their home, but what is the 'best' choice? Is there currently sufficient supply and is there enough knowledge about this supply? This study has shown that this is not yet sufficiently the case. Studies should be conducted into which building materials are good / medium / bad for various sustainable and circular applications in homes. For example, which materials are good for the energy transition, but less good for circularity and vice versa? Which materials positively influence both the energy and circular transition? Which materials have the least impact on the environment in relation to the various transitions?

- **Research into (circular) network of Rotterdam:** Chapter 3 lists various organizations and initiatives on different policy levels to which the Municipality of Rotterdam is affiliated. However, this is not a complete overview. I asked around within the municipality whether there is an overview of all partners in Rotterdam with regard to circular construction. However, many employees within the municipality could not tell me this themselves and did not know exactly who I could ask. It turned out that such a complete overview is currently not available. It would be useful to investigate which organizations and initiatives the Municipality of Rotterdam is (even more) affiliated with and how the relationships between these parties are in order to arrive at a complete overview of stakeholders. In this way, it could also be investigated which relationships should be strengthened or perhaps weakened. This could be the task of a designated internal coordinator.

conclusion.

In this chapter, the conclusion will be given following from the previous chapters, answering the main question that is central to this research: **How could CSCC be facilitated by municipalities to achieve upscaling of circular renovation of Dutch owner-occupied housing?**

7.1 Development of answering the main research question

In this chapter, the conclusion will be given following from the previous chapters, answering the main question that is central to this research: **How could CSCC be facilitated by municipalities to achieve upscaling of circular renovation of Dutch owner-occupied housing?** The answer to this question will be the final advice addressed to the Municipality of Rotterdam. Before this advice is given, the development of answering the main research question will be provided. In the following sections, answers will be given answering to the three sub-questions.

SQ1 What is the state-of-the-art of circular renovation of Dutch owner-occupied housing?

Research into the state-of-the-art has shown that in Europe as well as in the Netherlands, in the province of South Holland and in the city of Rotterdam, there are still many potential opportunities for housing renovation with the implementation of circular principles. Private owners represent a large part of the Dutch (and Rotterdam) population, which made it useful and interesting to focus the research on this group. Various governments have less influence on the actions of private homeowners, but there are various initiatives and (economic) incentives that encourage residents to renovate and make their homes more sustainable.

The number of Dutch companies and organisations that target the CE is increasing. Besides, the majority of these companies focusses mainly on recycling, repair and reuse of materials, which already existed before the discussion about the necessary circular transition started. There is still insufficient attention for innovative strategies and (circular) business models that can drastically reduce the use of fossil fuels. The current Dutch economy moves and functions too much in a linear society. On the other hand, it has also become apparent in recent years that there are indeed opportunities for circular development in the field of business models, knowledge platforms and production methods, but these must be scaled up.

The Dutch building sector is still in the formative phase of the transition towards a CCE. Typical characteristics for this phase are **creating new actor networks and relationships** in CSCs, **learning and experimenting** with circular products and services and **developing future visions**. In addition, this phase is also working on a **new generation of business models**: collective, cooperative, sustainable, circular and on the basis of cascading forms of value creation. What is important at the moment is to take the step to the growth phase, where the urgency of the transition will increase and stakeholders within the SC will start working together effectively. The following sections show what is currently required, related to the characteristics of the formative phase, to realise this step:

(1) Actor networks: In the Netherlands, different initiatives are taken, which will stimulate CSCC in their own way. However, these initiatives are mainly designed for national government, municipalities, supplying industries and knowledge institutions, and do not yet involve private homeowners sufficiently. In a CE, consumers, like private homeowners, are an essential part of the SC. However, it is assumed that the majority of this target group is insufficiently or not aware of the development of such actor network initiatives and that CSCC is not yet present in practice for private home renovation, which should be changed.

(2) Supply chain learning: In general, learning networks are well established in the Netherlands. A great deal of knowledge is already being developed by universities and knowledge institutions, whether or not in collaboration with private parties. However, a distinction must be made between fundamental and practical knowledge development. BKZ considers the link with practice or the applicability of the knowledge developed to be important for both. However, it is expected that these steps in knowledge development and upscaling will be less likely to be taken by private clients and local entrepreneurs. This group of individuals is difficult to reach, but it is important in the long process towards a CCE and within CSCC.

(3) Future visions: Visions regarding the realisation of a Dutch CE have also been established. However, sometimes these visions are still quite abstract. One of the recommendations of PBL (2021) to realise a CE is to develop detailed visions that are supported by private parties and social organisations and to develop this into concrete ambitions. These ambitions may differ per transition, which requires several different approaches. It is assumed that more detailed future visions, supported by (local) private parties and civil organisations, will have a positive effect on (local) CSCC and the achievement of a Dutch CCE.

(4) (Circular) business models: The current development of circular business models is still facing several challenges. Most of the circular business models used have been created in a linear environment. They are aimed at the company's own business operations in terms of raw material use and product design and are only aimed at the use of new revenue models to a limited extent. The consequence of this is that there is still insufficient CSCC or joint business models.

In conclusion from the analysis of the state-of-the-art, the adoption of an innovation and the factors mentioned formed the five research variables, which gave the motives for further literature research.

SQ2 Which factors are needed to facilitate CSCC according to literature?

To investigate which factors are necessary for facilitating CSCC, five research variables (innovation, actor networks, supply chain learning, future visions and business models) were further investigated by means of a literature review. Each section ended with relevant research indicators that were used in the development of the theoretical framework. The purpose of identifying these relevant research indicators was to address the aspects that are currently required to be able to take the next step towards the growth phase of the transitions towards a CCE. The developed theoretical framework (Table 4.9, p. 75) has summarized the literature review and has identified the research variables and associated indicators related to (facilitation of) CSCC. This table has formed the scientific justification for this research and is used as guidance for the interviews and focus-group discussion.

According to this literature review, the identified factors (research indicators) that are needed for (facilitating) CSCC in order to scale up circular owner-occupied housing renovation are: communication, knowledge and information exchange, coordination, integration, trust, learning and experimenting, win-win orientation, alignment, guidance and direction, openness and transparency, motivation, inspiration, clarity, awareness.

SQ3 How do different actors of CSC networks see and experience the role of the municipality within CSCC to achieve upscaling of circular renovation of owner-occupied homes?

Answering the third sub-question has been done by means of a stakeholder analysis, consisting of two phases of semistructured interviews, an internal survey and a discussion in a focus group. First, results are given of the current presence and importance of the identified research indicators related to (the initiation of) CSCC from different stakeholders' perspectives and whether and how municipalities could and should steer these indicators to scale up circular private home renovation (Table 5.3, p. 93 and Appendix VIII, p. 151). This analysis has resulted in four main barriers of CSCC in which the municipality, as main stakeholder, could influence to alleviate these: **insufficient internal integration**, **insufficient communication, insufficient realization** and **insufficient facilitation**. To find more clarity on how the first barrier could be overcome, an internal survey was circulated within the municipality. This has resulted in an overview of proposed possibilities from employees of different departments within the municipality to reduce the insufficient internal cooperation and the unfamiliarity among colleagues (Table 5.4, p. 96). The other three identified barriers are discussed within a focus group, where I have investigated whether the suggested opportunities mentioned by different stakeholders will work or not to solve the identified barriers and mismatches. This group discussion has resulted in an overview of additional insights and contradictions, mentioned by employees working in different departments within the municipality, regarding the proposed possibilities and strategies resulting from the interviews (Table 5.6, p. 101).

So, how the different actors of CSC networks experience the role of the municipality within CSCC to achieve the upscaling of circular renovation of private homes, are summarized in Tables 5.3, 5.4, 5.6 and in Appendix VIII. Based on these tables, and on the previous chapter in which the proposed possibilities and tasks for the municipality are theoretically substantiated, the final advice addressed to the Municipality of Rotterdam is drawn up, which answers the main research question in the following section.

7.2 Advice addressed to the Municipality of Rotterdam

Following from the answers to the three sub-questions, this section will provide a theoretically substantiated advice, addressed to the Municipality of Rotterdam. The advice focusses on what role they could play to facilitate CSCC to achieve upscaling of circular renovation of Dutch owner-occupied housing, which will answer the main research question:

RQ How could CSCC be facilitated by municipalities to achieve upscaling of circular renovation of Dutch owner-occupied housing?

During this research, four main barriers of CSCC have been identified that are currently insufficiently present in practice and where it is assumed that the municipality could and should exert influence. According to the participants in this research, the municipality could act as a director and could focus more on **internal integration**, **communication**, **facilitation** and **realisation**, as shown in Figure 7.1. The advice is drawn up on the basis of these four main tasks, whereby practical recommendations (R) are given that could be a positive stimulus for local CSCC to achieve upscaling of circular renovation of owner-occupied housing.



Figure 7.1 – Municipality as director, focusing on four main tasks to stimulate CSCC to achieve upscaling of circular renovation of private homes (own figure).

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INTERNAL INTEGRATION

In order to achieve effective (local) CSCC, it is important for the Municipality of Rotterdam that circularity becomes an integral part of the construction and renovation tasks and that different departments are sufficiently informed and aligned. To achieve this, there must be more internal integration between colleagues as well as between visions, ambitions and transition challenges of different departments. This means that sufficient information and knowledge must be shared internally, so that colleagues become more familiar with each other's themes and tasks that are being worked on, which will result in more internal integration. The internal alignment and integration must first be worked on before publicizing new applications and entering into partnerships with external parties with regard to the upscaling of circular renovation of the private housing stock in Rotterdam. If it is in order internally, the step to external transparent CSCC will be smaller. This research has shown that this internal integration can be achieved through the following three practical recommendations:

Introduce internal coordinator(s) - This research has shown that it will be a major challenge for municipalities to bring several ambitions of different departments and projects together in order to achieve integral internal cooperation. Because this has not yet been (sufficiently) successful so far, an internal coordinator might have to be appointed/adopted who integrates several themes, visions, ambitions and tasks of different departments and clusters within the municipality regarding circular (building and) renovation of the private housing stock of Rotterdam.

In order to contribute to the success of the organisation and to achieve the policy objectives, such an internal coordinator could inform employees at all levels of the actions that are being taken, because effective communication with employees will positively influence the outcomes of the organisation. It is important to regularly inform employees about the current state-of-the-art with regard to corporate policy and organisational goals and to support and help employees to understand them. The higher the level of internal communication, the more productively problems will be solved and the greater the satisfaction of the employees and engagement of external parties. Strategic coordination of this communication is required for successful organisation outcomes. Furthermore, an internal coordinator has to understand how innovative ideas move between different organisational levels. To enable feedforward and feedback, it is required to create an accessible and active (internal) knowledge network. This will be useful to clearly show that different assignments can be linked, to know which (local) policy instruments are available for which purposes, to develop and stimulate (internal) cooperation programs, to stimulate learning and experimenting, to collect effective information and to create mechanisms for sharing (financial) risks, accountability and benefits. For example, consideration could be given to freeing up money from several jars, which together is enough to finance necessary subsidies for certain measures, like implementing circular renovation principles. Because all these activities are still not or insufficiently present within the municipality and because circularity must be an integral part of the entire organisation, these tasks could be managed by an integral coordinator, which could be a new job within the municipality.

R1: An internal coordinator could be appointed/adopted before October 2021 who integrates several themes, visions, ambitions and tasks of different departments and clusters within the municipality regarding circular (building and) renovation of the private housing stock of Rotterdam.

Set up internal integrated working groups - A key success factor that plays a role in achieving circular oriented innovation is cooperation within organisations. Employees in an organisation are seen as key success factors of internal communication, which is a fundamental part of a successful organisation. Internal communication creates a confidential, open and trusted atmosphere within the organisation in which all employees are accepted and understood.





What is important here is the exchange of knowledge and information between the project, organisational and industry levels. Different departments could cooperate and discuss in integral working groups to see how the various goals and ambitions could be aligned and achieved together. At a later stage, regulations may help with this, but it have to start with the internal collective motivations and ambitions. However, research shows that it is difficult to transfer knowledge gained in individual projects to the organisations, so that the knowledge can be applied to other projects. So, organisations must be able to learn from new ideas and knowledge and then implement them and transfer the results to other organisational levels. This could be achieved by means of internal integrated working groups, consisting of employees from different departments and clusters within the municipality.

R2: Before January 2022, the appointed internal coordinator could set up integrated working groups consisting of employees working in different departments within the municipality. Under the leadership of the internal coordinator, these working groups will meet weekly to inform each other about the current state of affairs within the departments and to brainstorm together about how different assignments could be integrated.



Informal teambuilding workshops – In order to make circularity an integral and essential theme within the entire organisation and to activate and stimulate awareness of this among colleagues in all areas, it is important that, in addition to the integral working groups (consisting of a limited number of employees), informal discussions, knowledge sessions and team building workshops are regularly organised. An internal knowledge network within organisations throughout innovation processes is of great importance. Effective collaboration and communication is essential to increase the likelihood of innovation adoption, which also includes formal and informal communication between internal stakeholders. Such informal activities will create wider awareness and support internally, which is expected to contribute positively to integration and cooperation within the municipality.

R3: From January 2022, the integrated coordinator, perhaps in collaboration with the integrated working groups and knowledge institutes, could organise informal knowledge sessions and team building workshops once a quarter in which all employees within the municipality could participate. Within these sessions and workshops, circular construction, transformation and renovation of homes could be central.

COMMUNICATION

Whether or not to adopt an innovation is influenced by communication between both internal and external stakeholders. In addition to creating an internally innovative and integrated communication network, it is important that communication towards the market and residents is also open, accessible and sufficiently available, which is expected to positively influence CSCC. A number of recommendations are given to activate and stimulate this public-private communication.

Engage in dialogue with private parties, civil organisations and residents - Because a major task has to be approached in a relatively short period of time, cooperation between public and private parties is important, in particular in the field of communication, visions and policy making. Public and private parties could enter into dialogues together, because initiatives originating from market parties or housing associations could serve as input for renewal of municipal policy. To initiate (local) chain cooperation, the municipality, as 'director', could bring (like-minded) parties together. They could invite market parties and discuss their ambitions and ideas with them.



What is important here is that the municipality takes an equal position and will show (more) confidence in the market. It should not be the case that only the municipality draws up visions and policy documents, but that they discuss with the market what they can do and how they could be supported by municipalities to actually make this possible. This is currently insufficiently the case in practice. As a recommendation to the municipality, try to give a more concrete interpretation to municipal vision and policy documents together with private parties. Start by finding shared ambitions, both within organisations and with potential public and private partners. In addition, ensure a clear interpretation of circularity: from circular renovation and construction to circular area development. Where on the R-ladder of circularity does the municipality want to achieve results? Which cross-departmental choices does this require for possible solutions? Innovative market parties and socially engaged entrepreneurs play an important role in boosting circularity and tackling social challenges. Involve these parties early in the process.

In addition to a policy-based elaboration, it is important to discuss the theme of circularity with residents. Visit them in their neighborhoods and talk about daily matters. How do residents deal with waste, how do they organise their garden and how do they keep their home comfortable? What do people find important, and what are they already doing about sustainability, energy saving and recycling? What is the situation like and what needs and obstacles are there at the moment? Perhaps there is already a neighborhood initiative to exchange and borrow items? These activities are some starting points for collaboration with (pioneering) residents. These are the smaller steps that municipalities could take but are very important for forming support for the (later) larger steps, such as the (partial or eventually complete) switch to circular renovation and construction. Resulting from this research, there could be more listening to the experiences of residents than is currently the case in practice. So, when drawing up vision and policy documents, the municipality could listen to its residents, because they may be able to share a lot of experiences and relevant input.

R4: From January 2022, the municipality could enter into a dialogue with at least one local market party per month in order to be able to discuss possible projects, initiatives and collaborations. These meetings can possibly be organized by the internal coordinator and/or the integral working groups.



Use social media - During communication activities, a potential adopter goes through a decision-making process before the innovation is adopted, which includes awareness, interest, evaluation, trial and ultimately adoption. An example resources used as information source and communication channel is social media. What is important here is that the communication is simple and accessible, so that everyone could understand the essence.

It has turned out that the most promising way to reach people is during their daily activities. For example, social media could be used, with the aim of making people less averse to sustainability/circularity and giving them more insight into what it entails. Instead of having to look up information on a website on their own initiative, residents can easily encounter messages, blogs, informative videos, etc. via social media, which may attract their attention. This also stimulates awareness among people. If circularity is seen often enough during daily activities, for example by scrolling on Facebook, it is expected that the subject will automatically come to the attention of this target group. So, social media could be used (more) as means of accessible communication to activate and stimulate awareness among people and to stimulate, inspire and motivate homeowners.

R5: From January 2022, the municipality could use social media more effectively to activate the awareness of homeowners and to stimulate, inspire and motivate them to think about circular renovation options. The content of the posts on social media can possibly be initiated by the integral working groups in collaboration with knowledge institutes and local market parties.

Improve municipal website(s) – In addition to the use of social media, the municipal websites could be upgraded, as means of accessible communication to stimulate, inspire and motivate people and to bring supply and demand closer together. A lot of information about circularity is scattered on the internet, which makes it difficult for private homeowners to find the right information. However, within this fragmented information, there are many good initiatives and websites that both private parties and residents can turn to. What this research has shown, is that these are not sufficiently known and visible in practice. Facilitating a new website or platform is therefore not necessary.



However, the municipal websites www.duurzaam010.nl and www.rotterdamcirculair.nl could be improved, by means of a more accessible and better structured lay-out, with more references to existing (local) initiatives, information and examples related to circular home renovation. Currently, these websites, in particular www.duurzaam010.nl, contains insufficient information and is not accessible enough for its users. The municipality could actually play a very passive role in this, facilitating and being present in the background.

Moreover, the municipal websites have to be become accessible to different target groups: what can I do as a do-ityourselfer? What can I engage as a contractor? What can I do about circularity as a landlord? In this way, demand and supply can also be brought closer together, which is expected to have a positive effect on (local) CSCC. Fill the websites with (local) inspiring initiatives, examples, blogs from pioneering companies and residents and informative videos. Also refer to these websites in posts on social media for further information. Share both the successes and learning moments of (municipal) example projects and let involved stakeholders show them off. Previous research has shown that a potential adopter is more likely to invest in an innovation when information about competitors is available, as this will increase the profitability estimates of innovations. This will probably also strengthen support for the connection between circularity and other social challenges.

What is perceived as a barrier in practice is that municipalities are not allowed to link residents with a sustainable renovation demand directly to private parties. Municipalities work for national interest and are not able to give priority to specific local parties. However, the national (and/or local) government could issue 'circular quality marks' to private parties that deal with circularity sufficiently and properly (in this case in the construction and renovation sector). It would then be possible to refer to (local) companies with such a quality mark on the municipal websites. In this way, you reward pioneering companies with a platform, you stimulate the (still) conservative parties to also take the step towards circular business models and you give residents more insight into their choices, without the municipality favoring certain parties.

Furthermore, in order to optimise the user-friendliness of the municipal websites and to stimulate awareness of circular renovation principles, users, for example private homeowners, should be able to select certain criteria, such as the type of material, the color and the distance where circular material is available. Besides, when residents make certain choices, they should be able to see what kind of impact this will have on the environment. For example, the difference in CO2 impact could become transparent of bio-based materials vs. fossil materials. By developing something that gives people the choice for circular renovation options, awareness will be stimulated. And this awareness among residents is of great importance, because within a CE they are an essential part of the chain.

R6: From January 2022, the municipality could improve the municipal website(s) by filling them with links to existing networks, platforms and initiatives related to circular construction, renovation and transformation of homes. In addition, when there has been more experimentation and development, the websites can also be supplemented more and more with (local) inspiring initiatives, example projects, informative films and blogs/ vlogs of innovative companies and pioneering residents.

REALISATION

Because current Dutch legislation and regulations with regard to the heat and energy transition are sometimes at odds with circular ambitions in the construction industry, the search for opportunities to link circularity to other challenges is difficult. Innovation should not only be seen as developing a new idea, change or improvement, but as the entire process including the implementation of these ideas, changes or improvements. So, the developed circular renovation ideas and concepts must be realised, starting with experiments. This research also establishes 'it is a matter of learning by doing'. Especially in the field of circularity, learning helps to keep up with future (construction) developments. Action must be taken now to realise and accelerate the transition to a CCE, in which local authorities can make a major contribution, following three practical recommendations:



Test own policy and realise example projects – The (local) government is seen as a major launching customer, which could play a meaningful role in the development of innovations. Municipalities are not only policymakers, but also implementers of these policies, as the role of clients. In this way, they could set good examples to the city and its inhabitants. The municipality could therefore first test the formulated policy for its own facilities (real estate, public space etc.), in collaboration with private parties, to see what is and is not feasible. This is important, because it does not appear credible on the market if the municipality prescribes a policy for them but does not implement it itself (which sometimes still occurs in practice).

Until the market has passed the first introduction phase of the transition towards a CCE (where we are currently still in), and innovations have been accepted and adopted by the majority resulting in rapid growth and volume of circular renovation principles and actor networks, (local) authorities could set an example and have the responsibility to contribute to get to this point. Beside economic contributions, laws and regulations, this could be done by using example projects as means of (accessible) communication to activate and stimulate awareness among people and to stimulate, inspire and motivate the (local) market.

The use of example projects could be interesting for the municipality as well as for market parties and residents, which will result in a win-win situation. The municipality wants to show what is possible to (local) market parties and its residents, the market parties could show what they have to offer, and the residents will become more aware of circularity and can see and experience what is possible. Example projects have proven to be good communication tools for entering into a dialogue with people, which can help in involving residents in the transition to a CCE. This citizen participation will also activate awareness among people and stimulates them to consider alternatives when the home is due for renovation.

R7: From June 2022, the municipality could realize at least two example projects (municipal property, public space) per year and communicate to the city in an accessible manner what is circular about these projects. The municipality could play a pioneering, inspiring, motivating and informative role in this regard.

Experimental possibilities – Within the current innovative phase of the transition, it is important that cooperation takes place such that knowledge can be shared, that people can learn from prototypes and demonstration projects, and that suppliers connect in innovation teams. In order to get parties more motivated to switch to circular business models, the municipality could challenge the market to come up with circular and modular building and renovation solutions. Not only by informing and inspiring the market with opportunities and successful projects, but also by offering the market space and putting them to work in, for example, designated experimental areas where there will be (more) flexible handling of current legislation and regulations.



By making the municipality's own real estate (and public space) available as an experimenting space, both market parties and (local) authorities could gain experience and share knowledge. In the longer term, this could also be beneficial for private homeowners, because in this way (by seeing circular (renovation) examples in the built environment and public spaces) they become more aware of circularity and its possibilities.

R8: From January 2023, after the municipality has spoken with different market parties about possible projects and collaborations, they could designate experimental areas and buildings and challenge private parties and encourage them to collaborate in these experiments (including for example focusing on circular private home renovation).

Regular evaluation moments - After these 'sample projects', both in which policy will be tested or in which room for experimentation is given to the market, regular joint evaluation meetings have to be conducted. This is important in projects in which policy will be tested to see whether the own policy is correct, after which these documents may have to be adjusted. External parties who have contributed to these types of projects could also attend these evaluation meetings in order to be able to share their knowledge and experiences with regard to the realisation and feasibility of municipal visions and policy making.



Ultimately, what matters is the cooperation between policy and non-policy makers (including municipalities that can take up both roles), in which feasible solutions must be looked at together. Furthermore, regular evaluation moments are also necessary during the phase where municipal buildings and areas are designated in which the market is given more space to experiment in order to be able to share knowledge and experiences. This will stimulate learning by doing.

R9: The municipality should regularly organize evaluation moments during and after projects initiated by the municipality, such as the projects in which its own policy is tested or the projects that are designated as experiments for local market parties.

FACILITATION

In the current phase of the transition to a CCE, it is important that (local) governments play a facilitating role. Public and private parties need each other to achieve national and regional goals. To accelerate the transition, municipalities can offer the market various tools to help them in this start-up phase, including the following:

Organise (online) theme sessions - To reduce the current (online) fragmentation of knowledge and information, municipalities could, in collaboration with knowledge institutions, play a facilitating role, particularly in the sense of collecting and sharing the required knowledge. In addition to organising informal discussions, knowledge sessions and team building workshops internally, (online) theme sessions about for example circular design, construction, renovation and demolition could be organised where everyone should be able to register, public and private actors as well as social organisations and citizens.



Knowledge networks with involved stakeholders throughout the innovation process are of great importance, which will also influence the awareness among people. The involvement of knowledge institutions is desirable here in order to disseminate the required knowledge to local, medium and high levels of government and to support them so that the necessary knowledge is sufficiently available in order to cooperate with the market. Furthermore, knowledge institutes

play a stimulating role. It has turned out that they try very hard to focus on integration and cooperation between both public and private parties. Because knowledge institutes are 'neutral' within these processes and collaborations, they could create a kind of 'level playing field', in which it is assumed that an open and transparent atmosphere will arise, which will have a positive influence on CSCC.

R10: From July 2022, the municipality, in collaboration with knowledge institutes, could start organizing (online) theme sessions on, for example, circular design, construction, demolition and renovation. The existence of these events can be announced through social media, municipal website(s) and via informative emails.

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Facilitate comprehensive courses - For organisations it is important to acquire learning abilities in order to survive between competing organisations at firm and network level. To achieve this, the municipality could facilitate (in collaboration with knowledge institutions) comprehensive courses on certain material uses or ways of CSCC that are given to people already working in the construction industry, such as architects or contractors, but who want to learn more about other construction activities. In addition, there is currently a shortage of labor for renovation work.



already working in the construction industry, such as architects or contractors, but who want to learn more about other construction activities. In addition, there is currently a shortage of labor for renovation work. Rotterdam is looking for people who can give meaning to making the private housing stock more sustainable. The municipality should attract these people by facilitating training through vouchers or something similar. Municipalities should not only work with certified companies, but also look at the smaller organizations and the quality they want to achieve. Application of certain (circular) materials sometimes requires different expertise than that of traditional organizations. The municipality could facilitate the gathering of this knowledge in collaboration with knowledge organizations.

R11: From January 2023, the municipality, in collaboration with knowledge institutes, could start facilitating extensive courses for actors who are already working in the construction sector, but who would like to retrain with regard to, for example, circular renovation.

Facilitate teaching programs and workshops – Effective communication is essential to increase the likelihood of innovation adoption, which includes informal communication and activating awareness. This research has shown that awareness among people can also be activated and stimulated through children and young people, by means of integrating the theme of circularity more into curricula in primary and secondary education and organising workshops for (local) primary and secondary schools.

Children and young people should be able to acquire knowledge about circularity in an accessible way from an early age. It is expected that children will tell about this at home, which indirectly results in more awareness among parents. Furthermore, theme afternoons/ evenings at schools could be organised for both children and parents, where various (local) initiators and pioneers could share knowledge about circularity in an accessible way. In this way, the theme of circularity will increasingly be included in the 'usual' way of thinking and acting in small steps.



R12: The municipality, in collaboration with primary schools, secondary schools and knowledge institutes, could start drafting and facilitating educational programs and workshops for students and their parents in order to increase awareness of circularity in the construction sector in January 2023.



Facilitate location for material hub - (Local) authorities have the responsibility to contribute to the acceleration of the CE transition. This can be done by facilitating locations for material hubs (storage of used building materials). When a building is demolished, releasing materials and products that could be reused at product level (toilets, wash basins, washing machine taps, etc.), they could be taken to such a 'material hub' where they would then be thoroughly cleaned and stored. The municipality, as a director, could make a location available and could link this to existing initiatives in the city, such as 'Buurman Rotterdam' (workshop and shop for recycling materials) and the Rotterdam 'Milieuparken' (free collection points for household waste, bulky waste and useful second-hand items).

Such an initiative already exists on a national scale. The circular demolition company A van Liempd is the owner of 'www.gebruiktebouwmaterialen.com', which can be seen as an online material bank. On this website, demolition material is offered to both private individuals and business companies. They would like to enter into more collaborations with municipalities, including Rotterdam, in order to realise the national (and local) circular ambitions. Also, for the Municipality of Rotterdam, a combination of local physical material hubs and cooperation with a nationally operating organisation such as A van Liempd could be of great benefit. When the municipality has its own real estate demolished by this company, they can see per project what has arrived at A van Liempd. These materials are then either sold on the open market or the municipality can indicate that they want to use the materials themselves in subsequent projects. When the materials are be reused internally within the organisation, you achieve the maximum value, which results in double profit: no waste and no new products to buy. If this is not the case, the demolition materials will be sold by A van Liempd and the municipality will receive a certain percentage of the proceeds from the sale. I would recommend the Municipality of Rotterdam to collaborate with a party such as A van Liempd, because these kinds of collaborations can contribute to the realisation of both municipal and national circular ambitions.

R13: The municipality, as a director, could make a location available for a construction hub and could link this to existing initiatives in the city, such as 'Buurman Rotterdam' and the Rotterdam 'Milieuparken'. Furthermore, the municipality could collaborate with a national operating party, such as A van Liempd. These kinds of collaborations can contribute to the realisation of both municipal and national circular ambitions.

What should be taken into account is that the thirteen recommendations mentioned, addressed to the Municipality of Rotterdam, should be submitted to the municipal council before actions can actually be taken. After submission to the city council, the (timestamps of the) recommendations may need to be revised and adapted based on their own vision and policy documents.

In conclusion, this research has shown that the mentioned recommendations, divided into four main tasks in which the municipality takes on a director's role, will stimulate (local) CSCC in order to achieve circular renovation of private homes. This answers the main research question of this study.

reflection.

This chapter will provide the reflection of this research. Section 8.1 will reflect on the research outcome (**product**). Section 8.2 will reflect on my research **process**, including the relation with the Master Management in the Built Environment (MBE) and the studios Real Estate Management (REM) and Design and Construction Management (DCM). Finally, section 8.3 will reflect on whether the expected **planning** has been followed.

8.1 Product

The report you have just read is the outcome of almost a year of research, which I can be proud of. In the first weeks of my research process, I expected that the outcome of this study would become a detailed CSCC model that I would hand over to the Municipality of Rotterdam. However, after several months of research, this turned out to be an infeasible goal. Because the transition to a CCE is still in the early innovative phase, there is still insufficient awareness and clarity, both among public and private parties, about what such a concrete collaboration model should look like. Even the definition of circularity is still interpreted in many different ways. I expect that once the (inter)national frameworks have been clearly established, it will be possible to delve deeper into concrete (local) CSCC models, as mentioned by many participants of this research.

When I managed to put the development of a concrete CSCC model out of my mind, I tried to articulate as clearly as possible what role the municipality should play in initiating and stimulating (local) CSCC. No concrete partnerships with specific private parties have yet been worked out. However, I have tried to formulate from a management perspective how the first steps could and should be taken by municipalities to scale up this type of circular partnerships in the construction and renovation sector, with a specific focus on the private housing stock. These steps are described in the advice (Chapter 7), which is in line with the existing vision documents and programs of the Municipality of Rotterdam. If I had more time for this research, I would have liked to work out some of these steps in more detail and test them in practice, starting with setting up integrated working groups, organising theme sessions for both public and private actors and engaging in dialogue with local primary and secondary schools about possible curricula/workshops to activate and stimulate awareness of circularity (in construction) among children and indirectly their parents.

In my opinion, the structure of the report, and also of the research process itself, is clear and aligned. Because the different chapters are successively based on each other, the guiding thread can be clearly followed. It started with the problem definition, which required five critical factors to address it, according to the analysis into the state-of-the-art. These factors were further investigated during the literature review, after which related research indicators were identified that served as guidance during the stakeholder analysis. From this analysis, four main barriers were discovered, after which the importance of addressing these barriers was substantiated by the previously established theoretical framework. Finally, I reflected on the results and formulated what this research has contributed to the state-of-the-art knowledge and existing literature, after which I formulated a theoretically substantiated advice towards the Municipality of Rotterdam. Overall, I am proud of what I have delivered within the given time frame.

8.2 Process

8.2.1 Establishment of graduation team

At the end of the previous academic year (May 2020), I did not know exactly what my topic would be for my graduation research, but I did know that I wanted to delve deeper into the sustainable and circular construction industry. During the bachelor and the first year of the master, these subjects have always attracted my attention. I had also already registered for the extra course 'Circular economy for a sustainable built environment' (offered by DelftX), which started in February 2021. This course gave me even more insights and knowledge about my graduation research, which was especially useful during the conversations with the interviewees. In April 2021, I have my certificate for this extra course.

At the same time (May 2020), I got in touch with the Municipality of Rotterdam and arranged my internship for the period January-June 2021. I came into contact with **Oubbol Oung**, Strategic Advisor and Project Manager Urban Development Department, who has become one of my internship supervisors. She spoke to colleagues within the circular department of the municipality and told them about my graduation topic. Colleague **Wouter Streefkerk**, Consultant Building Physics, Circularity and Integrated Sustainability, was enthusiastic and offered to guide me in terms of circular content during my internship. Wouter became my other internship supervisor. Unfortunately, due to the current COVID-19 situation, the internship took on a different form. All the work was done at home and meetings took place online.

After I had contacted the Municipality of Rotterdam, I came into contact with dr. ir. arch. **Erwin Mlecnik**, Assistant Professor at the REM section. Erwin researches and develops transitions in the construction industry, with regard to market developments of sustainable building concepts and process innovation. His areas of interest are the promotion of collaboration and the development of an innovative supply in the construction sector (including renovation construction), which fitted well with my own interests and intended ideas for my graduation research. His knowledge and experiences in management are a valuable support in my graduation process and that is why I asked him to be the first mentor. He agreed and wanted to guide me during my graduation process.

In the first week of this academic year (September 2020), I came into contact with **Queena K. Qian**, PhD student at the TU Delft. She was very enthusiastic about my subject and asked me if it would be okay to join Erwin during my graduation process (meetings and presentations, etc.). Via Erwin and Queena, I came into contact with **Henk Visscher**, Professor of Housing Quality and Process Innovation in the section DCM. His interests are focused on process innovations that contribute to safeguarding and improving the quality of homes. Henk became my second mentor and Queena became my third mentor.

8.2.2 Reflection on graduation process

When I reflect on my own graduation process, I am generally positive. During the first half of the academic year, every two weeks (with some exceptions) Erwin, Queena and I met online. Within these sessions, we discussed my progress until then. Once every few weeks, Henk joined the meeting and gave his input and feedback as well. It was a nice way of working and also stimulated me not to lag behind. In addition, I had several meetings with Oubbol and Wouter to discuss how the internship will look like and to steer my process in the direction that would also be relevant for the Municipality of Rotterdam.

In the first quarter of this academic year, I worked towards my first presentation. This period was still fairly quiet, although I had sometimes underestimated how much time it takes to search for relevant scientific articles, to read up sufficiently and to get the essence from existing literature. After some tips about search techniques and reading, this process went better and less slowly. During the first presentation (November 2020), I had to clarify the main problem, research-questions and research approach. In this presentation, Erwin, Henk, Queena and Wouter were present. After this presentation there were hardly any comments. According to those who were present, it was a clear story, which gave me confidence and motivation to continue the process in this way.

In the period between the first and second presentation, I worked on the analysis of the state-of-the-art and the literature review. I experienced more difficulties during this period, because pressure from the other master courses also increased (deadlines, assignments, exams, etc.). Moreover, due to the current COVID-19 circumstances, all work had to be done at home and online. The second presentation (January 2021) was the first official assessment moment. Erwin, Henk, Queena, Wouter and Jurjen Zeinstra (Delegate of the Board of Examiners) were present. During this presentation, I again presented the main problem, research questions and research approach, supplemented by the analysis of the state-of-the-art and the literature review. This presentation was approved, which meant that I was allowed to continue my research process. However, points for attention were given with regard to the continuation of my research process, which I had to adjust in my research approach.

Even though I had the necessary approval and (generally) positive comments, after the second presentation I lost a bit of my self-confidence and motivation. On the one hand I was satisfied with the result so far, but on the other hand I lost the inspiration how to proceed. This was because I was not sure how to continue my process. After (extra) guidance with all three TU mentors at the end of that same week, I made a plan to resume the process, where I started by (partly) adjusting the theoretical framework. This was necessary because this framework would serve as a basis for the continuation of the research. Furthermore, I adjusted my research methodology. Initially, my plan was to collect data using the case study method. The intention was that I would investigate three (CSCC processes of) private homes that had been renovated in a circular manner. However, during the search for suitable cases, this turned out to be a very difficult task. There are hardly any examples of circular private home renovations. And the few that have been done are either not documented or not known, because we are still in the innovative phase of this transition. As a result, and in response to the comments of my mentors on my second presentation, I decided to organise my empirical research design differently, which is explained in Chapter 2. In my own expectations, I was unable to collect sufficient relevant data using the case study method. It seemed a lot more relevant to organise the interview phases differently and to compare the perspective from public and private parties and then test these results in a focus group discussion. By organising my research in this way, I expect to collect much more relevant information than I could have gathered with the case study method, because I could now investigate more different perspectives of stakeholders within the supply chain of circular renovation, which will strengthen my substantiation of the final advice. This research method has worked out positively for me, in order to arrive at a broadly substantiated advice to the municipality.

Once the theoretical part and the research methodology were clear, I was less stressed and more motivated to keep going, because I was back on schedule. In the next phase, I contacted all potential participants to ask if they would like to participate in my research. This went very well, because many participants were enthusiastic and immediately made time for me. The following two weeks were fully scheduled with interviews, which went very smoothly. Within this period (February/March 2021), I was mainly working on planning, conducting, coding and analyzing interviews, which meant that weekly appointments with all mentors were no longer necessary. All collected data was transcribed, coded and analyzed, after which I discussed some sub-conclusions in the weekly meetings with Wouter and Oubbol. I did also have contact with my first mentor Erwin a number of times about some small questions regarding the process and method. This way of working continued throughout the rest of the process.

Halfway through the interview phases, the partial conclusions were presented during the third presentation (April 2021), where Erwin, Henk, Queena, Wouter and Oubbol were present. This was not an official assessment moment, but an (informal) moment where I could show my progress so far and where feedback was given. The mentors suggested to look at the remaining with a lens on achieving recommendations what would work and what not in term of concrete strategies to solve detected barriers (showed in the presentation). This was also my own plan, which was planned for the period between the third and fourth presentation. In the week after the third presentation, I had completed my interviews. The following week, the focus group discussion was scheduled. Prior to this discussion, I was a little unsure about having to guide and direct the discussion online, which I had never done before. However, this turned out to be unnecessary, because the discussion went smoothly. I received the necessary additional insights about the issues that I presented to the participants, which reinforced my final conclusions. After the focus group discussion, I started working out and analyzing all the results. This lasted until the fourth presentation. During this period, I had weekly contact with Erwin, Wouter and Oubbol (with a few exceptions). I am satisfied with my own way of working in these last weeks. I kept to my own schedule and constantly had in mind what my end goal was: what I would like to present during the next presentation.

The fourth presentation (May 2021) was an official assessment moment, during which my mentors determine whether I have reached a sufficient level with my graduation research. My goal was to provide a report that was as complete as possible, including processing all previous feedback that the mentors from the TU and the supervisors from the Municipality of Rotterdam had given me.

I learned a lot during the entire research process. Not only in the field of circularity in the construction sector, but also about the way of investigating, conducting and analyzing interviews, my own time management, flexible handling of setbacks and setting realistic standards for myself. Overall, I am very satisfied with both the result and the process towards it.

8.2.3 Research process related master track

This research fits in the master Management in the Built Environment. During the whole research process, I have looked from a management perspective: How could activities within the built environment be better managed to achieve the (inter)national climate and environmental goals? How could local SCs be better managed? How could collaboration be better managed? Furthermore, I have looked at the organisational aspects of the municipality and whether any profit could and could be achieved in the future. To relate this research to **REM**, I have researched the transition to a CCE, whereby the areas of interest were the promotion of collaboration and the development of innovative SCs in the construction sector (including renovation). These topics correspond to what is currently happening within REM and what my first mentor Erwin is working on. Besides, within construction management, the manager is responsible for the day-to-day management of the construction team, including SCs. Because my research is about collaboration opportunities for CSCM and because the focus of this thesis is on renovation of owner-occupied housing, this research also fits into the field of **DCM** (and the working context of my second mentor Henk).

8.3 Planning

I am a very driven person and I always work with structured schedules, to-do-lists and deadlines set for myself, also for this research process. In general, I kept to my plans, with the exception of some setbacks, such as switching the research method halfway through my process, which took quite some time. In my own opinion, I was flexible with these kinds of moments. I quickly tried to come up with alternatives and resume planning. Sometimes it worked better than other times, but in the end everything turned out fine.

By nature, I am a perfectionist and I want to reach my potential as well as I can. However, sometimes this does not have a positive effect. When I fell behind on my schedule during the research process, I worked evenings, weekends and holidays to get back on track. I had no problem with this at the beginning of the process. But from the third presentation (April 2021) this became increasingly difficult. I noticed that I didn't take enough time off and kept working continuously. Full concentration also decreased. This gave me some stress, because I only had a few weeks left before I had to complete the research. However, because I still had to persevere, I planned more rest in recent weeks, which increased my motivation and concentration and allowed me to complete the research at the level that I had expected from myself.

The current COVID-19 situation also affected my process. Especially the last few weeks I found it difficult to do everything from home alone. However, my parents stimulated and supported me a lot throughout the process, which gave me motivation to continue. In my opinion, giving up is impossible, but now and then I had a hard time.

Due to my perseverance and motivation to complete this research at a sufficient level and to obtain my master's degree, I managed to deliver this report within the given time, which makes me feel satisfied and proud.

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appendices.

Appendix I - Key elements of the Renovation Wave, with the corresponding views of BPIE

Related to research	Intervention point of the Renovation Wave	BPIE's views on the intervention point
Renovation	Double the annual energy renovation rate in the EU by 2030 (compared to 2020) and foster deep energy renovations.	Reliability, consistency and comparability of energy performance certificates (EPCs) across the EU should be improved so that they become a trusted market tool to assess performance and quality of buildings. Also, complementing the EPC with a building renovation passport can accelerate deep renovation by providing personalised renovation roadmaps to building owners.
Circularity	Reducing the total carbon impact of the construction industry by implementation of circular principles in building renovation.	EU legislation has a track record of addressing buildings' operational energy performance, but the current framework is not yet designed to address circularity and embodied carbon in buildings. To achieve climate neutrality in the building sector, circular economy principles should become the norm starting with procurement policy, without hindering implementation of the energy performance legislation.
Management	Designing and implementing of effective building policies and measures with consistent and reliable data, for example digital building logbooks related to their energy consumption or environmental performance.	More comprehensive, dynamic and easily accessible information on buildings data is the basis for unleashing synergies between the construction value chain, building owners, the financial sector and local authorities. Digitalisation enables more systematic data collection and management, which must be mainstreamed across the entire lifecycle of buildings.
Role of local authorities	Technical assistance is regarded as a crucial component of the Renovation Wave, since the different beneficiaries, including local authorities, must be able to design good programmes and plan and implement projects which are eligible for support. The Renovation Wave highlights the importance of aggregation and reaching small-scale projects, which often struggle to access EU-level funding and technical assistance.	Steps for improving technical assistance must focus on aggregation services to ensure that small-scale renovation projects can access finance more easily. Additionally, even when technical assistance programmes are in place, it is often unclear which type of support is available for beneficiaries and where to go/who to contact to seek advice. Information on how to access these services needs to be strengthened, including by providing all relevant information in every EU language.

Research variables	Research indicators	Guiding interview questions
0. Introduction	Х	Introduction researcher, research, interviewee, organisation and function interviewee.
	X	What does a circular construction economy mean for the organisation?
	X	How involved in the circular construction ambitions within the organization?
	Х	Sufficient attention to circularity within organization?
1. Actor-network	Cooperation and collaboration	Experience cooperation with market parties and governments?
	Information and knowledge exchange, communication	Sufficient sharing of knowledge and experience about circularity between various parties involved?
	Openess and transparancy, communication, trust	Confidential and open-transparent communication within collaborations? Trusted network?
	Cooperation and collaboration	Direct or indirect bottlenecks within the organisation and collaboration ?
	Cooperation and collaboration	Possibilities to improve or optimize collaborations between government and the market (and between the market parties themselves)?
	Cooperation and collaboration	Possibilities for municipalities to stimulate and upscale chain partnerships between local market parties?
2. Supply chain learning	Information and knowledge exchange	<i>Learned</i> from collaborations with external market parties or governments?
	Information and knowledge exchange, guidance and direction	Role of the municipality in the development of pilot projects and experiments to enthuse the market and initiate development? Giving guidance?
	Information and knowledge exchange	<i>Wise lesson</i> or advice for the housing renovation sector that contributes to the transition to a circular construction economy?
3. Future visions	Motivation, inspiration, guidance and direction	How do municipal visions (and ambitions) of the future contribute to the realization of circular construction and renovation of homes? Motivate ? Inspire ? Give guidance and direction ?
	X	Do municipal visions (and ambitions) also contribute to the upscaling of circular renovation of private homes?
4. Business models	Motivation, inspiration, guidance and direction	Possibilities for municipalities to support or guide local market parties and organizations in the transition to a circular business models and value creation for organisation?
	Win-win orientaion, mutuality	<i>Will this also have a positive effect on the chain cooperation between supply chain partners? Win-win orientation</i> ?
	x	And a positive consequences for the upscaling of circular renovation of private homes?
5. Role municipality	Cooperation and collaboration, coordination, motivation	Role of the municipality in the transition to a circular construction economy? Cooperate? Coordinate? Motivate?
	Coordination, motivation	Stimulating activities that the municipality should organise to accelerate the transition to the circular construction and renovation sector?
	Alignment	Do you also experience obstructive laws and regulations ? Is there alignment ?
6. Closing	X	Do you recommend involving other relevant organizations in research?
	X	Additions or comments regarding the discussed topics?
	Х	Thanking and informing about research planning up to publication.

Appendix II- Overview of initiatives in the Netherlands to realize circular construction
Appendix III- Internal Survey

To what extent are you familiar with circularity in the construction and renovation sector?



(More) cooperation between different departments is needed to scale up the sustainable (and circular) renovation of the private housing stock in Rotterdam.

= Strongly agree = Agree = Neutral = Disagree = Srongly disagree

25 25 275 455

I am willing to collaborate (more) with other departments/clusters to scale up the sustainability and/or circular renovation of the private housing stock in Rotterdam.

= Stronglyagree = Agree = Neutral = Disagree = Srongly disagree



(More) sharing of knowledge, experiences and ambitions between different clusters/departments is necessary for the upscaling of the sustainable (and circular) renovation of the private housing stock in Rotterdam.



I am in favour of sharing (more) knowledge, experiences and ambitions with other departments/clusters in order to scale up the sustainability and/or circular renovation of the private housing stock in Rotterdam.

= Stronglyagree = Agree = Neutral = Disagree = Srongly disagree



Are you experiencing bottlenecks with regard to internal cooperation within the municipality? If yes which one?

Theme

Verschillende aansturing zorgt soms voor conflicterende belangen.	Conflicterende belangen
Nee	x
Verduurzaming van particuliere woningen is in de eerste plaats de verantwoordelijkheid van de particuliere eigenaar. Om de duurzaamheidsambities van de gemeente realiseren is het van belang deze eigenaren te verleiden om hun woning te verduurzamen. Hierin kunnen verschillende afdelingen een rol hebben (bijv. bouw en woning toezicht, gebiedsontwikkeling, duurzaam, communicatie, ingenieursbureau). De vraag is echter bij welke afdeling ligt de primaire verantwoordelijkheid om de particulieren aan te zetten tot verduurzaming en welke middelen (geld) stelt de gemeente hiervoor beschikbaar. Als verantwoordelijkheid, urgentie en geld zijn bepaald komt de samenwerking tussen de afdelingen 'vanzelf' tot stand.	Onduidelijke verantwoordelijkheid
Geen eenduidige belangen (meer bouwen bouwen bouwen vs klimaatadaptief of natuurinclusief of circulair bouwen). Geen regelgeving, klimaatadaptief is een vrijwillig convenant. Materialenpaspoort geen verplichting alles is financieel gedreven (tegen zo laag mogelijke kosten zo veel mogelijk woningen) ipv waarde gedrevan (mensen kunnen er lang wonen ondanks dat het klimaat verandert en het pand is na x jaar netjes af te breken). Verschillende tijdshorizon (problemen van later is voor volgende generatie).	Conflicterende belangen
Vergelijkbaar met dit onderzoek; 4x 'zeer eens' invullen is waarheidsgetrouw, makkelijk (en voelt als het juiste antwoord). Dat is iets anders dan iets daadwerkelijk DOEN! De wens is er soms wel, de uitvoering mist vaak. Samenwerken vraagt m.i. om stappen maken op de 'trap van samenwerking' (https:// www.hbadvies.nl/themas/ketensamenwerking/). We focussen vaak op de bovenste treden, terwijl het probleem lager op de trap ligt.	Gebrek aan uitvoering
Ik merk dat de meeste collega's van goede wil zijn om samen te werken. Maar samenwerken moet wel ergens toe leiden. Vaak is alleen informeren of feedback vragen al voldoende. Het is bij deze opgave aan de vakspecialisten bij Duurzaam om waar nodig en zinvol collega's te informeren over de voortgang en de dilemma's, te betrekken bij eventuele acties en feedback te vragen op de benadering ook als reality check.	Onvoldoende communicatie
Ik merk dat circulariteit nog nauwelijks speelt bij projectmanagers van Vastgoed en Stadsbeheer. Het is voor velen een bekend woord, maar er zijn nog onvoldoende best practices en voorbeelden bekend hoe dit concreet betrokken kan worden bij eigen projecten.	Onbekendheid
Er wordt te laat gecommuniceerd en afgestemd, in een te verre fase. Eerder checken met afdelingen voorkomt terugval. Het geeft ook ruimte om wat verder te durven gaan als je eerder al hebt gechecked met anderen waar de ook afhankelijk van bent.	Onvoldoende communicatie
Werkdruk is de grootse knelpunt om in samenwerking te investeren. Alles moet snel, strakke deadlines en weinig tijd voor afstemming, informatie uitwisseling ed.	Hoge werkdruk
Soms, verschillende belangen en tijdlijnen. Energietransitie gaat over doelen in 2030/2050. Andere clusters gaat het over doelen in 'deze collegeperiode'.	Conflicterende belangen
Ja, er is weinig kennisdeling, we zoeken elkaar niet op, agenda's worden niet op elkaar afgestemd, eigen project is het belangrijkst, etc.	Geen afstemming
Niet persé, de mensen van duurzaam zijn benaderbaar en tegenwoordig zit het aspect duurzaamheid vaak al aan de start van een project.	х
1) Afstemming van werkzaamheden/planningen van SO en SB. 2) Duidelijk opdrachtgeverschap/verantwoordelijkheid bij meekoppelkansen.	Geen afstemming Geen interne regie
Interne autorisaties nodig om in elkaars bestanden te kunnen kijken helpt niet echt mee als er meer samenwerking nodig is.	Geen interne regie
Vooral tussen de clusters kennen we elkaar niet altijd goed, waardoor de drempel tot samenwerking soms te hoog ligt.	Onbekendheid
Niet snel genoeg tot een besluit kunnen komen en daarom vertraging. Ook als iets niet kan moet het duidelijk zijn.	Onvoldoende communicatie
"De eigen taak/klus/doel is al ingewikkeld genoeg, zonder de 'extra doelen' van duurzaamheid en circulariteit"	Bezig met eigen werk
We werken teveel in onze eigen koker en hebben te weinig collega's die door deze kokers heen verbinden.	Bezig met eigen werk
ledereen heef zijn eigen kijk op circulair, zowel SB als SO heeft een programma circulair.	Bezig met eigen werk
Communicatie; we weten van elkaar niet waar we mee bezig zijn. We zijn eilandjes.	Onvoldoende communicatie
Collega's gaan voor eigen successen, het is moeilijk om aan te sluiten!	Bezig met eigen werk
Er mist een interne regie op strategie en betrekken van stakeholders.	Geen interne regie
Bekende processen te geancreerd, minder openheid tot nieuwe dingen	Niet open voor vernieuwing
Ja, elke afdeling heeft zijn eigen belang en andere budgetten.	Bezig met eigen werk
Bestuursopdrachten zijn niet voor alle afdelingen hetzelfde.	Bezig met eigen werk
Verkokering, organisatie in clusters is geen goede zaak.	Bezig met eigen werk
Kijk naar de mogelijkheden i.p.v. naar onmogelijkheden.	Niet open voor vernieuwing
Ja, men kijkt niet buiten zijn eigen werkgebied.	Bezig met eigen werk
De samenwerking met SO vastgoed.	Onvoldoende samenwerking
Houding van sommige collega's	Onvoldoende communicatie
Nee, eigenlijke niet.	х
Tijd en mandaat.	Gebrek aan tijd
Х.	Х

Appendix IV- Practical agenda focus group discussion

Practical agenda	Activities	Timeslot	
Introduction discussion	Velcome participants 12:00-		
	Thank people for coming		
	Announce that a recording is in progress		
	Share screen (presentation slide 1): broadly explain (repeat) the purpose of the focus group		
	Share screen (presentation slide 2): broadly explain (repeat) the main results of the interview phases		
	Share screen (presentation slide 3): explain the practical agenda of the discussion		
	Explain that results are elaborated anonymously		
	Make agreements: everyone's opinion counts, but they are not mixed up; there is always one person speaking.		
Interavtive activity: Mentimeter	Share screen (presentation slide 4): Explain Mentimeter and show log in code	12:05-12:10	
Mentimeter	Mentimeter slide 1: participants provide first thoughts and input to the question: What roles do you yourself see for the municipality in scaling up the circular renovation of private homes?		
	Mentimeter slide 2: the participants indicate to what extent they agree with eight statements (scale 1 to 10).		
	Show and discuss briefly results Mentimeter		
Discussion theme 1: Realization	Introduce theme 1, including the viewpoints from the market parties, knowledge 12:10-1 organizations and interest groups.		
	Discuss question 1: How could cooperation between policymakers and non- policymakers be organized in order to realize future visions?		
Discussion theme 2: Facilitation	Introduce theme 2, including the viewpoints from the market parties, knowledge organizations and interest groups.	12:25-12:40	
	Discuss question 2: How could (local) circular chain cooperation be facilitated and stimulated?		
Discussion theme 3: Communication	Introduce theme 3, including the viewpoints from the market parties, knowledge organizations and interest groups.	rm and enthuse its residents	
	Discuss question 3: <i>How could the municipality reach, inform and enthuse its residents about circular renovation options?</i>		
Closing discussion	Briefly reflect on what was discussed (global conclusions)	12:55-13:00	
	Close Miro Board and stop screen sharing in Microsoft Teams		
	Thank participants		
	Close Microsoft Teams call		

Appendix V- Overview of a number of finished and ongoing projects within the Horizon2020 program that contribute (or have contributed) to my research field

Project	Time span	
HOUSEFUL	May 2018- Oct 2022	HOUSEFUL project proposes an innovative paradigm shift towards a circular economy for the housing sector by demonstrating the feasibility of an integrated systemic service composed of 11 circular solutions. HOUSEFUL will introduce solutions to become more resource efficient throughout the lifecycle of a building, taking into account an integrated circular approach where energy, materials, waste and water aspects are considered. This approach fosters new forms of co-creation, increasing the collaboration among stakeholders of the housing value chain to develop new circular solutions and services. SOURCE: https://cordis.europa.eu/project/id/776708
BAMB	Sept 2015 – Feb 2019	The aims of BAMB (Buildings as Material Banks) are the prevention of construction and demolition waste, the reduction of virgin resource consumption and the development towards a circular economy through industrial symbiosis, addressing the challenges mentioned in the Work Programme on Climate action, environment, resource efficiency and raw materials. The focus of the project is on building construction and process industries (from architects to raw material suppliers). SOURCE: https://cordis.europa.eu/project/id/642384/fr
R2π	Nov 2016- Oct 2019	R2 π examines the shift from the broad concept of a CE to one of a Circular Economy Business Models (CEBM), by tackling both market failure (business, consumers) and policy failure (conflicts, assumptions, unintended consequence). Its innovation lies in having a strong business-focus, examining stimuli beyond environmental goals and in examining the role of policy innovation. R2 π unfolds in diverse contexts with a strong emphasis on involvement and exchange. The research design employs mixed-methods, including case-studies, desktop research, feasibility assessments policy formulation & stakeholder involvement. The ultimate goal of the project is to see the widespread implementation of the CE based on successful Business Models to ensure sustained economic development, to minimize environmental impact and to maximize social welfare. SOURCE : https://cordis.europa.eu/project/rcn/206221/pl
RE-SOURCING	Nov 2019-Oct 2023	Transparency in the company supply chain is important. When managing relationships with suppliers, companies should take into account social and environmental factors. This is supply chain responsibility, also referred to as responsible sourcing. Essentially, it's an umbrella term encompassing all sourcing and designed to be socially responsible, economically viable and environmentally sensitive. To promote responsible sourcing, the EU-funded RE-SOURCING project will create a global digital and physical platform for stakeholders to facilitate the development of a globally accepted definition, support EU businesses on responsible sourcing practices, and to facilitate the implementation of the European Innovation Partnership on Raw Materials. SOURCE : https://cordis.europa.eu/project/id/869276
CIRCuIT	June 2019 – Nov 2023	Four European cities – Copenhagen, Hamburg, Helsinki's region of Vantaa and Greater London – are planning to undertake a full circular and regenerative transition. These cities joined in a partnership to create a value chain that will allow them to become fully smart, eco-friendly, regenerative, and circular economies. The EU-funded CIRCuIT project will aim to present the whole system of elements engaged in the transition process: from dismantling buildings for reuse of materials to Circularity Hubs and CIRCuIT Academy, promoting the development of further solutions. SOURCE : https://cordis.europa.eu/project/id/821201
CityLoops	Oct 2019 – Sept 2023	Construction and demolition waste (CDW) – including soil – and organic waste (OW) are two of the most significant urban material flows with a remarkable environmental impact in European cities. The EU-funded CityLoops project will develop a circular city scan methodology and indicators by adapting material flow analysis (MFA) and urban metabolism methods to drive the transition to a circular economy. Seven small- to medium-sized cities in Denmark, Finland, the Netherlands, Norway, Portugal and Spain will test a number of innovative tools and processes to support circular planning and decisions making related to CDW and OW. The project will prepare scale-up plans in each of the demonstration cities, while collaborative learning networks will be established at the regional level. SOURCE : https://cordis.europa.eu/project/id/821033

Appendix VI- Partners of the Municipality of Rotterdam

Scale	Some partners of Municipality of Rotterdam	Description
National	Platform CB'23	Connects all links of the circular construction chain, both within the civil engineering sector and residential and non-residential construction: from producer to demolition worker, from client to contractor and from large contractor and SME to start-ups (Platform CB'23, 2019a).
	Concrete Agreement (Betonakkoord)	A national chain agreement for sustainable growth of the construction sector. In the agreement, agreements have been made about which chain partner will realize which goals and ambitions. In seven implementation teams, the signatories are working on the concrete implementation of the goals and ambitions of the concrete chain. The Concrete Agreement is open to all parties in the Concrete chain, both public and private (Betonakkoord, 2021).
	'Samen Versnellen' program	BZK and Cirkelstad have taken the initiative for the 'Samen Versnellen' program. Rijksvastgoedbedrijf, Rijkswaterstaat, Amsterdam, The Hague, Rotterdam, Utrecht, Dura Vermeer, Van Wijnen, Volker Wessels, BAM and Synchroon are working towards signing the covenant: 'Circular construction: The new normal' in 2023 (Cirkelstad, 2021).
	Opdrachtgeversforum	Network of (semi-)public clients who exchange experiences, share knowledge and initiate ideas about new themes in construction and infrastructure. Opdrachtgeversforum aims to contribute to the professionalization of commissioning of public and semi-public organizations and to bring about innovation and quality improvement in the construction sector. (Opdrachtgeversforum, 2021).
	BTIC	Bundling innovation questions from the government, innovation needs from the market and research pro-jects from knowledge institutions in public-private, knowledge and innovation programs. Through a more efficient, bundled innovation process, innovations can be accelerated and realized on a large scale to solve major social challenges (BTIC, 2019).
	City Deal	Thematic collaborations between national govern-ment, municipalities, private parties, knowledge institutions and other organizations that work on innovative solutions for the built environment, which stimulates knowledge exchange between the various parties involved (iCircl, 2020b).
Provincial	Verstedelijkingsalliantie Zuid- Holland	A collaboration between eight municipalities, the province of South Holland and the metropolitan region of Rotterdam The Hague in the South Wing of the Randstad. There appeared to be a strong shared vision of the future: a much stronger spatial cohesion in the South Wing of the Randstad, with a better economic structure and jobs for everyone, who can be reached by high-quality public transport. A housing market with innovative affordable forms of housing for all population groups and with the preservation of open green landscapes as a counter-mould to an urban residential environment. The municipalities recognized each other in the task and realized that they need each other to come up with solutions. Certainly in view of the housing challenge that is increasingly taking place at the scale level of the alliance. In addition to the goal of working together in knowledge development and regulations, they are also working on a joint strategy for dealing with investors, with whom they want to make programmatic agreements so that phasing can be coordinated (Ruimte + Wonen, 2021).
Municipal	Cirkelstad Rotterdam	A cooperative association that offers the Netherlands a platform for ambitious private and public parties who want to work together on 'cities without waste' (iCircl, 2020a). They inspire municipalities, supplying indus-tries and companies to participate in Circle Cities networks. Meetings and events are organized to providing information, connecting parties and allowing them to learn from each other's circular ambitions.

Appendix VII- Agreements and strategies on different policy levels

Торіс	European	National	Provincial	Municipal
Climate and energy efficienty	European Green Deal Realizing energy transitions, implementing CO ₂ taxes, integrating alternative fuels, tackling biodiversity, air, water and soil pollution, and stimulating research and innovation.	Climate Agreement In order to achieve global and European climate goals, the Dutch government has set the goal that the Netherlands must emit 49% less CO ₂ by 2030 and in 2050 this must be 95% less, compared to 1990.	Weerkrachtig Zuid-Holland This document provides direction for the efforts of the province of South Holland in the field of climate adaptation and subsidence and is a starting point for substantive further development of environmental policy. Choice scenarios and financial consequences become part of an annual implementation agenda that can easily be adapted to the needs of the moment. That is adaptive policy: there is room for changing circumstances and political considerations in the short and longer term.	Rotterdam Climate Agreement 50 'climate deals' that provide a boost for the low-carbon economy. The measures show, among other things, that in ten years' time Rotterdam will halve the emissions of CO_2 and other greenhouse gases. The Rotterdam Climate Agreement contains among other things large-scale insulation of Rotterdam homes.
Circularity	Circular Economy Action Plan Various legislative and non-legislative measures to reduce consumption footprint and increase circular use of products and raw materials in EU. Includes initiatives to green the production design of products, as well as the composition, (re)use and recycling of products and raw materials. In addition, Commission wants to strengthen the position of consumers in this field: there must be better access to reliable information about the sustainability of products. Important steps in achieving European climate neutrality target of 2050.	Program 'Nederland Circulair 2050' Government presented the efforts of the national government: a fully CE in 2050. Supports innovative pilot projects to deliver lessons and to create enthusiasm. National government is also stimulating market developments by adjusting rules, co-developing a materials passport, setting up a knowledge institute for circular construction, releasing subsidies for circular business and revenue models and from 2023 all government requests will be circular.	Program 'Circulair Zuid Holland: samen versnellen' Province is working together on themes of construction, green raw materials and food, manufacturing industry and plastics. In this regard, transition thinking is paramount in innovator networks, chain cooperation and innovation.	Program 'Van zooi naar Mooi' Rotterdam is challenging residents, companies and the municipality itself to think in circular solutions with new circular campaigns
		Raw Materials Agreement Ambition of fully circular in 2050 was more widely endorsed in Raw Materials Agreement by companies, branch organizations within the building sector, governments, nature and environmental organizations, knowledge institutes, financial institutions and many other social organizations. Contains binding agreements to run the Dutch economy on reusable raw materials.	Bouwprogramma Zuid-Holland Province of South Holland acts as a constructive partner for government policy and municipalities and joins initiatives such as Platform CB'23. They actively collaborate with Cirkelstad and help developers with process guidance, knowledge sharing and product development. These activities come together in Bouwprogramma Zuid-Holland, which was established jointly with the province.	Rotterdam Sustainability Compass Contains the objectives that Rotterdam is pursuing for the period 2030-2050 in the field of sustainability; how the transitions in this field can be brought closer together and how they can be integrated so that they reinforce each other and how the city will get closer to realizing the ambitions: in 2030, circularity is very normal and the city have halved the use of primary raw materials. In addition, 3,500 to 7,000 jobs have been created that contribute directly to the CE. In 2050, Rotterdam society will be completely circular (material loops are closed) and the entire housing stock will be C02 neutral.
		Transition Agenda CCE Describes strategy to achieve a CCE in 2050 and contains the Agenda for the period 2018-2021. Agenda is based on Raw Material Agreement and drawn up by a transition team of experts from science, government and market parties.	Interreg CircE project aims at strengthening the diffusion of CE in Europe. This project has eight partners, including the Dutch Province of Gelderland, and will steer their economy towards a circular model, by helping them to increase the capability of policy instruments.	Program 'Rotterdam Circulair 2019-2023' Describes the circular ambitions of the municipality and expresses the ambition to use half less primary raw materials in the city by 2030. The key sector 'construction' focuses on the development, layout and management of areas, buildings, infrastructure and public space. The task for 2019-2023 is to stimulate circular construction, which means extending the lifespan of existing buildings and ultimately dismantling as many buildings as possible and efficiently reusing the materials released.
Sustainable built environment	Level(s) Voluntary reporting framework to improve the sustainability of buildings, aims to establish a common language of a sustainable built environment and provides a set of metrics and indicators that could be used by measuring the environmental performance of individual buildings, including the full life cycle.	Linking opportunities Cabinet wants activities related to realization of a CCE link up with other major urban tasks where possible (such as energy transition, making homes more sustainable, climate adaptation and quality of life issues).		Rotterdamse Stijl intended to contribute to Rotterdam as an attractive living and working city with a well-designed outdoor space and the use of beautiful materials. It provides peace, unity and recoginsability in the public space of Rotterdam. The guidelines are described in a manual and a toolkit, which includes the products that can be recycled in a 100% high- guality manner. Ultimately, when ordering products and materials, this environmental tool should be able to measure the environmental impact, so that the most circular-proof and energy-efficient products can be chosen

Opportunities: desired/needed roles and actions of the municipality related to (initiation of) CSCC from different stakeholders' perspectives

		Insufficient internal integration	Insufficient communication	Insufficient realisation	Insufficient facilitation
Public parties	Rotterdam - Alliance Manager Next Generation Residential Areas	Integrate the different transitions Organize internal theme sessions	Show examples Unburden residents (components)	Challenging the market Stimulate the market Launching customer	Organize theme sessions Facilitate innovation platform Make visions concrete
	Rotterdam - Program Manager Circularity	Give concrete cause Combine learning and 'we' factor	Create a campaign	Show confidence in market Enter into a dialogue with market Start small but real	Make location available for 'hub' Act as a director
	Rotterdam - Consultant Circular and Climate adaptive	Integrate the different transitions	Challenge the residents Stimulate the residents Show good examples	Encourage at demand Do not work too project-based Start small but real	Facilitate space to gain experience
	Rotterdam - Residents advisor home maintenance and sustainability	Cooperate with other departments Organize internal theme sessions Financial contribution of departments Interne director	Use social media Provide a physical service point Unburden residents (components)	Do not work too project-based Do good preliminary research	Organize purchasing actions Create knowledge sharing platform
	Amsterdam - Senior Advisor Energy and Circular Development	Circular Office: knowledge sessions, training and education	Unburden residents	Enter into a dialogue with market Set up frames Link to social factor Circular tendering	Help the market in the start-up phase (pilots, own real estate etc.)
Intermediaries	TU Delft - Doctoral Researcher Housing Management	Integrate the different transitions	Unburden residents (components) Emphasize urgency Use model homes	Be clear in your prioritization Include market initiatives in policy Start small but real	Help the market in the start-up phase (pilots,own real estate etc.) Make visions concrete
	Bouwhulpgroep - Consultant and lecturer Sustainable Renovation	Create integral project and organization quality	Designate experiment area Unburden residents (components) Provide a physical service point	Tap into market initiatives Designate experiment area Start small but real Circular tendering	Help the market in the start-up phase (pilots, own real estate etc.) Make visions concrete
	TNO - Scientist Integrator Sustainable and Circular Construction Concepts	Integrate the different transitions Financial contribution of departments	Inspire, stimulate, explain, unburden the residents (components)	Show confidence in market Take a pioneering role with own real estate Circular tendering	Make visions concrete
	Platform31 - Project Leader Sustainability, Circular Society and Upscaling	Integrate the different transitions Financial contribution of departments	Draw up achievable visions	Designate experiment area (more flexible licensing)	Facilitate space to gain experience
	C-Creators - Circular Construction Specialist	X	Draw up achievable visions Inspire, stimulate residents Explain added values	Challenging the market Stimulate the market Circular tendering	Help the market in the start-up phase (pilots,own real estate etc.) Facilitate space to gain experience Facilitate training/education
Private parties	VERAS - Secretary	X	Provide information to the public Repetition in communication	Circular tendering Designate experiment area (more flexible licensing)	Facilitate space to gain experience Act as a director
	BRBS - Director and member of the CCE transition team	Integrate the different transitions, visions, ambitions	Enhance people through R-center Physical meeting places	Start small but real Launching customer	Help the market in the start-up phase (pilots and, real estate etc.) Materials bank
	NVTB - Director and member of the CCE transition team	Integrate the different transitions, visions, ambitions	Draw up achievable visions Inspire, stimulate residents Explain added values	Challenging the market Stimulate the market	Surveillance and enforcement Make visions concrete
	Technology NL - Team leader Technology Netherlands Advice	Interne director	Draw up achievable visions Inspire, stimulate residents	Circular tendering Launching customer Start small but real Enter into a dialogue with market	Provide guidance, inspire, give examples to the market Make visions concrete
	Architect MAKEN - Founder and Architect	X	Communicate through children Show urgency of transition Sharing experiences (platform) Inspire, stimulate residents	Start small but real Enthuse and make it mandatory Enter into a dialogue with market Create open atmosphere	Facilitate space to gain experience Make a location available for material 'hub' Create knowledge sharing platform
	A van Liempd - Circular demolition specialist	Create integral project and organization quality	Show examples	Connecting with national initiatives Circular tendering	Make location available for 'hub' Connect with existing initatives Do not do things that are not part of your core business
	Copper8 - Consultant	Integrate the different transitions, visions, ambitions	Communicate through education/ children Inform, inspire residents Show examples	Launching customer (create mass) Challenging the market Designate experiment area (more flexible licensing)	Offer help, support financially Facilitate space to gain experience
	Van Omme en de Groot - Director Renovation & Maintenance	X	Draw up achievable visions Show examples	Enter into a dialogue with market Give concrete cause to learn More flexible licensing	Surveillance and enforcement Support financially Organize theme sessions Make visions concrete
	Raab Karcher - Greenworks- Deputy Director of Greenworks	Integrate the different transitions, visions, ambitions Independent coach	Show examples Knowledge transfer Communication platform	Enter into a dialogue with market Create support for plans	Facilitate market dialogue Organize (online) knowledge event and make project available
Civil organizations	Stichting WOON! - Consultant and member of the Natural Gas Free project	Integrate the different transitions, visions, ambitions Independent coordination	Use model homes (on a wider scale) Communicate through education Reward good behavior	Circular tendering Set up frames Link to social factor	Surveillance and enforcement Bringing supply/demand together Facilitate training/education Make location available for 'hub'
	VEH - Construction Specialist at the Knowledge Center of VEH	Integrate the different transitions, visions, ambitions	Unburden residents (prefab) Citizen participation	Stimulating modular construction Designate experiment area (more flexible licensing) Enthuse and make it mandatory	Facilitate space to gain experience
Home owner	Het Groene Bureau - private homeowner who has renovated his house (circular)	Х	Citizen participation Use residents to promote in city Communicate through children	Start small but real Designate experiment area (more flexible licensing)	Bringing supply/demand together Make location available for 'hub' / R-centrum, (de)centralized

