Innovation upscaling and citizen participation: two conflicting elements of the living lab concept?

A research to identify barriers and conditions for citizen participation and innovation upscaling in the context of the transition towards circular road infrastructure at Rijkswaterstaat.

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Master thesis EIP
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Preface

Dear reader,

In front of you is my master thesis, which forms the capstone of my study period. This research was written as part of the Master Environmental and Infrastructure Planning at the University of Groningen and it was written during my internship at Rijkswaterstaat as part of a collaboration between the University of Groningen and Rijkswaterstaat. The subject of my thesis is a combination of citizen participation and innovation upscaling in the context of living labs as part of the transition towards a circular economy. This research is an interesting mix of subjects, which motivated me to keep working on this research.

During the research process, I found out that innovation as a subject and writing a master thesis have similarities. As Bram van den Heuvel (Rijkswaterstaat) said:

> *''When innovating, you never know in what direction you are going. You are busy with launching a rocket to the moon, but it is unknown what you will find on the moon.''*

This quote not only illustrates the difficulty of innovating, it also corresponds to the research process I encountered. At the beginning of my research, I did not know in what direction I was going, despite wanting to have a subject that concerned citizen participation and infrastructure construction. During the research process you are busy with finding theory, thinking about the methods to deploy and collecting data. Despite having thoughts and ideas of your results, it is exciting until the last moment to experience what results derive from interviews and whether this result is satisfying. At the end of nine months doing research, I can say that I am happy with how the process went and with my results. Doing this research in combination with an internship was educational and it made me realize that doing research is difficult, but in the end, everything will fall into place.

I hope that you will enjoy reading!

Joost van der Wal
Groningen, 9th of July 2021

Abstract

This master thesis is concerned with citizen participation and innovation upscaling as part of living labs for a transition towards circular road infrastructure. The aim of this research is finding conditions to enable citizens to participate in living labs and to establish conditions to enable innovation upscaling from a living lab. Finding living lab citizen participation conditions is relevant, since citizen participation in living labs is constrained by specific barriers. Citizens possess knowledge of their local context, which effectively contributes to the innovation process in living labs. At the same time, upscaling of the innovations created in living labs is crucial to progress in the transition towards circular road infrastructure, but this is also blocked by specific barriers. Citizen participation in living labs creates a focus on the local context, constraining upscaling. To achieve the goal of creating circular road infrastructure by 2030 in the Netherlands, innovations are needed. Living labs are a tool to create these innovations, but citizen participation barriers and upscaling barriers need to be solved.

This research is based on literature research and a case study with interviews to answer the following research question: '*What conditions enable citizens to participate in a living lab and are necessary for innovation upscaling to achieve the transition towards circular road infrastructure in the Netherlands?'* This research was conducted in the context of Rijkswaterstaat, with the InnovA58 project as case study.

The conducted research illustrates that a variety of conditions for both citizen participation and innovation upscaling need to be implemented. The main citizen participation enabling conditions entail expectation management and transparency about the co-creation possibilities by a living lab initiator, an initiator that allows for feedback and creates true empowerment, and an initiator that shows appreciation and puts effort into understanding community problems. For innovation upscaling, creating an upscaling- and learning strategy is crucial, cross-sectoral collaborations should be established, a diverse group of stakeholders should be involved in the living lab, and room for innovation customization should be reserved. The results show that there is overlap between conditions to enable citizen participation and upscaling. Therefore, the main recommendation is to deploy the conditions simultaneously, since the differing conditions complement each other. Citizen participation in a living lab is not constraining upscaling. Instead, it enables upscaling.

Keywords: Citizen participation, circular economy, experimentation and innovation, energetic society, living lab, multi-level governance, transitions.

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EU	European Union
Ministry of IenW	Ministry of Infrastructure and Water Management
LLIADB	Living Lab Infrastructure & Area Development Brainport
NEPA	New Environmental Planning Act *(Dutch: Omgevingswet)*

1. Introduction

1.1 Background

1.1.1 Circular road infrastructure

In 2019 the EU Green Deal was presented, which contains a strategy to create a sustainable European economy (Europa Decentraal, 2019). A main pillar of the EU Green Deal is a circular economy, which entails that all resources are re-used instead of ending up as waste (Kemfert, 2019). Moreover, products are locally produced to reduce environmental impact (Kerkhofs et al., 2021). Figure 1 compares the circular economy with the current linear economy. The aim of a circular economy is to reduce harmful waste for the environment, and create safe and healthy living and working conditions (Rijksoverheid, 2017). Moreover, economic growth is achieved by finding alternatives for environmental degradation and natural resource degradation, and restoring ecology (Williams, 2019). However:

''Governments optimistically bet on a circular economy, while extensive innovation is still necessary to achieve a circular economy'' (Van Noort, 2020, p.1).

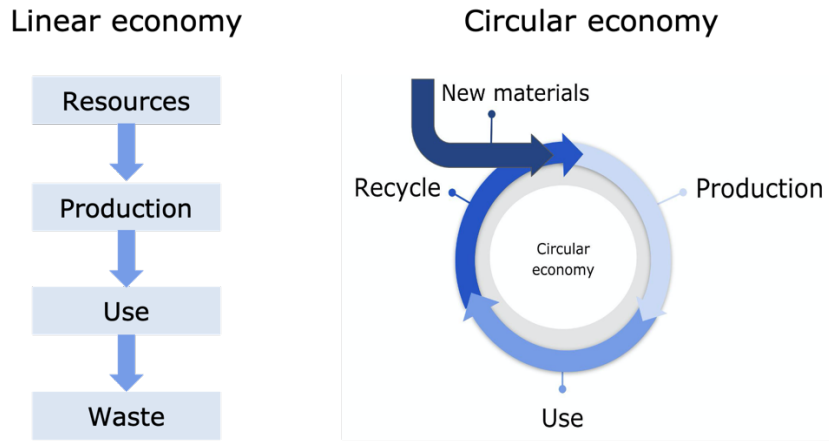

Figure 1: A circular economy (author, based on: Europa Decentraal (2019).

The change towards a circular economy is considered as a transition (Rijksoverheid, 2017), because society needs to be structurally changed towards a desirable future and developments need to take place at different levels (McCrory et al., 2020), for example on the macro-, meso- and micro-level (Van der Brugge et al., 2005). To progress in the transition towards a circular economy, local innovation upscaling is crucial (Naber et al., 2017).

Especially for road infrastructure in the Netherlands there is a challenge to create a circular economy (Mantalovas et al., 2020). Rijkswaterstaat, the governmental organization exploiting Dutch road- and water infrastructure, aims to work in a circular way in 2030 (Rijkswaterstaat, n.d.b). This goal creates an opportunity to renew road infrastructures in the Netherlands, since current road infrastructures were built 50 to 70 years ago and is aging. Moreover, the NEPA of the Netherlands demands Rijkswaterstaat to integrate their activities better into the living environment in a sustainable and inclusive way (Kerkhofs et al., 2021). Nevertheless, adapting infrastructural systems is problematic because space in the Netherlands is limited and current

road infrastructures have been in place for a long period of time (Williams, 2019). Additionally, there is still a 'socio-technical' view (Mantalovas et al., 2020), which obstructs the creation of circular road infrastructure. Especially the integration of road infrastructure with other infrastructure should lead to the fulfillment of a circular economy but current efforts are not sufficient yet (Ibid.).

1.1.2 Living labs to create innovations

To progress in the transition towards circular road infrastructure, innovation is crucial (Hysa et al., 2020). Establishing living labs conceivably supports innovation and finding circular road infrastructure solutions (Ibid.). Living labs contribute to wider socio-technical change because living labs enable experimentation, learning and reflexivity (Kuhlmann & Rip, 2014). Additionally, living labs stimulate innovation because living labs connect the creativity of the different actors to test and experiment with innovations in a real-life context (Nesti, 2017). Creating synergy between different arenas and policies is crucial, meaning that citizens, public authorities, and private stakeholders have to collaborate to develop innovative solutions to create zero waste and reduce the use of non-renewable resources (Remoy et al., 2019). As Kalinauskaite (2019, p.1) stated:

''Living labs are a new, magic concept for success and innovation to improve our living environment.''

Living labs are public-private-people partnerships (Neef et al., 2017) and help to create innovative solutions to create a circular economy. Involving citizens in living labs is crucial, since citizens act as contributors, co-creators, informants and testers (Juujarvi & Pesso, 2013). Furthermore, involving citizens in road infrastructure planning fits with the NEPA and supports the integration of road infrastructure into the landscape (Lane, 2005). The development of a living lab takes place at the micro-level in a transition towards a circular road infrastructure. However, to establish circular road infrastructure, upscaling of the micro-level living lab developments to the meso-level is necessary (Schot & Geels, 2008).

1.1.3 Citizen participation and upscaling connected

Living lab innovations are adapted to the specific, local context of the living lab. The locality of a living lab is expressed in the stronger role citizens are getting in spatial planning (Hajer, 2011). Usually, citizens represent and promote a local agenda, without considering other communities and contexts (Seebauer et al., 2018). Citizen participation in living labs enables the alignment of living lab innovations to societal needs, since citizens obtain specific knowledge about their environment (Tsui, 2019). However, specific barriers block citizens to participate in a living lab. Therefore, the potential of a living lab is s not always deployed to its fullest extent (Turnhout et al., 2010). The NEPA of the Netherlands demands the improvement of integrating road infrastructure into the living environment and enhanced citizen involvement in spatial planning (Rijksoverheid, n.d.). Hence, solving citizen participation barriers for living labs is crucial (Tsui, 2019).

As Schot & Geels (2008) illustrated, bundling and upscaling of innovations by governmental organisations is necessary to achieve wider system change, which is in this case a transition towards circular road infrastructure. Upscaling can be achieved by diffusion processes, called

scaling, translation and embedding (Wirth et al., 2018). However, upscaling is challenging due to specific upscaling barriers (Ibid.). Currently, research on the translation and adaptation of living lab innovations to other spatial scales is lacking (Van Geenhuizen, 2018). Additionally, Molinari et al. (2020) concluded that the goal-oriented nature of living labs challenges the adoption of uniform guidelines implementable elsewhere. Nevertheless, living labs are effective in creating innovations to achieve sustainability goals, but innovation upscaling is blocked by specific upscaling barriers and the goal-oriented nature of living labs (Molinari et al., 2020; Van Geenhuizen, 2018).

Thus, living labs are established in a local context to find innovative solutions to local problems (Wirth et al., 2018). Involvement of citizens in living labs is crucial, since citizens possess knowledge about the local environment (Tsui, 2019). Overcoming citizen participation barriers is necessary to enable citizen participation in living labs (Turnhout et al., 2010). Since living labs are established in a local context, governmental organisations are responsible for translating, embedding and diffusing the local innovations to a larger scale (Wirth et al., 2018). However, certain barriers block upscaling, which need to be solved to achieve wider socio-technical change (Ibid.). In the end, citizen participation and upscaling are connected because:

''[…] social exclusion is a key constraint affecting upscaling itself […]''
(Cellina et al. 2018, p. 13).

1.1.4 Research context

Seebauer et al. (2018), Wirth et al. (2018), Van Geenhuizen (2018) and Molinari et al. (2020) illustrated the important role of citizens in a living lab to bridge the gap between individual citizens and the centralized government. Citizens possess place-specific knowledge, have different interests than governments and companies, and are concerned with their own living environment, which fosters innovation (Hajer, 2011). Nevertheless, the citizens' focus on the local environment increases the context dependency of living lab innovations (Cellina et al., 2018), which constrains upscaling (Veeckman & Van der Graaf, 2014). Both citizen participation and innovation upscaling are constrained by specific barriers (Veeckman & Van der Graaf, 2014; Gasco, 2017). Living lab citizen participation and innovation upscaling are related: barriers, such as context dependency of living lab innovations constrain upscaling, while citizen participation contributes to context dependency. Therefore, this research is concerned with finding citizen participation- and innovation upscaling conditions to overcome the barriers in the context of living labs for circular road infrastructure. Moreover, the relationship between citizen participation- and innovation upscaling conditions is further researched, since citizen participation and upscaling are related (Cellina et al., 2018).

This research is concerned with creating circular road infrastructure, since innovations are needed in this field. Therefore, this research expands on the research of Wirth et al. (2018), Van Geenhuizen (2018) and Molinari et al. (2020) by doing research in the context of Rijkswaterstaat. Rijkswaterstaat is ''*The largest client in the Netherland in construction and uses a lot of materials''* (Rijkswaterstaat, 2020, p.1) and responsible for road management in the Netherlands (Ibid.) In the end, Rijkswaterstaat is responsible for creating circular road infrastructure in the Netherlands. Living lab innovation upscaling is crucial for Rijkswaterstaat to progress towards circular road infrastructure, while citizen participation in living labs is crucial to accord with the NEPA (Ibid.).

1.2 Research aims

This research consists of two research aims:

1) Identify barriers to and conditions for citizen participation in a living lab.
2) Identify barriers to and conditions for upscaling of living lab innovations.

By identifying these barriers and conditions, the relationship between citizen participation and innovation upscaling can be further dissected.

1.3 Research questions

This research answers the following research question: ‘’*What conditions enable citizens to participate in a living lab and are necessary for innovation upscaling to progress in the transition towards circular road infrastructure in the Netherlands?’’*

This research identifies barriers and conditions for both citizen participation in a living lab and innovation upscaling from a living lab to ensure that the potential of living labs is deployed to its fullest extent. The different conditions facilitate the streamlining of living lab process within Rijkswaterstaat.

To answer the main research question, a case study of the InnovA58 project was conducted. Within this project, two living labs will be constructed, which address circular road infrastructure. This is a relevant project within Rijkswaterstaat, since citizen participation and innovation upscaling are two key subjects in the living labs.

To answer the main research question in a structured way, the following secondary questions will be answered:

1. How is the living lab concept defined from a theoretical perspective and how is citizen participation and upscaling connected to the living lab concept?
2. What barriers to and conditions for citizen participation and innovation upscaling are identified in theory?
3. How is the concept of living labs defined in the context of Rijkswaterstaat and the Ministry of IenW and why is it an important concept?
4. What barriers to citizen participation and upscaling of innovation can be identified in the context of the InnovA58 project?
5. How can Rijkswaterstaat overcome citizen participation barriers and enable citizens to participate in a living lab?
6. How can Rijkswaterstaat overcome innovation upscaling barriers and enable innovation upscaling from a living lab?

Secondary research question 1-2 are addressed by literature research. Secondary questions 3-6 are answered by conducting semi-structured interviews within Rijkswaterstaat and the Ministry of IenW, and with citizens that are connected to the InnovA58 project. The literature research and case study enable the formulation of conditions for citizen participation in living labs and upscaling from living labs in the context of creating circular road infrastructure at Rijkswaterstaat. Further information on the methodology is provided in chapter 3.

1.4 Academic relevance

Research on citizen participation and the importance of citizen participation in spatial planning is widespread. The popularity of researching citizen participation in spatial planning is expressed in the number of available literatures in the database of Scopus. Scopus is a database of scientific literature (Scopus, 2021) and is a search-engine used by the Faculty of Spatial Sciences of the University of Groningen. Searching for ''citizen participation'' in Scopus (www.scopus.com) leads to 20.301 hits, illustrating the widespread availability of citizen participation literature. However, as figure 2 illustrates, the combination of citizen participation, upscaling and living labs is unique.

Search results background

Searching for general terms in Smartcat and Scopus for academic literature generates no results when searching for:

- ''Innovation upscaling'' leads to 176 results. However, these results are not connected with the transition towards circular road infrastructure.
  - Changing the search term to ''innovation upscaling'' AND ''circular'' leads to one result.
- ''Living lab'' AND ''Upscaling'' leads to six results, of which some are included in the theoretical framework. However, these results are not concerned with circular road infrastructure.
- ''Upscaling barrier'' leads tot 212 results. However, only a few results are concerned with a circular economy or living labs.
  - ''Upscaling barrier'' AND ''living lab'' leads to zero result.
  - ''Upscaling barrier'' AND ''circular economy'' leads to four results.
- ''Upscaling conditions'' AND ''living lab'' leads to zero result.
- ''Citizen participation'' AND ''living lab'' leads to 47 results.
  - Adding ''barriers'' to citizen participation leads to only two results.
- ''Citizen participation conditions'' AND ''living lab'' leads to four results, but these results are concerned with open data and not with a living lab for circular road infrastructure.
- ''Citizen participation'' AND ''Upscaling'' leads 11 results. However, these are all concerned with the energy transition, not specifically with living labs.
- ''Citizen participation'' AND ''upscaling'' AND ''living lab'' leads to zero results, which illustrates the knowledge gap.

Figure 2: Search results illustrating the knowledge gap (author).

Corresponding with figure 2, Maas et al. (2017) described that limited research is available on the different barriers to and conditions for citizen participation in living labs. The researched barriers and conditions for citizen participation remain theoretical and are not specifically concerned with the transition towards circular road infrastructure. Moreover, the theoretical conditions identified are difficult to deploy, which calls for practical research (Veeckman & Van der Graaf, 2014). As Tempelman & Pilot (2010) stated:

''It may be true that 'nothing is more practical than a good theory', but putting a good theory into practice is never easy'' (Tempelman & Pilot, 2010, p.261)

Living labs becoming a popular method in spatial planning and gain interest within Rijkswaterstaat, since public administrators need to innovate (Gasco, 2017). Furthermore, challenges, for example the introduction of the NEPA and aging road infrastructure, make it indispensable for Rijkswaterstaat to innovate (Kerkhofs et al., 2021). Small, local living lab innovations are insufficient to achieve the transition towards circular road infrastructure. Therefore, bundling of the initiatives and upscaling to a larger context beyond the living lab is crucial. However, conditions that enable innovation upscaling are lacking. Therefore,

qualitative studies should be established to research living lab innovation upscaling conditions (Gasco, 2017; Wirth et al., 2018).

Figure 2 illustrated a knowledge gap. Research on conditions that enable citizens to participate in a living lab is minimal, while conditions for innovation upscaling from a living lab are also lacking. Moreover, a connection between citizen participation and innovation upscaling is barely generated in academic research. Especially for Rijkswaterstaat both are important, since the NEPA demands Rijkswaterstaat to foster citizen participation, while the goal of achieving a circular economy for road infrastructure by 2030 requires immense innovations.

This research contributes to academic knowledge by doing qualitative research into the mentioned knowledge gap. The relationship between living lab innovation upscaling and living lab citizen participation needs further research, since both factors are important but can also be conflicting. Therefore, this research contributes to identifying different barriers to citizen participation and innovation upscaling in the transition towards a circular economy for road infrastructure. Moreover, by establishing citizen participation and upscaling conditions, innovation upscaling and citizen participation are enabled to progress in the transition towards a circular economy.

1.5 Societal relevance

Rijkswaterstaat as public administrator is important for society, since public administrators are generally responsible for creating sustainability, managing the environment, building communities, managing crises and ensuring public safety (Norwich University, 2017). Rijkswaterstaat is responsible for societal challenges, such as safety, livability and accessibility (Rijkswaterstaat, n.d.c.). The Dutch society has interests in creating circular road infrastructure, since this creates a more sustainable living environment (Rijkswaterstaat, 2021). Rijkswaterstaat needs to innovate to serve society and create a circular, sustainable living environment (Ibid.).

As explained above, living labs contribute to create innovations for a circular economy. The case selected, namely the InnovA58 project, is relevant for society because different societal actors have an important role in this project. The InnovA58 project has a significant spatial impact, since the living labs change the current land uses, which impacts society. As explained, it is of interest for society that Rijkswaterstaat starts working in a circular way and creates a sustainable living environment. To do so, innovation upscaling is crucial. However, as explained, living lab innovation upscaling is constrained by certain barriers. It is therefore of interest to society to overcome these barriers. Furthermore, researching the tension between citizen participation and upscaling is important for society since citizens need to be involved in achieving a sustainable living environment, which fits the NEPA. Thus, it is relevant for society to conduct this research since it is of interest for society to be involved in spatial planning, but it is also of interest to upscale the developed innovations to improve the living environment.

1.6 Practical relevance

In 2021, Rijkswaterstaat developed a new innovation agenda (innovatieagenda), which includes innovation goals. This research contributes to two of these goals. First, Rijkswaterstaat wants to establish complementary and equal collaboration, with room for learning and experimenting (Rijkswaterstaat, 2021). This research contributes to this goal by researching conditions for citizens to participate in an 'equal and complementary' collaboration. Second, innovations upscaling needs to take place faster (Ibid.). This research will contribute to this goal by establishing conditions for innovation upscaling from a living lab, which enables quicker upscaling.

1.7 Reading guide

The next chapter, chapter 2, discusses the theoretical framework. It discusses the role of citizens in spatial planning, the living lab concept, citizen participation barriers and conditions, innovation upscaling in general and, finally, innovation upscaling conditions and barriers. Chapter three further explains the methods deployed in this research, while chapter four provides the results and analysis of data collection. Finally, chapter five provides an answer to the main research question, a conclusion, a discussion and recommendations to Rijkswaterstaat and for further research.

2. Theoretical framework

2.1 A rising role for citizens in spatial planning

This chapter discusses the communicative turn in spatial planning, the development of network governance, the energetic society and the NEPA in relation to citizen participation, and forms a basis for chapter 2.2 to 2.6.

2.1.1 From a technical rationale to a communicative rationale in planning

In the past spatial planners relied on a technical rationale to control the physical environment, which entailed top-down control, creating certainty, blue-print planning, and is object-oriented (De Roo & Porter, 2007). However, the pluralistic conditions in the 20th century and increasing complexity in service delivery and public policymaking demands for a different approach (Klijn & Koppenjan, 2014). Technical rationality is only acceptable in situations with limited actors, a single, fixed goal and in situations of a high degree of certainty (De Roo & Porter, 2007). Often, situations are fuzzy, encompassing a high degree of uncertainty and thus complexity (Ibid.).

Spatial planning often addresses problem of complex adaptive systems (Skrimizea et al., 2018). In response to complexity and the pluralistic conditions, communicative and participative planning approaches developed (Skrimizea et al., 2018; Allmendinger & Haughton, 2012). Communicative approaches in spatial planning encompasses a focus on dialogue, interaction, communication (Innes & Booher, 2014), joint image building, a learning process, and cooperation (Klijn & Koppenjan, 2014). Instead of assuming that there are universal realities in planning, the communicative approach assumes that reality is constructed by interaction between crucial actors. The collective understanding, based on intersubjective communication, decides what strategy should be deployed to deal with uncertainty and complexity (De Roo & Porter, 2007). Based on different cultural, societal, and personal experiences, spatial planning is undertaken (Allmendinger & Haughton, 2012).

2.1.2 The energetic society

Hajer (2011) addresses the ‘energetic society’ as societal development. The energetic society entails that citizens are speaking up, with creativity, a high degree of learning ability and a reaction speed. Governments need to respond to the emergence of an energetic society and need to rethink their governance philosophy to enhance the creativity of society (Ibid.). The underlying driving factor behind this philosophy is that individuals should autonomously and collectively define and influence the direction of their own life’s (Ravensbergen & Van der Plaat, 2009). The energetic society entails a stronger role of citizens in the public domain, combined with a decentralized government. The energetic society corresponds with the communicative turn because the energetic society demands a different government that enables citizen participation and networking of society, and based on intersubjective communication a collective understanding is created (Van der Steen et al., 2015; De Roo & Porter, 2007).

The energetic society is a promising governance theory to improve the effectiveness and legitimacy of policy (Van der Steen et al., 2015). To improve the effectiveness and legitimacy of policies, a better understanding among citizens of the problems, objectives and solutions needs to be created. Moreover, governments should not be exclusively responsible for spatial planning, with focus shifting away from the government to society to create room for creativity (Hajer, 2011).

2.1.3 New governance modes to enable the energetic society

The energetic society coincides with an energetic government (Van der Steen et al., 2015). According to Hajer (2011) and Van der Steen et al. (2015) the energetic government:

- Involves society and engages with society to find solutions;
- Dares to experiment and provides room for new initiatives;
- Believes in the capacity of society to innovate.

To improve the effectiveness and legitimacy of policies, the relationship between society and government should change (Hajer, 2011). This development leads to network governance with a networking society (Ibid.) Citizen participation should lead to changing the status quo (Ravensbergen & Van der Plaat, 2009) and in a networking society, citizens decide on changes in their environment instead of being the object of change (Ibid.).

Shift towards network governance

The development of the energetic society corresponds with the development of network governance, with a shift from government to governance. Governance entails a new governing process and according to Rhodes (2007) network governance can be defined as:

⇒ Broader than the government. In governance non-state actors are also included and the boundary between public, private and other sectors is blurring.
⇒ Networks are self-organizing, meaning that there is a significant degree of autonomy from the state.
⇒ The rules of the game are negotiated and agreed upon by the different actors and there are game-like interactions.

The emergence of network governance is a response to increasing complexity (Klijn & Koppenjan, 2014). The changing positions of different actors, such as citizens and the state, results in increased complexity in the decision-making process, which demands for networking between different actors to achieve satisfactory outcomes (Ibid.). The most important element of the new governance style is greater engagement of citizens and businesses (Hajer, 2011). Network governance includes a wide array of private, semi-private, public and other actors (Klijn & Koppenjan, 2014). Central in network governance is public value creation by involving different stakeholders (Stoker, 2006). Network governance encompasses a focus on nodes of activity and creativity, and on the flows of people, images and money. Nodes in this story are partnerships between organizations and these nodes attract flows of money, which enables development. Living labs are an example of such nodes of activity (Evans et al., 2017).

The New Environmental Planning Act

The introduction of the NEPA aims at improving the links between different spatial activities and projects, the different Dutch regions, and sustainable development (Rijksoverheid, n.d.). The NEPA prescribed that both citizens and entrepreneurs actively participate in the decision-making process in their living environment (Timmermans, 2019). The NEPA merges all laws that aim at improving livability and demands citizens to take an active role to participate and improve the living environment (Ibid.). Therefore, the NEPA affects citizens, who will have increasing responsibility in improving the living environment and need to collaborate closely with governments. This development underlines the shift towards network governance, while living labs enable an active role of citizens to contribute to their living environment (Evans et al., 2017).

2.1.4 Critics of a rising role for citizens in planning

Despite the development of an energetic society as part of network governance, Davies (2012) also criticized this development. According to Davies (2012), the low trust of society in the government and ongoing hierarchical network management form a barrier to further deploy network governance. Networks continue to behave like hierarchies and have no trust. In the end ‘*’fear, contract, coercion, selective incentives, resource interdependencies, and trust’’* (Ibid., p. 2700) block the provision of an important role to citizens (Ibid.). Hajer (2011) illustrated the potential of the energetic society, but to deploy the potential the critics need to be taken into account (Davies, 2012). The critics relate to barriers for citizens to participate in a living lab and are further elaborated in chapter 2.3.

To summarize this chapter, the communicative turn, the energetic society, and network governance resulted in the NEPA, which demands active citizen participation. To create solutions and enable experimenting to innovate, citizens increasingly obtain an important role in this solution creating. The next chapter will elaborate on the nodes of activity of Evans et al. (2017) with the concept of living labs.

2.2 Citizen participation and living labs

This chapter further describes and defines living labs and the different roles of the different actors in a living lab. Moreover, citizen participation is further explained in relation to the living lab concept.

2.2.1 Living lab development

The living lab concept emerged in the beginning of the twenty-first century and originates from the industry sector. The concept aimed at discovering the potential of participants to contribute to innovating the production-consumption system (Kressler et al., 2018). Despite the early development of the living lab concept, the definition of living labs remains inconsistent and vague (Schuurman et al., 2015). Nowadays, living labs are widely established outside the industry sector, for example for the energy transition, education, but also for infrastructural development (Neef et al., 2017). Due to the widespread use of living labs multiple meanings emerged (Ibid.), contributing to the inconsistent and vague living lab definition (Schuurman et al. 2015).

Living labs are a form of niche experiments (Sengers et al., 2017). Niches are created in the context of a socio-technical transition to enable radical innovation. It means that ‘*’innovation is exposed step-by-step to real world conditions”* (Ibid., p.160). In living labs, there is a crucial role for users and citizens (Ibid.). Living labs fit with communicative interaction as mentioned by De Roo & Porter (2007) and integrate knowledge, relations and actions in a learning process, which leads to learning outcomes (Beers et al., 2016). Figure 3 illustrates that the living lab learning process leads to innovations.

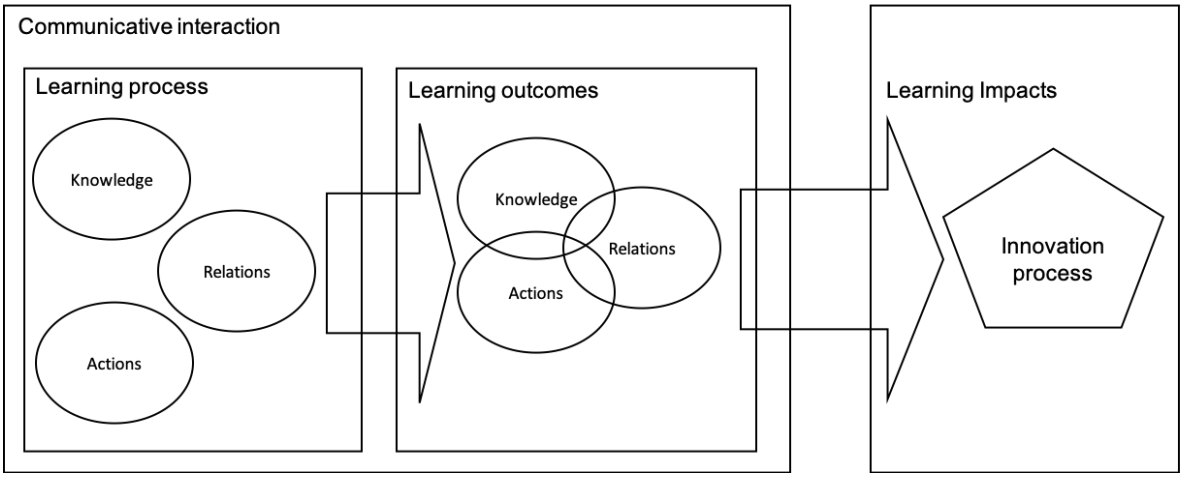

Figure 3: Living lab learning process (based on: Beers et al., 2016).

2.2.2 Living lab definition

A diversity of living lab definitions exists (Schuurman et al., 2015). Living labs are a form of experimental network governance in which stakeholders together innovate and experiment to find new technologies, services, products, and ways of living (Voytenko et al., 2015). Living labs stimulate tackling climate change challenges, urban sustainability challenges and resilience challenges. Schuurman et al. (2015) add experimentation in a real-life context, while Steen & Van Bueren (2017) add that living labs aim at innovating, increasing urban sustainability and formal learning for replication by co-creation to develop a product with all kinds of stakeholders.By combining different definitions, the following definition of a living lab for this research is formulated:

1) Living labs aim at innovation and learning and are a multi-method approach, meaning there is no single living lab methodology (Evans et al., 2017). Innovation and learning are achieved by experimentation by ‘*’integrating processes of research and innovation”* (Steen & Van Bueren, 2017, p. 23). Innovation means developing new products and tackling existing problems by discovering new solutions, while learning and experimentation is producing and exchanging knowledge between participants (Ibid.).
2) Living labs achieve the aim by co-creation. Co-creation indicates searching for a solution together with different actors with equal power (Steen & Van Bueren, 2017).
3) Co-creation is accomplished by multi-stakeholder participation. Users of the final product, public actors, knowledge institutions and private actors should be involved and collaborate in the living lab (Steen & Van Bueren, 2017; Evans et al., 2017).

4) Multi-stakeholder participation takes place in a real-life context (Schuurman et al., 2015). In this real-life context, experimentation with innovation takes place (Steen & Van Bueren, 2017; Evans et al., 2017).

Different actors can establish a living lab. This research focuses on a public administrator, Rijkswaterstaat, as living lab initiator, who establish living labs to find solutions to societal and technical problems (Scozzi et al., 2017), such as circular road infrastructure. Living labs are established in different ways, by different actors. Although living labs contain participatory and bottom-up elements, the experiments in a living lab are often still organized in a top-down manner (Ibid.).

2.2.3 Connecting citizen initiatives and the living lab concept

The change towards network governance and an energetic society is connected to the living lab concept. Multi-stakeholder participation means that a wide array of public administrations, citizens, companies, policy-makers, academics, consultants, city managers, and developers are involved in the living lab (Scozzi et al., 2017). Leminen (2015) also refers to multi-stakeholder participation as a public-private-people partnership. The public-private-people partnership developed since public-private partnerships are sometimes failing (Leminen, 2015). One of the main challenges of the public-private partnership is stakeholder opposition, which causes failure of projects (Ng et al., 2013). Therefore, it was suggested to involve people, which are citizens and users, in the public-private partnership to create a support base for innovations and to use societal creativity (Ibid.).

The development of the public-private-people partnership fits the trend of attributing power to citizens in planning and the communicative turn (Lane, 2005). In addition to adding ‘people’ to the public-private-partnership, knowledge institutions, participate in a living lab to enable knowledge exchange between theory and practice (Evans et al., 2017). Figure 4 illustrates the living lab partnership.

Although figure 4 illustrates that citizens and users are part of the living lab partnership and chapter 2.1 argues in favor of a prominent role for citizens in spatial planning, it remains unclear what role citizens exactly obtain in living labs (Juujarvi & Pesso, 2013). There are different roles within a living lab, while the role of citizens also plays a role in the decision of citizens to participate in a living lab (Ibid.).

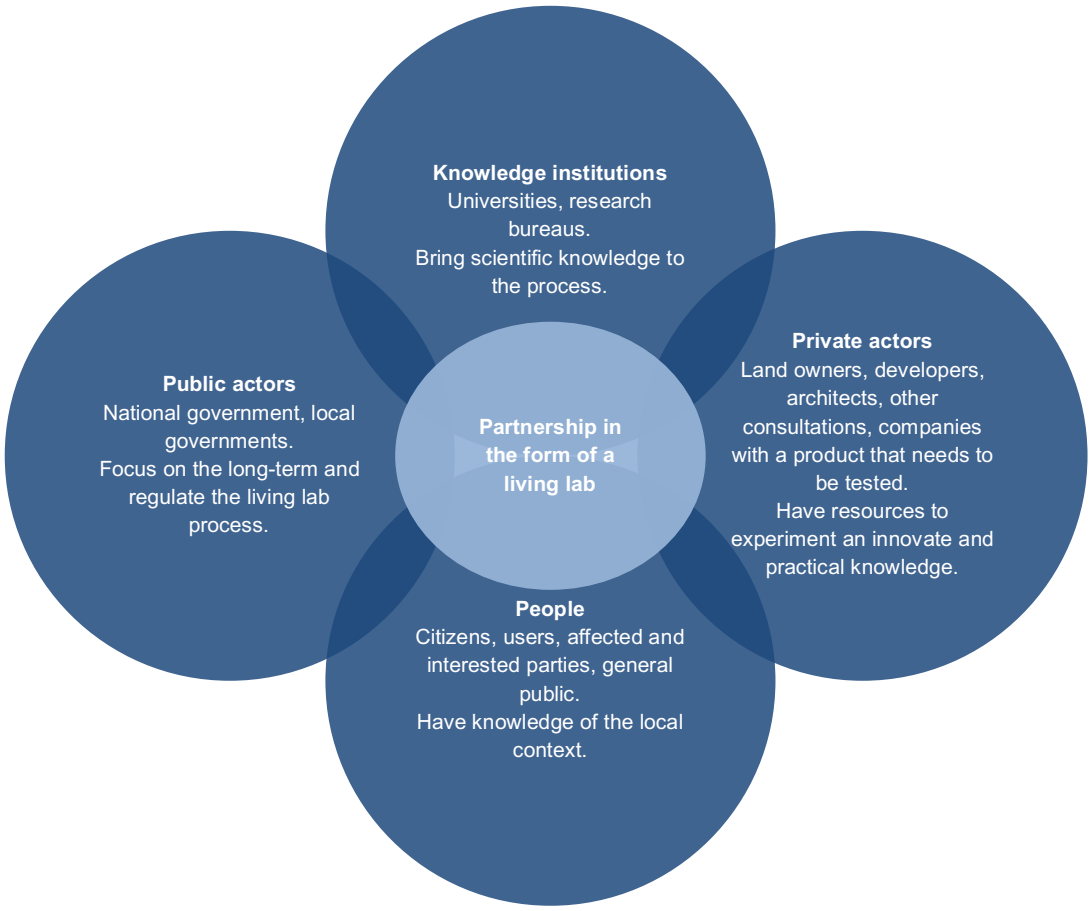

Figure 4: Living lab partnership illustration (author, based on: Ng et al. (2013) and Evans et al. (2017).

According to Juujarvi & Pesso (2013) and Bergvall-Kareborn & Stahlbrost (2009), the role of citizens in a living lab is crucial. The influencing power of citizens in the partnership should be significant, since citizens are able to generate serious suggestions about innovations, can act as informant and testers, but can also act as contributor or co-creator (Bergvall-Kareborn & Stahlbrost, 2009; Juujarvi & Pesso, 2013). The motivation of citizens to shape their environment is high and should be used in a living lab to innovate and find solutions to local problems (Juujarvi & Pesso, 2013). Scozzi et al. (2017) and Juujarvi & Pesso (2013) established different roles for citizens in the co-creation process. Table 1 illustrates the different roles.

Table 1: Citizens' living lab roles (author, based on: Scozzi et al., 2017 and Juujarvi & Pesso, 2013).

Role	Description
Explorer	Identifying, discovering and defining problems. Citizens are then not always part of the co-creation process.
Ideator	Conceptualizing solutions for local problems. Citizens are then part of the co-creation process.
Designer	Developing and designing implementable solutions. Citizens are then part of the co-creation process.
Diffuser	Citizens who support and facilitate the adoption and diffusion of innovations into the population. Citizens then produce place-based user experience and do not have to be part of the co-creation process.

A factor to consider for citizen participation is formal or informal citizen participation in the co-creation process (Puerari et al., 2018). Formal co-creation refers to a process in which the initiator of a living lab clearly defines procedures, participants, audiences and steps (Ibid.) In formal participation, the citizens are selected by living lab initiators,. In informal participation, participants are not selected and the process is less planned, short-term engagement is enabled and rules and practices can change over time (Ibid). Formal or informal participation could be a barrier for citizen participation (Ibid.).

2.2.4 The essence of citizen participation and living labs

This chapter illustrated the contested definition of a living lab and the different roles citizens play in the co-creation process. Living labs are partnerships between public- and private actors, citizens and users, and knowledge institutions. These actors are in a co-creation process which takes place in a real-life context to experiment with innovations. In this process, citizens acquire different roles. Despite the important role of citizens in living labs, citizen participation in a living lab is relatively low in the Netherlands (Maas et al., 2017). This is remarkable, since co-creation with citizens is an important characteristic of the living lab concept (Ibid.) and therefore forms the further motivation for chapter 2.3

2.3 Barriers to and conditions for citizen participation in a living lab

This chapter aims to describe the barriers for citizens to participate in a living lab and explores the conditions to overcome the barriers. Subsequently, the barriers and conditions are connected.

2.3.1 Barriers to citizen participation in a living lab

Citizen participation in a living lab is low (Maas et al., 2017), which is caused by specific barriers that block citizen participation (Veeckman & Van der Graaf, 2014).

The first barrier to participation is technical issues. Technical skilled co-creators often dominate the co-creation process. Citizens are unfamiliar with these technics, which frustrates citizens and leads to citizens deciding to drop out of the living lab (Veeckman & Van der Graaf, 2014).

Second, participation is often restricted right from the start. Citizens collaborate with other powerful actors, such as governments and businesses. Living lab initiators often present a pre-defined problem, which is a barrier for citizen participation because it restricts outcomes and influences the room for co-creation (Turnhout et al., 2010). Additionally, when citizens have freedom to explore solutions, another more powerful actors could decide whether this solution will be implemented. This creates hesitation among citizens to participate (Wolff et al., 2018). Ianniello et al. (2019) refer to restrictions from the start by explaining the attitude of public officials. Often, public officials see citizen participation as a constraint and is imposed by external pressure (Ianniello et al., 2019).

A lack of capacity and skills among citizens forms another barrier for citizens to participate in living labs (Turnhout et al., 2010). Sometimes, specific technical skills or capacities are needed to co-create. This could intimidate citizens, which reduces citizens' willingness to participate in a living lab (Turnhout et al., 2010; Wolf et al., 2018).

The fourth participation barrier is called selectivity (Wolff et al., 2018). Participation is selective, because some citizens simply refuse to participate, lack time or money, are not invited and thus neglected, or there is no urgency to participate due to mismatching interests (Turnhout et al., 2010). Citizens need money, resources, and expertise to participate, which is not always accessible to citizens (Wolff et al., 2018).) Selectivity connects with a lack of capacity and skills (Ibid.). Hard to reach groups are also part of the selectivity barrier. Low-income populations, seniors, people with disabilities or minorities are often neglected in living lab processes (Giering, 2011)

A final barrier entails distrust in living lab initiators (Giering, 2011). Often, public administrators consider citizen participation as formality, which creates the feeling among citizens that it is not worth it to participate (Ibid.) Distrust relates to the principal-agent problem (Ianniello et al., 2019). Citizens often suffer from information deficits and asymmetries, which is caused by a lack of knowledge about the preferences of citizens by the government. The information deficit causes unrealistic expectations for citizens, which in turn forms a barrier to participate (Ibid.).

2.3.2 Enabling conditions for citizen participation in a living lab

Overcoming the different citizen participation barriers of a living lab is difficult (Panten et al., 2018; Giering, 2011; Ianniello et al., 2019). Nevertheless, establishing different conditions supports citizen participation in living labs.

To overcome technical issues, spontaneity should be enabled (Bergvall-Kareborn & Stahlbrost., 2009). Personal desires should be met, participants should be inspired and the environment should fit and contribute to societal and social needs (Ibid.). Other barriers to overcome technical skills correspond with conditions to solve a lack of capacity and skills.

To solve restrictions from the start, a living lab initiator should allow freedom to citizens without imposing strict rules for co-creation or restrictions on the solution space (Bergvall-Kareborn & Stahlbrost, 2009). Moreover, power should be equally distributed between the co-creators and a living lab initiator should allow for feedback from citizens (Puerari et al., 2018). Additionally, there should be openness and transparency. An open, transparent process enables wide-spread citizen participation and invites citizens to participate. This entails that the initiator of a living lab is open and transparent about possible restrictions and informs the citizens about these restrictions beforehand (Bergvall-Kareborn & Stahlbrost., 2009). Being transparent about the solution space is crucial (Wolff et al., 2018) and realism should be created (Bergvall-Kareborn & Stahlbrost, 2009). Citizens should be aware that the generated innovations are valid for real markets (Ibid.). Realism not necessarily solves restrictions from the start, but makes it easier to deal with.

Trust creation is crucial to overcome a fear of lacking capacity and skills. An initiator of a living lab should create awareness among possible participants that everyone can contribute to co-creation, despite lacking capacities or skills (Panten et al., 2018). For example, technical

knowledge is not always needed to contribute in a meaningful way to the living lab process (Ibid.). Continuity, which are cross-border collaborations also help in solving a lack of capacity and skills (Bergvall-Kareborn & Stahlbrost, 2009).

To reach hard to reach groups, a living lab initiator should take the time and put effort into understanding the issues at stake in a community (Giering, 2011). Overcoming selectivity can also be achieved by creating spontaneity, which means that personal desires of citizens are met to persuade them to participate, despite a lack of time or money (Bergvall-Kareborn & Giering, 2011).

Overcoming information deficits is difficult (Ianniello et al., 2019). To solve distrust, trust should be created. This seems obvious, but trust creation remains difficult and is time-consuming (Panten et al., 2018). Trust creation should solve distrust and prevent citizens from dropping out of the co-creation process. Therefore, trust creation also relates to a lack of capacity and skills, since providing trust convinces citizens that, despite a lack of capacity or skills, they still can contribute (Giering, 2011). However, this takes time and thus is patience needed (Ianniello et al., 2019). There should also be continuity, which means that there are good cross-border collaborations. This strengthens creativity of the citizens participating and builds trust (Bergvall-Kareborn & Stahlbrost., 2009).

2.3.3 Merging citizen participation barriers and conditions

By connecting the barriers of paragraph 2.3.1 and the conditions of paragraph 2.3.2, figure 5 was created. The connection between the barriers and conditions form the basis for identifying citizen participation barriers and conditions in the context of living labs to create circular road infrastructure.

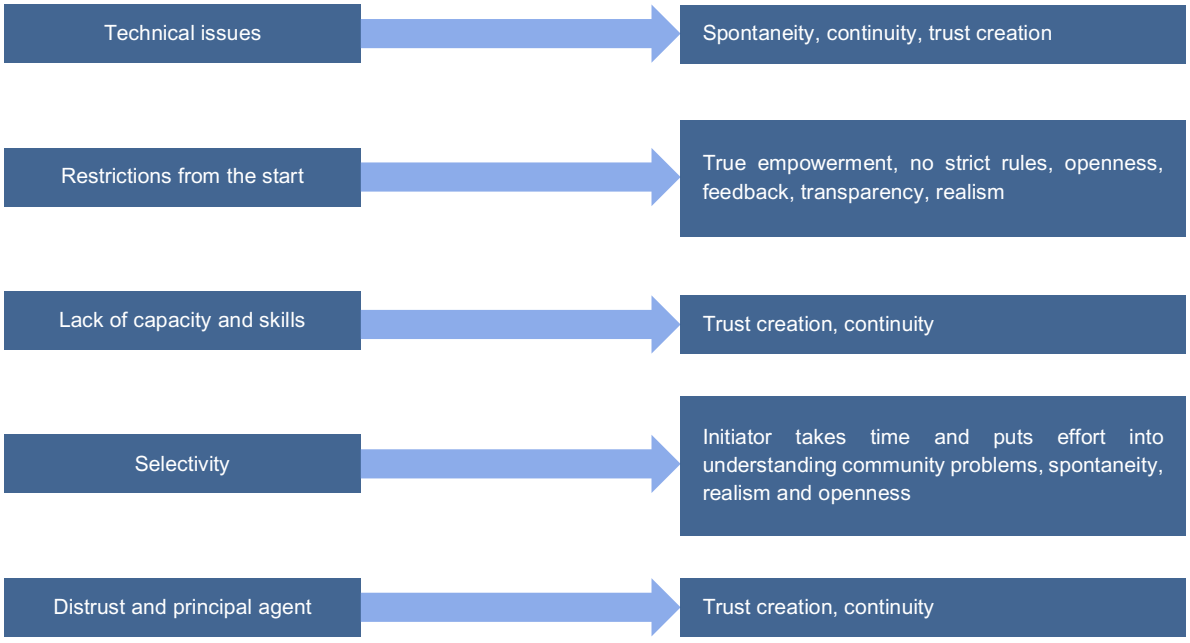

Figure 5: Connection between barriers and conditions (author).

2.4 Living lab innovation upscaling

Chapter 2.1 to 2.3 discussed citizen participation in living labs. This chapter shifts to innovation upscaling as subject. First, innovation upscaling is defined. Second, the importance of upscaling is illustrated.

2.4.1 Upscaling definition

According to Ruijer & Meijer (2019) and Gasco (2017), the living lab process consist of three stages, displayed in figure 6. At the same time, Ruijer & Meijer (2019) emphasize that the process is chaotic and non-linear, meaning that these stages are not a blueprint.

Figure 6: Living lab stages (author, based on Ruijer & Meijer, 2019 and Gasco, 2017).

As stated in chapter 1, upscaling refers to embedding, scaling and translation (Wirth et al., 2018). Figure 7 illustrates these different forms of upscaling. Embedding entails the integration and adoption of innovation into existing, local structures. Translation involves replicating an experiment or innovation at another spatial scale of in another institutional context. Finally, scaling refers to an experiment that grows in terms of content or actors involved (Ibid.)

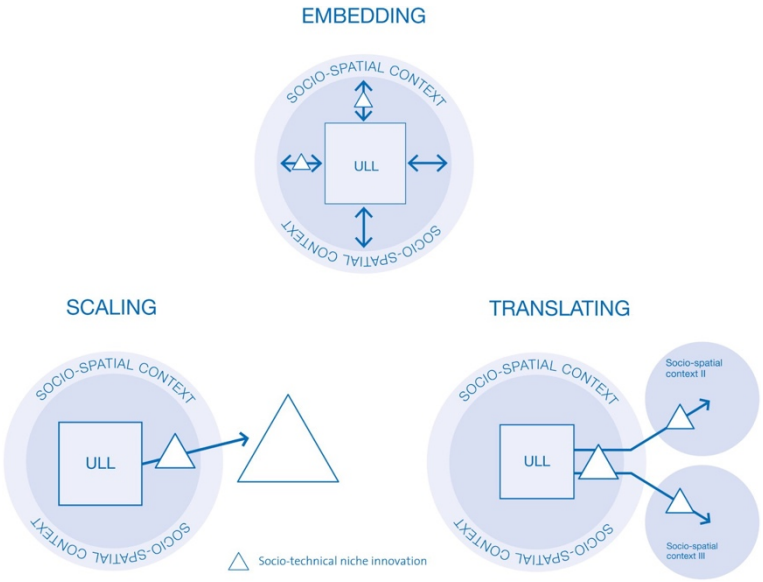

Figure 7: Main forms of innovation upscaling (Wirth et al., 2018)

While Wirth et al. (2018) identified different forms of upscaling, Da Chio et al. (2019) concluded that upscaling is often considered as the broader adoption of innovations developed in a living lab outside the living lab. In addition, Dijk et al. (2018) defined four upscaling stages, which correspond with Wirth et al. (2018). These stages are:

1) Growing or actor scaling, which means that more actors get involved in the experiment. This refers to 'scaling' as defined by Wirth et al. (2018).
2) Replication or spatial scaling, which means that the experiment is expanded to other locations. This refers to 'translating' as defined by Wirth et al. (2018).
3) Accumulation or content scaling, which is linking an experiment to another experiment. This refers to 'scaling' as defined by Wirth et al. (2018).
4) Transformation, which entails wider institutional change by the experiment and the adoption of innovations into institutional structures. This refers to 'embedding' as defined by Wirth et al. (2018).

In line with Wirth et al. (2018), Dijk et al. (2018) and Da Chio et al. (2019), Schulz et al. (2020) also distinguish between different forms of upscaling, who concluded that upscaling in most cases refers to enlarging the scale of experiments. In addition, upscaling questions current structures and relationships as well as current ideas. Therefore, Schulz et al. (2020) conclude that upscaling leads to harvesting of experimental renewal and to shake up the status quo. Upscaling as harvesting and commotion is illustrated in figure 8. Figure 8 shows, for example, that upscaling means that you use practice to establish rules or to facilitate professionalization. The four stages identified by Wirth et al. (2018) and Dijk et al. (2018) specifically refer to upscaling as harvesting.

The different forms of upscaling and the various stages of upscaling illustrate that multiple upscaling definitions exist. However, the mentioned definitions mostly refer to upscaling as harvesting as defined by Schulz et al. (2020). Therefore, this research uses the harvesting and commotion framework as basis to define upscaling, with a focus on spatial scaling.

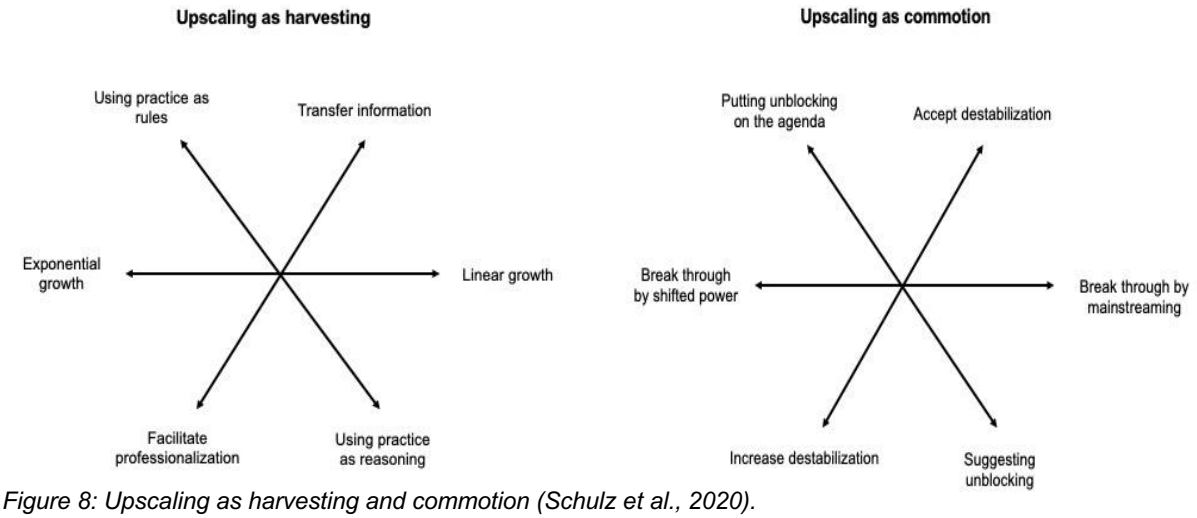

Figure 8: Upscaling as harvesting and commotion (Schulz et al., 2020).

2.4.2 Upscaling importance and multi-level governance

Transitions entail the change of the societal and institutional context (Van der Brugge et al., 2005). Experimentation in a living lab also entails that lessons should be drawn from these experiments (Wirth et al., 2018). Transitions include experimentation on a small, local scale, which are niches on the micro-level where novelties emerge (Geels & Schot, 2007). Living labs are a form of niche innovations and niches are developed by '*'small networks of dedicated actors''* (Ibid., p.400). In transitions, pressure from the landscape level (macro-level) occurs,

which are deep cultural patterns, macro-economics and macro-political developments. Development on this level is slow (Ibid.). Between the landscape and niches, the sociotechnical regime is positioned (meso-level), which aligns and accommodates the broader social groups and their activities. At the regime level, regulations and standards are in place, it exists of routines and technical systems, and lifestyles are adopted at this level (Ibid.).

The niche, regime and landscape level connect with multi-level governance (Beers et al., 2016). However, the multi-level phenomena in transitions, namely niches, regimes and landscapes does not equal multi-level governance. The local living lab developments (niches) eventually need to lead to changes in the regimes, so regulations, standards and routines at for example the local- and national governments (Ibid.), which is in this research Rijkswaterstaat. Figure 9 shows the reconfiguration pathway developed by Geels & Schot (2007) and illustrates the importance of upscaling. It shows that niche innovations, developed in niches are adopted by the regime to solve local problems. This adoption will eventually trigger further changes in the composition of the regime (Geels & Schot, 2007). In transitions, linking the niche-level development to the regime by for example transformation, replication or accumulation is crucial to create new linkages in the regime and in the end create a new architecture of elements and linkages, which is shown in figure 9 (Ibid.). The new architecture of elements and linkages in this research is circular road infrastructure. The multi-level concept of transitions as explained by Geels & Schot (2007) relates to multi-level governance, since local changes (niches) in which local governments are involved, need to change in policies at higher governments, such as Rijkswaterstaat and ministries (national government) and the EU (supranational government) (Beers et al., 2016). Governments, such as Rijkswaterstaat, are responsible for this upscaling (Ibid.)

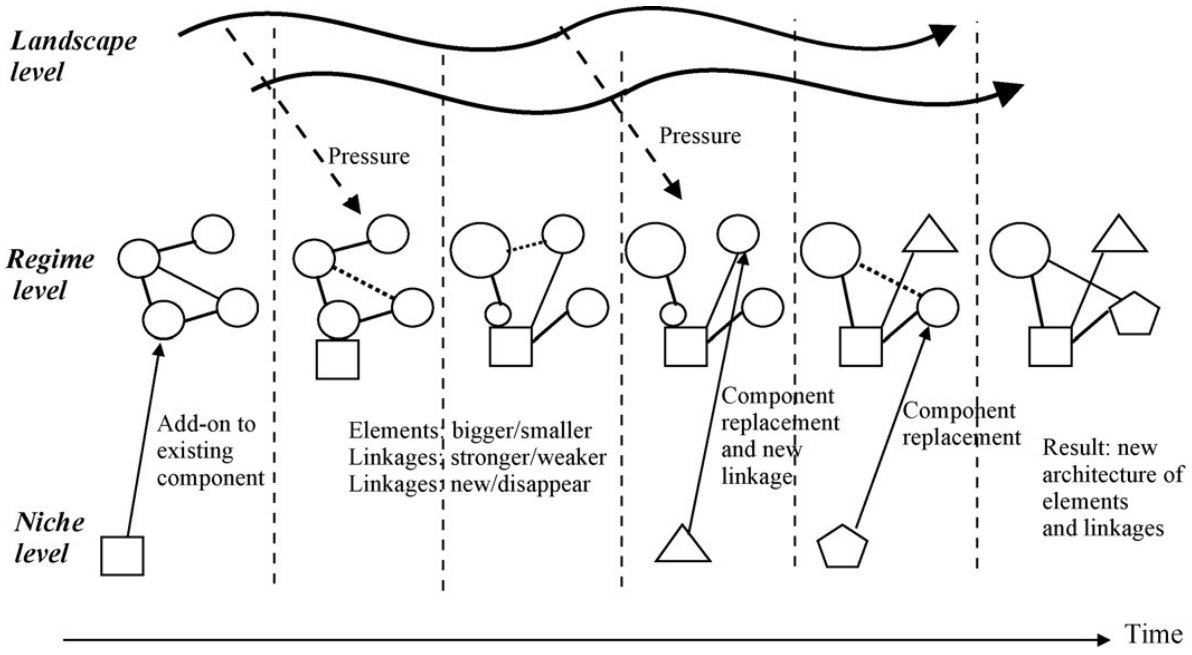

Figure 9: Reconfiguration pathway (Geels & Schot, 2007).

Upscaling is crucial to achieve broader goals and create new elements and linkages (Wirth et al., 2018). Ruijer & Meijer (2019) and Gasco (2017) acknowledge the importance of upscaling to achieve broader goals. However, despite upscaling being an important living lab stage:

> *''Living labs focuses on small-scale performance tests and technology-user interactions, mostly neglecting the larger social-institutional context. Therefore, successful implementation of new practices in the reality of a Living lab does not warrant broader adoption outside the Labs (i.e. ''upscaling''), required to reach their full innovative effect.''* (Da Chio et al., 2019, p.2).

Sometimes upscaling is undesirable and sometimes the notion of upscaling is a problem, since upscaling imposes that the development of an experiment should grow linearly. However, in general innovation upscaling is crucial, since the underlying assumption of experimentation is wider system change (Wirth et al., 2018).

2.4.3 Upscaling criticisms

This chapter defined upscaling as the adoption of innovations developed in a living lab at the wider socio-technical scale. Different forms of upscaling can be distinguished, such as replication, accumulation, growing and transformation. The different forms of upscaling fit within the harvesting and commotion framework. Upscaling is necessary to transform the wider institutional and societal context and accelerate transitions.

Despite the importance of upscaling, steering upscaling is problematic (Sengers et al.,2017). Living lab experiments often take place in a vacuum, ignoring broader dynamics, making upscaling challenging. Upscaling is important, but in a transition, focus should also be on government support and it should be ensured that you will not get lost in ''*a labyrinth of experimental paths''* (Ibid., p.161). This illustrates that upscaling is important, but that there are also other important aspects to consider. Gasco (2017) agrees with Sengers et al. (2017) that upscaling is time-consuming and difficult. The difficulties with upscaling, such as ignoring the broader dynamics, forms the motivation for the next chapter.

2.5 Barriers and conditions innovation upscaling

This chapter builds upon the upscaling criticisms. First, the various upscaling barriers are explored. Second, conditions to overcome these barriers are identified. At the end of this chapter, the various upscaling barriers and conditions are connected.

2.5.1 Barriers to upscaling

Developing and operationalizing experiments and innovations at a wider scale is problematic (Gasco, 2017). Also, Da Chio et al. (2019) and Sengers et al. (2017) mention difficulties with upscaling living lab experiments, which is explained by a lack of attention the broader dynamics outside of the living lab. Cellina et al. (2018) underline the findings of Gasco (2017) and Da Chio et al. (2019) by stating that the current living lab approach aims at finding small scale innovations, which neglect the wider social-institutional context. Large-scale adoption of

innovations is not ensured by the development of an innovation within a living lab. There are different barriers that stand in the way of upscaling. The different barriers can be divided into contextual factors and living lab design factors.

Contextual factors

Replicating innovations or transformation is challenging, since living lab stakeholders often work on topics appearing at a local or regional level (Mastelic et al., 2015). It depends on the context, which can be spatial, but also cultural or institutional, what kind of innovations are found (Ibid.) Even when upscaling is enabled, innovations could work out different at another spatial scale. Moreover, practices that are translated into policies may work out different in a different geographical, ecological or political context (Wigboldus, 2016).

Cellina et al. (2018) identified five factors that constrain upscaling related to the living lab context. The first one is called low stakeholder receptiveness. This means that consensus about the created innovations beyond the living lab participants is non-existent due to a lack of support by the population or politics (Cellina et al., 2018; Dijk et al., 2018).

The second contextual factor constraining upscaling is called low institutional receptiveness (Cellina et al., 2018). Low institutional receptiveness entails that policy-makers and institutions are not open-minded and receptive to innovations. This means that policy-makers are unfamiliar with elements of living labs, for example co-creation. Moreover, policy-makers or institutions could believe that interacting with stakeholders causes more complexity to policy development (Ibid.). Low institutional receptiveness can also be referred to as an internal organizational barrier (Ruijer & Meijer, 2019). For organizations, innovation upscaling could entail leaving behind a way of working that always been in place as an integral part of their organization (Ibid.).

The third identified contextual factor is institutional fragmentation (Cellina et al., 2018). Upscaling of innovations might be limited due to fragmented institutional arrangements. There could be fragmented departments and units within administrations (Ibid.). This makes it difficult to upscale and hinders effective cooperation between the different departments involved (Cellina et al., 2018; Da Chio et al., 2019). Institutional fragmentation also entails that different institutional have differing interests (Dijk et al., 2018). Moreover, different governance structures make it difficult to use specific innovations in a different institutional setting (Wolff et al., 2018).

The fourth constraint identified by Cellina et al. (2018) is called sticky urban assemblage. This constraint comes down to a situation in which the circumstances are unfavorable to allow changes. It can be hard to achieve wider scale change, because of financial, legal, infrastructural or technical aspects. In urban areas, infrastructures are often in place for already for a long time, which causes persistence. Moreover, legal lock-ins or long-term contracts prevent wider change and in this way upscaling of innovations (Ibid.). The sticky urban assemblage also refers to beliefs existing within the population that constrains upscaling, for example fossil fuel car believes (Dijk et al., 2018). Some people believe that electrical cars are not a good alternative, making upscaling of electrical cars difficult. This is also referred to as ‘unfavorable circumstances’ (Ibid.). Current practices and cost structures

can stand in the way of upscaling. The sticky urban assemblage in the end comes down to unfavorable circumstances in the current socio-technical system.

The final contextual factor that constrains upscaling identified by Cellina et al. (2018) is neglecting effects outside project locality. Upscaling innovations from a living lab to policies and a broader area can be constrained because the generated knowledge is specific to the context in which the living lab is located (Cellina et al., 2018). Dijk et al. (2018) also call this barrier limited representativeness, which means that the innovations developed in the living lab are only limited applicable to a larger scale.

Living lab design factors

Living lab design factors refer to how the living lab is designed (Cellina et al., 2018) The first constraint related to the living lab design is limited learning. Often, the living lab process is run by people that have other duties. It is important to monitor the lessons that are learnt in the process, but a lack of resources or time can stand in the way of this learning. Single actors often have a narrow overview of the process. The narrow overview on the different options, impacts and mechanisms that emerge in the living lab limits upscaling and learning (Ibid.).

The second constraint related to living lab design is a wait-and-see attitude (Cellina et al., 2018). Managing living labs as a routine project is often the case, in which there is a lack of attention to diffusing learning and knowledge. This also means that it is assumed that upscaling occurs by itself or that upscaling strategies can be implemented after the living lab project end, but this constrains upscaling (Ibid.). Moreover, there can be technical uncertainties (Dijk et al., 2018), which enhances the wait-and-see attitude.

Third, poor timing can be identified as a constraint to upscaling (Cellina et al., 2018). This poor timing means that the design of the experiment assumes that it is taking place in a vacuum. Broader dynamics are disregarded, for example the specific cultural, political or social situation (Ibid.).

2.5.2 Conditions to enable upscaling

Contextual conditions

Different conditions can be established to overcome the barriers of chapter 2.6.1. To overcome low stakeholder receptiveness open participation should be part of the process as early as possible (Cellina et al., 2018). This means that during the development of the visions, selecting the methodologies and the identification of possible actors that are involved, there is already a high degree of participation. Involving all possible actors already in the visioning stage favors consensus in later stages (Ibid.).

Low institutional receptiveness can be solved by involving policy-makers as soon as possible in the process. Policy-makers should not be afraid of losing formal power, because this will constrain upscaling (Cellina et al., 2018). Moreover, living lab organizers should show that they are committed and that they give responsibility, voice, and an important role to the different stakeholders (Ruijer & Meijer, 2019). Upscaling might require extra resources and

even institutional transformation, which entails that the structure of organisations is changed (Ibid.)

Institutional fragmentation can be solved by transparency and active collaboration between the different administrative units (Cellina et al., 2018). People of different organizations and departments should be invited to attend the co-creation process. In this way, the different people of the different departments personally experience how much effort is put into experiments and innovations, which also makes it easier for them to see the potential of the living lab environment to deal with complex topics (Ibid.). According to Dijk et al. (2018) national funding is necessary to overcome institutional fragmentation and align different institutions. At the same time, Dijk et al. (2018) agree with Cellina et al. (2018) that it is important to develop visions in a participatory way.

Enabling upscaling by ensuring that there is a clear communication strategy and methodology is critical to ensure that expectations are tempered and that the sticky urban assemblage can be dealt with (Cellina et al., 2018). There should be a focus in the living lab on what is actually possible within long-term contracts and within legal rules to deal with a sticky urban assemblage (Ibid.).

To overcome neglecting effects outside project locality it is important that cross-scale and indirect effects of the living lab are taken into account by engaging stakeholders from a broader spatial context (Cellina et al., 2018). Limited representativeness can be dealt with by including a diverse group of (relevant) stakeholders, by including future users outside the local project and by making explicit what is contextual and what not (Dijk et al., 2018). Based on the conditions above and the barriers of chapter 2.5.1, figure 10 was created, which provides an overview of contextual barriers and conditions

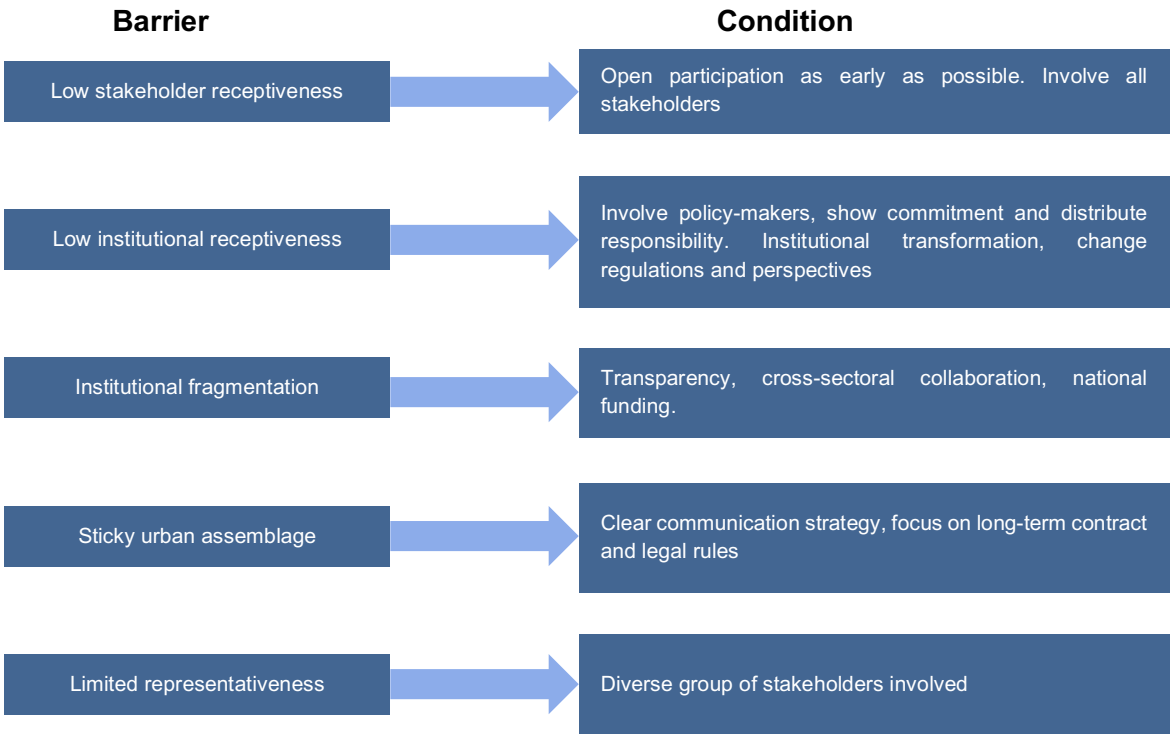

Figure 10: Contextual upscaling barriers and conditions (author).

Living lab design conditions

To overcome limited learning, explicit learning strategies should be implemented. This entails that it is upfront defined what you want to learn and how. This should ensure that knowledge creation is captured, monitored and transferred to all different actors to enable upscaling. Real life people-to-people interactions are necessary (meetings) to ensure learning and let knowledge grow (Cellina et al., 2018).

To solve the wait-and-see attitude it is important that at the start of the living lab process it is identified what could be upscaled. Moreover, an upscaling strategy should be developed, which states what and how you want to upscale and is deployed by all relevant actors. During the development of these strategies it is important to keep the strategies flexible to adjust the strategies during the process. The living lab process should not be seen as a linear process but rather as a non-linear process in which the steps are not always clear (Cellina et al., 2018).

Overcoming the poor timing constraints can be achieved by maintaining a high degree of flexibility during the process. It is important that objectives are continuously adjusted by all actors. Citizens should be at the core of this process, since citizens have the best understanding of local contexts. Moreover, it is important to coordinate with other societal developments, for example by cooperation and information sharing (Cellina et al., 2018).

Finally, Dijk et al. (2018) conclude that upscaling innovations is more than just 'rolling out'. To be able to upscale it is necessary to foster change in the different components of the socio-technical system. Regulation (formal institutions), capabilities (informal institutions) and actor perspectives have to be changed next to the 'technical' solution that is developed during the living lab experiment (Ibid.) Based on the conditions above and the barriers of chapter 2.5.1, figure 11 was created, which provides an overview of living lab design barriers and conditions.

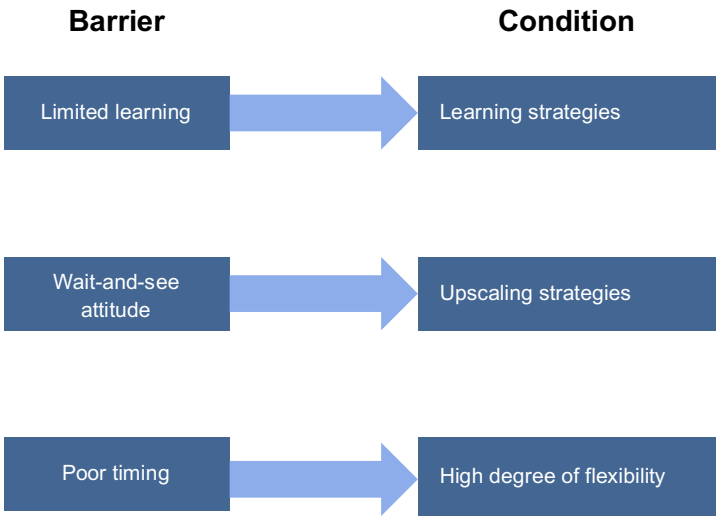

Figure 11: Living lab design barriers and conditions (author)

2.6 conceptual model

Figure 12 displays the conceptual model of this research. The conceptual model is based on the three main concepts from the theoretical framework, namely upscaling barriers and conditions, citizen participation barriers and conditions, and the living lab concept. The model shows that innovation upscaling and citizen participation are two important notions of the living lab concept.

From the perspective of the development of an energetic society, citizen participation is important. However, there are barriers for citizens to participate in living labs, which should be solved by implementing participation enabling conditions. The model illustrates that citizens who participate have a specific role in the co-creation process and that citizen participation is part of the multi-stakeholder definition of a living lab. Moreover, the model shows that experimentation and the real-life context are at the basis of the living lab concept. On the left side of the model innovation upscaling is implemented. To upscale innovations, barriers need to be overcome by establishing living lab context conditions and living lab design conditions. However, there is a possibility that these conditions are conflicting with citizen participation enabling conditions, which is what the blue, dotted line represents. Thus, the model shows that a living lab is a local initiative in which citizen participation is important as part of the co-creation process and due to the multi-stakeholder origin of the concept and it is important from the perspective of the emergence of an energetic society. Moreover, the blue line shows that citizen participation conditions and upscaling conditions are related, for example since upscaling makes societal creativity relevant to create a support base for innovations.

The conceptual model forms the basis of the interviews that will be conducted, which is further explained in chapter 3. The different barriers and conditions in relation to citizen participation and upscaling represented in the model are based on the theoretical discussion and these barriers and conditions will be tested in a real-life case. By taking the conceptual model as a basis for the interviews, the theoretical barriers and conditions are tested. During the interviews it will be tested whether this model is complete or that there are missing barriers and conditions and whether the conditions for innovation upscaling and citizen participation are reconcilable.

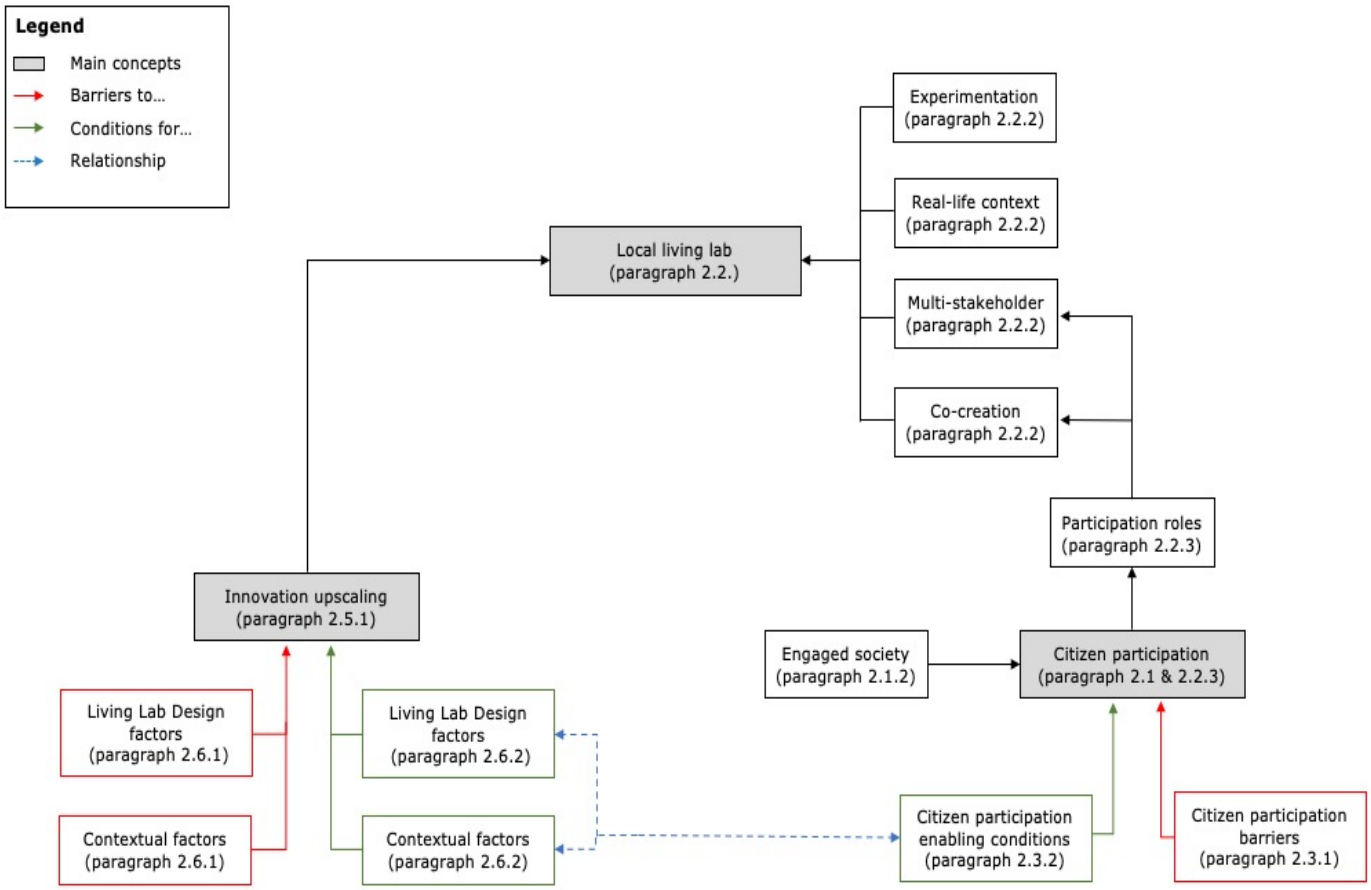

Figure 12: Conceptual model (author).

Chapter 3: Methodology

This chapter addresses the methodology of data collection of this research. Several steps are at the basis of data collection, which are illustrated in table 2. The different steps illustrated in table 2 are further elaborated in this chapter.

Table 2: Research steps (author).

Step	Description
1	Literature research to answer secondary question 1-2 and to form a theoretical basis for the case research.
2	Case study InnovA58 project by doing semi-structured interviews within Rijkswaterstaat and the Ministry of IenW in May and June 2021.
3	Data-analysis and arranging the results of data-analysis.
4	Conclusions: answering the research questions with the help of the results and the control group interview.

3.1 Literature research

This research started with a literature research to establish the theoretical framework of chapter 2. Based on the background of this research and by comparing policy documents that are concerned with living lab innovation upscaling and citizen participation, search terms were established. Different search terms were used, such as: 'circular economy', 'living lab', 'innovation upscaling', 'energetic society', 'multi-level governance', 'transition theory', 'living lab context', 'living lab design', 'communicative rationality', 'network governance', 'living lab roles', 'participation barriers', 'innovation replication', 'innovation embedding', 'living lab participation' and 'upscaling experiments'. Smartcat, Scopus and Google Scholar were used as search engines. Smartcat is the search engine of the University of Groningen. The literature review consists of academic, peer-review literature and a few, officially, published reports. To ensure up-to-date data, articles from the year 2005 and onwards were used. In addition, some non-scientific articles were used, especially from within Rijkswaterstaat. This literature is relevant to construct an image of the application of the concepts in academic literature in practice. In the reference list, footnotes are placed at the internal Rijkswaterstaat documents.

With the search-terms mentioned above, articles were selected based on the title of the article. When the title and abstract matched the research topic, the introduction, theory, conclusion and other possibly interesting parts were read. The read articles contain references to other articles, which were also used to find relevant literature. The reference list provides an overview of the used articles and shows that most articles come from a wide range of journals, such as Planning Theory, Sustainability, Public Management Review or Planning Theory & Practice. The theoretical framework is based on literature research, while the results are based on semi-structured interviews. Therefore, this is a qualitative study. The literature research answers the first two secondary questions, while the interviews answer the final four secondary research questions.

3.2 Case Study

3.2.1 Relevance of a case study for this research

This research includes a case study. Research benefits from doing a case study because this helps identifying knowledge in specific circumstances (Flyvbjerg, 2006). How theory works in practice is contingent on situational ethics and in practice context dependent judgements are in play (Ibid.). A case study is relevant for this research, since a case study enables understanding of processes and contexts, how causes and outcomes are linked and case studies provide depth (Flyvbjerg, 2011). Especially since Wirth et al. (2018) explained that qualitative and in-dept empirical data is needed on conditions for innovation upscaling, doing a case study is relevant. According to Yin (2014), case studies are especially interesting when researching a real-life phenomenon with an unclear distinction between context and phenomenon. Living labs are situated in a specific context, which makes it difficult to separate it from its context, making a case study interesting for this research.

Additionally, Flyvbjerg (2006) stated that without studying examples, a study is ineffective. Case studies are a crucial element to fight this infectivity and form a crucial part of the human learning process, which justifies the choice to conduct a case study (Flyvbjerg, 2006). Yin (2014) adds that a case study enables triangulation. Triangulation entails that multiple methods of data collection are used. This research is partially based on literature research, while doing a case study with semi-structured interviews diversifies the methods used. In a perfect situation the results from the literature research and case study would converge, which means that both methods lead to the same results and that the results from both studies are supportive (Ibid.).

Nevertheless, case studies have an unknown statistical significance, a selection bias may understate or overstate relationships, and there can be a weak understanding of things that occurred in the population of the phenomena that is being studied (Flyvbjerg, 2011). These weaknesses were taken into account during data collection and in the conclusion and discussion. To ensure that relationships are not under- or overstated, the different interviews were compared with each other and with theory from chapter 2.

3.2.2 The selected case

This research utilizes the InnovA58 project as a case. Figure 13 provides background information on this case. The InnovA58 project was chosen because it aims to find innovations which can be upscaled to other projects and in which the living lab concepts, and citizen participation, plays a crucial role (Rijkswaterstaat, n.d.a). Therefore, this case fits this research, since this research is also concerned with upscaling innovation and citizen participation in a living lab. The InnovA58 project is the case of this research, with the InnovA58 living lab and the LLIADB being the two embedded units of analysis.

InnovA58 background

The InnovA58 project is concerned with the widening of the A58 highway in the Netherlands. The location of the project is illustrated in the pictures in this box. The improvement of the traffic flow of the A58 will have to be achieved by innovating. To achieve this, Rijkswaterstaat considers some main themes as crucial in the project, which are: 'experimenting' by establishing a living lab, 'together with the market' which entails smart mobility, circularity, and climate and energy goals, and the 'rest area 2.0'.

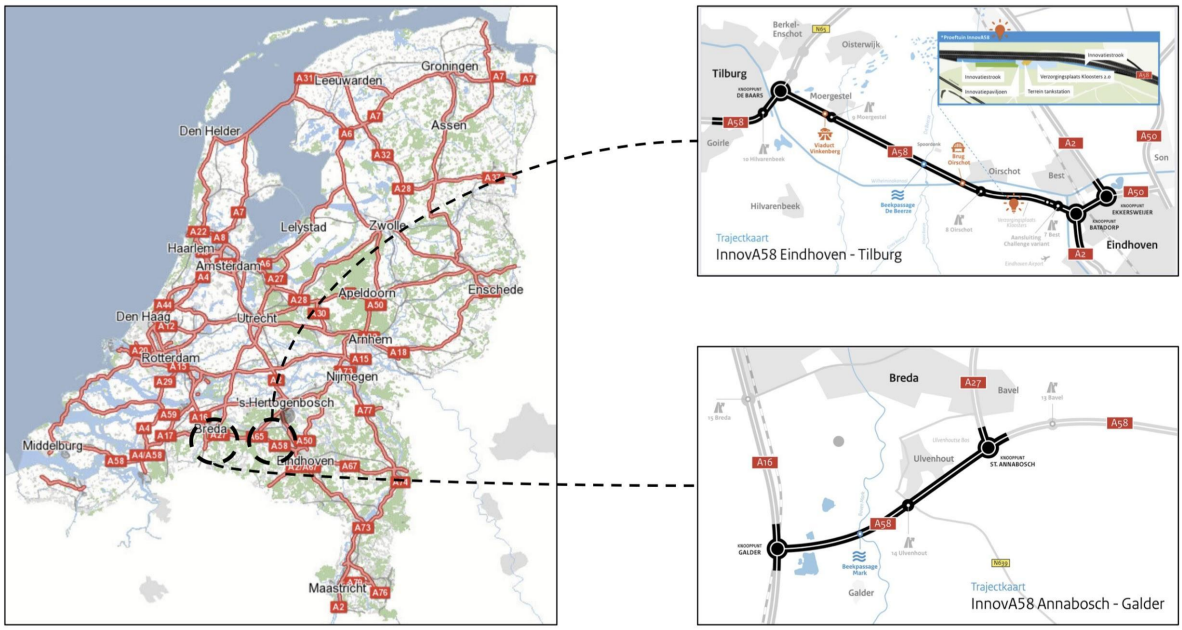

Figure 13: Background information box of InnovA58 (author, based on Rijkswaterstaat n.d.b).

Embedded unit of analysis 1: InnovA58 living lab

The InnovA58 living lab is one of the embedded units of analysis of the InnovA58 project case. Figure 14 provides the background information on the InnovA58 living lab. The InnovA58 living lab fits this research, since it is specifically concerned with circular road infrastructure innovation and eventual upscaling of these innovations (Rijkswaterstaat, n.d.a). The InnovA58 living lab is already being established, creating an opportunity to interview professionals from Rijkswaterstaat to discover how the project enables innovation upscaling.

InnovA58 living lab background

To fulfil the crucial goals of the InnovA58 project, Rijkswaterstaat initiates and facilitates the InnovA58 living lab, which consists of multiple components. The InnovA58 living lab is an area around the A58 highway in which experiments are conducted in the upcoming ten years to find innovations. Market parties, governments, users and academics are involved in this living lab and there are multiple themes on which the actors of the living lab can work. Especially innovations around circular concrete and material, circular nuisance shields, emission-free building and new services are themes on which the living lab focuses. The living lab consists of a test lane for innovations and an innovation pavilion. The image in this box illustrates the situation, which is only available in Dutch.

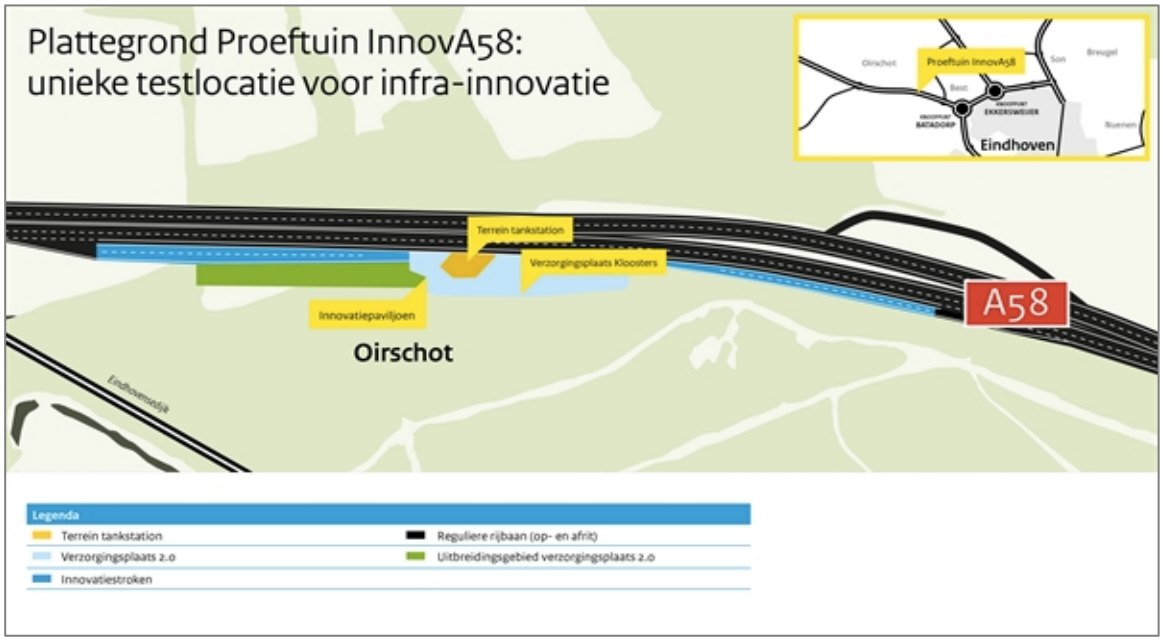

Figure 14: Background information box of the InnovA58 living lab (author, based on Rijkswaterstaat, n.d.a)

Embedded unit of analysis 2: The Living lab Infrastructure & Area Development Brainport

The second embedded unit of analysis is the LLIADB. Figure 15 provides background information on the LLIADB. One of the main goals of the LLIADB is creating the Low-Tech Campus and replicating (upscaling) it across the Netherlands. Moreover, it aims at creating circular road infrastructure with a connection to the living environment, which results in a strong role for citizens in the living lab. This is the reason for choosing this embedded unit of analysis, since the goal of upscaling and citizen participation correspond with this research. Moreover, this LLIADB was accessible to the researcher, since the researcher was part of the project-team as intern, which provided the opportunity to speak with the people employees and citizens that will be involved in the project. Furthermore, it is important for the project to know how to involve citizens in living labs and what is necessary to ensure that the found innovations can be upscaled (Kerkhofs et al., 2021).

Living Lab Infrastructure & Area Development Brainport background

The LLIADB entails the development of a Low-Tech Campus around rest area Kloosters near the A58 between Eindhoven and Tilburg. The Low-Tech Campus consists of a living lab where experiments and initiatives are brought together to create circular infrastructure and sustainable mobility, with a crucial role for inhabitants and entrepreneurs from the surrounding environment. The living lab will search for integrated, scalable ideas and solutions to achieve the transition towards a circular, climate adaptive, inclusive living environment. The LLIADB project is one of the first projects within Rijkswaterstaat that aims at finding innovative solutions to develop circular road infrastructure by connecting road infrastructure with the wider living environment and societal context with a crucial role for citizens. The image in this box illustrates the social highway, which is a concept commissioned by Rijkswaterstaat and concerns circular road infrastructure. The Low-Tech campus is based on this concept, with an living lab at the rest area (Verzorgingsplaats, in the image 'VZP'). Since it is a Rijkswaterstaat image, it is only available in Dutch.

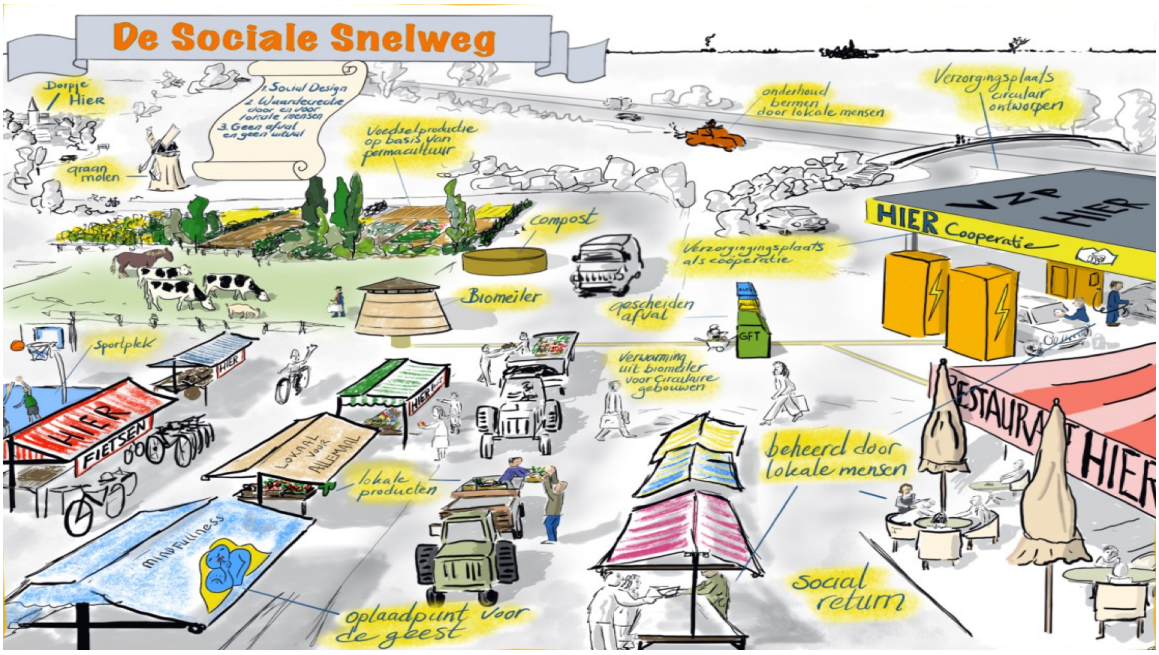

Figure 15: Background information LLIADB (author, based on Kerkhofs et al., 2021)

3.3 The interviews

The interviews are divided into two groups: interviews with citizens that consider participating in the LLIADB or are known with the InnovA58 project and interviews with experts from Rijkswaterstaat and the Ministry of IenW that are dealing with innovation upscaling or citizen participation.

3.3.1 Semi-structured interviews

Fourteen semi-structured interviews were conducted for this research. Semi-structured interviews enhance the possibility of spontaneous answers and it provides flexibility throughout the interview (Husband, 2020). Semi-structured interviews are especially interesting to explore opinions and perceptions of complex issues (Ibid.), such as innovation upscaling. By conducting semi-structured interviews, the research creates the opportunity to

explore statements in depth during the interview. Moreover, semi-structured interviews were chosen, since it offers respondents the opportunity to include their own opinions and semi-structured interviews provide room for explanation or discussions when necessary. This is crucial when discussing complex subjects such as citizen participation and innovation upscaling (Ibid.).

Nevertheless, there are drawbacks to semi-structured interviews, which need to be taken into account (Husband, 2020). For example, there can be language barriers, questions are unclear or ambiguous, or the respondent gives a socially desirable answer. Therefore, it is important to have an interactive interview to prevent socially desirable answers, there should be freedom to explore ambiguous or unclear questions, and to have room for questions when there is a misunderstanding due to a language barrier (Ibid.). The interviews were conducted in May and June 2021.

3.3.2 Preparing the interviews

In order to conduct the semi-structured interviews, questions were prepared in advance, which are provided in appendix 1. During the interviews it was possible to ask follow-up questions to ensure that important information was collected (Salmons, 2011). The interview questions are built up by starting with ‘easier’ questions and during the interview the questions become more complex. Since the interviews were semi-structured, the interview questions were constructed beforehand, but there was room for the interviewer and the interviewee to deviate.

Of the 14 interviews, six were related to citizen participation and eight to innovation upscaling. This division was chosen since citizen participation was also a subject during the interviews with experts from Rijkswaterstaat and the Ministry of IenW, making it unnecessary to interview more citizens. The respondents were selected in collaboration with the internship supervisor and the thesis supervisor to find the most suitable people within Rijkswaterstaat. Moreover, a stakeholder manager of InnovA58 helped to select suitable citizens for this research. Appendix 2 provides an overview of the respondents.Before conducting the interviews, the interviewees were asked to read and sign two forms. By signing these forms, the interviewees agreed that the information provided would be used in this research and they could choose to be anonymous. The forms are available on request.

3.3.3 Citizen interviews

Since the LLIADB project aims at giving a central role to citizens and entrepreneurs from the surrounding environment, contacts with possible participants are already established. It was important that the citizens that were interviewed had different backgrounds. This means that for example farmers, entrepreneurs, and citizens were involved in the interview process. During the interviews with the citizens there was an emphasis on the barriers and conditions for citizen participation, but also on what is important for them during the co-creation process of the living lab and what role the citizens prefer. The questions asked during the citizen interviews can be found in appendix 1.1. The questions for both the citizens interviews and the expert’s interviews are based on the concepts used in the conceptual model.

3.3.4 Rijkswaterstaat & Ministry of IenW interviews

To research innovation upscaling, employees from Rijkswaterstaat and the Ministry of IenW were interviewed. During the interviews there was an emphasis on the barriers and conditions in relation to upscaling innovations. Moreover, it is important to identify how the experts enable citizen participation, since it is important to know what the view of different experts is on developing circular road infrastructure and the role of living labs in creating innovations. During the interviews with the Rijkswaterstaat and Ministry of IenW employees it was also asked whether they have a suggestion for another person to interview to ensure that all relevant information will be collected. A few suggestions were made, which led to the addition of two respondents.

To research innovation upscaling, different people from different levels within Rijkswaterstaat and the Ministry of IenW were interviewed. A combination between interviewees from Rijkswaterstaat and the Ministry of IenW was necessary, since Rijkswaterstaat is an executing organization and needs the Ministry of IenW to upscale innovations, for example to change frameworks and legislation. Appendix 2 provides an overview of the departments within Rijkswaterstaat and the Ministry of IenW which were involved in the interviews. A wide array of departments was chosen, but there was a focus on Water Verkeer & Leefomgeving and Large Projects (Grote Projecten en Onderhoud) as departments, since these departments are concerned with knowledge development, innovation and executing projects such as the InnovA58 project. For the Ministry of IenW interviews there was a focus on departments that are concerned with innovation and citizen participation. The questions asked during the expert based interviews can be found in appendix 1.2. Since interviews with different people from different departments were conducted, the questions were sometimes slightly adapted to the specific function of the respondent.

3.3.5 Online interviews

Due to the corona crisis at the time of this research, almost all interviews were conducted online. Some interviews were conducted face-to-face when necessary. There are some difficulties during an online interview. Technology, such as Skype or Google Meet, makes it possible to have real-time exchange. However, it can be difficult to focus during an online-interview, for both the interviewee as the interviewer (Salmons, 2011). Moreover, an unstable internet connection can disturb the interview process (Ibid.). At the same time, organizing a video meeting contributes to personal communication and is authentic (Ibid.). The difficulties were taken into account during the preparation of the interviews and during the interviews itself.

3.4 Data analysis

After conducting the interviews, the interviews needed to be transcribed and coded to analyze the data. Therefore, the first step after conducting the interviews was transcribing the interviews. Transcribing was manually executed, which means that the researcher listened to the audio recording at low pace and literally typed out what was being said. This ensured that the transcriptions were detailed to ensure that no information was lost. All transcripts contain a respondent tracking number, the name of the respondent, the date of the interview and the duration of the interview. The transcripts are available on request. After transcribing the

interview, the transcript was sent to the respondent to provide the respondent the opportunity to correct the transcript or delete sentences. A few respondents utilized this opportunity. In these cases, only minor details were corrected, for example names of suggestions for interviews. No sentences were deleted from the transcripts and only after the researcher received the approved transcript, data-analysis was started. This ensures that the research quality was improved, since minor mistakes in the data were removed and sometimes additional clarification was added to the transcript.

To analyze the transcripts in a structured way, the interviews were coded. To code the interviews, the software of Atlas.ti was used. This program helps to manage the collected data (Atlas.ti, 2020). According to Chametzky (2016, p.164) coding ‘’*allows you to get raw data to a well-developed theory”* and it is the process of assigning tags to interesting themes of the research to understand and evaluate the interview (Chametzky, 2016).

Coding occurs in three phases, namely open coding, axial coding and selective coding (Ravenstein, 2017). In the open coding phase, the researcher does not know yet exactly what he is looking for. During this phase, parts of the transcripts with relevant information for this research are labeled. After open coding, axial coding was executed. This means that the produced codes are divided into main- and subthemes. In this way the researcher can distinguish between important and less important elements of the interview. The important codes are labeled with a name, based on the coding scheme that was established before analysis. The coding scheme can be found in appendix 3 and is based on the conceptual model of chapter 2.6. In this way, the most important fragments of the interview are collected under a common code. After axial coding, selective coding will happen. During this phase a connection between the different codes was established by comparing the different codes. This made it possible to identify the relation between concepts that are recurring (Ibid.). Thus, the interviews were compared to create conclusions. Since the interviews were conducted in Dutch, chapter 4 contains quotations translated from Dutch to English.

In the coding process, the coding scheme of appendix 3 was leading. The different components of the conceptual models formed the categories for the coding scheme. Within these categories, different codes were formulated. These are deductive codes. Inductive codes were established during the axial and selective coding process and are a result of the coding process. In the end, none of the codes had to be merged or were empty.

3.5 Research ethics

When conducting research, it is crucial to consider research ethics. As Aagaard-Hansen & Vang Johanssen (2008, p.15) state: ‘’*specifically articulated ethics codes for research are a relatively new phenomenon, they have a common reference to the more ancient principle of ‘respect’, ‘beneficence’, and ‘justice’ ‘’.* Respect as a principle refers to the researcher showing respect during the execution of the research, beneficence to minimizing ‘environmental’, physical and emotional damage, and justice refers to a fair distribution of income and expenses (Aagaard-Hansen & Vang Johannsen, 2008). During this research it was important to comply with these three principles. Especially during the interview process, it was important to be respectful to the respondent and to show respect to the respondent. Moreover, by

providing an information- and confirmation sheet of the Research Ethics Committee, compliance with beneficence and justice was ensured. The sheets are available on request.

In the end, all interviews were anonymized. This ensured that the privacy of the respondents is ensured (Coffelt, 2018). Although almost all respondents approved the use of their name, all results were anonymized. This decision was made, since ‘*’[…] for the social scientist, peoples’ behaviors and experiences are of great interest, rather than an expose about individuals”* (Ibid., p.228). To anonymize the respondents, all respondents were assigned with a number from 1 to 14, which can be found in appendix 2. To ensure anonymity, some quotes in the result chapter were paraphrased.

The position of the researcher especially played an important role in this research. This research was written for a master thesis but was combined with an internship at Rijkswaterstaat. Being part of the organization made it possible for the researcher to get in close contact with employees concerned with the subject. However, this position could also cause a different attitude towards the interviewee respondents. The InnovA58 project is a sensitive project in which many citizens are involved. It was crucial to act with care during the interviews, but it could also be the case that citizens did not speak freely, since I was part of Rijkswaterstaat, the organization they sometimes had trouble with. To ensure that this was not happening, the interviewer asked open questions and clearly stated beforehand that he was operating for the University of Groningen, not Rijkswaterstaat.

Chapter 4: Results & analysis

This chapter discusses the case study results and compares the results with the theoretical framework of chapter 2, and is structured based on the main concepts of the conceptual model in figure 16. The living lab concept itself is discussed first. Subsequently, citizen participation and innovation upscaling are discussed. This chapter ends with the relationship between citizen participation and upscaling conditions. The presented results are based on the coded interviews. The codes are based on the coding scheme of appendix 3, which is in turn based on the conceptual model. Respondents 1 to 9 are respondents from Rijkswaterstaat and the Ministry of IenW, while respondents 10 to 14 are citizens.

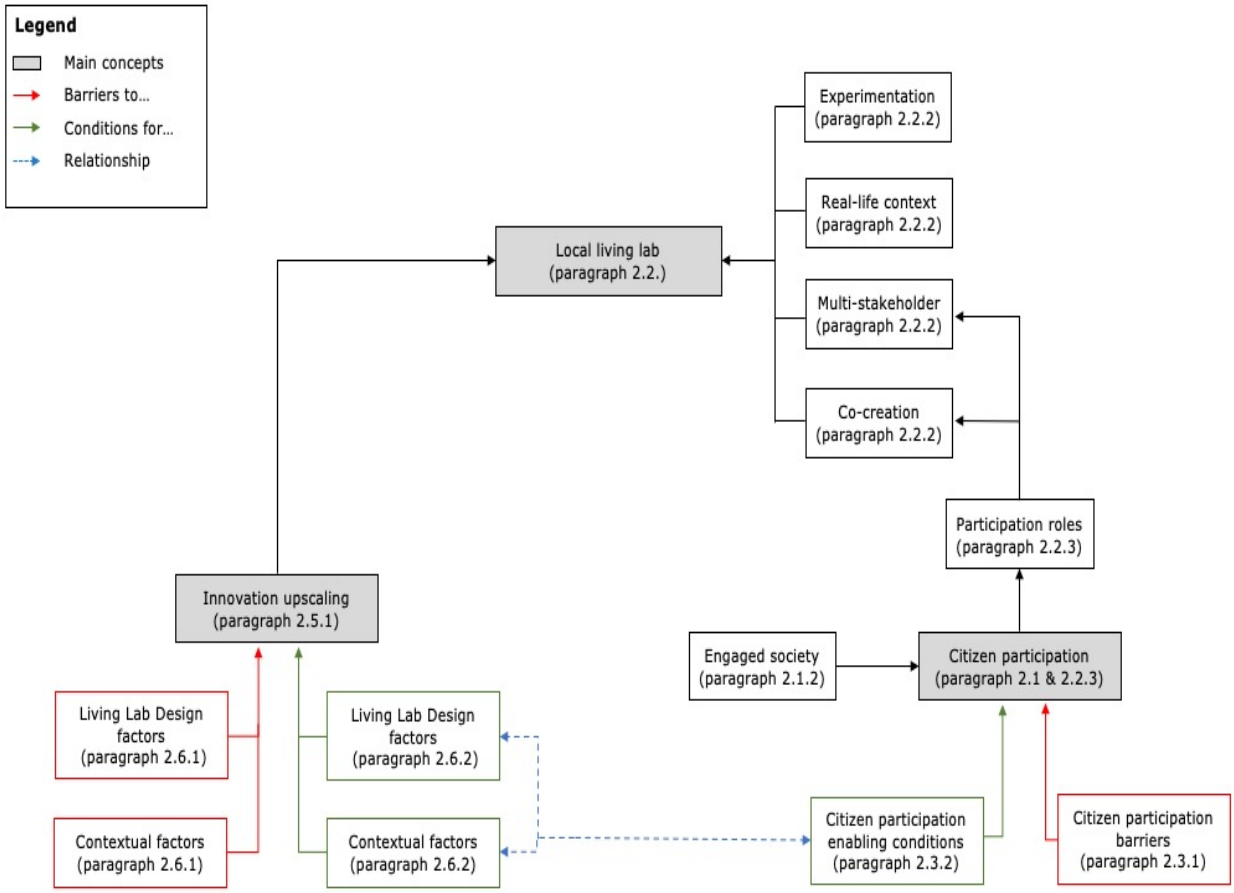

Figure 16: Conceptual model (author)

4.1 Living lab

This chapter discusses the definition of living labs in the case study. Moreover, the importance of living labs for innovation in the context of the transition towards circular road infrastructure is discussed.

4.1.1 Living lab definition

All Rijkswaterstaat and Ministry of IenW respondents were familiar with the living lab concept. However, when asking what elements define living labs, not all theoretical aspects of chapter 2.2 were recognized. Figure 17 provides an overview of the four theoretical aspects of chapter 2.2 and how many Rijkswaterstaat and Ministry of IenW respondents recognized the aspects.

Two respondents considered the living lab definition ambiguous. According to respondent 3 ‘*’[…] there is no standard way of structuring living labs. In some projects a living lab is established, but there is simply no structured format”,* while respondent 5 considered experimenting as a crucial living lab aspect but ‘*‘[..] there is no ‘protected’ definition”.* Although respondent 5 stated that there is no protected definition, co-creation, experimentation, a real-life context and multi-stakeholder were eventually mentioned as important aspects, while respondent 3 only mentioned co-creation and experimentation as crucial living lab aspects.

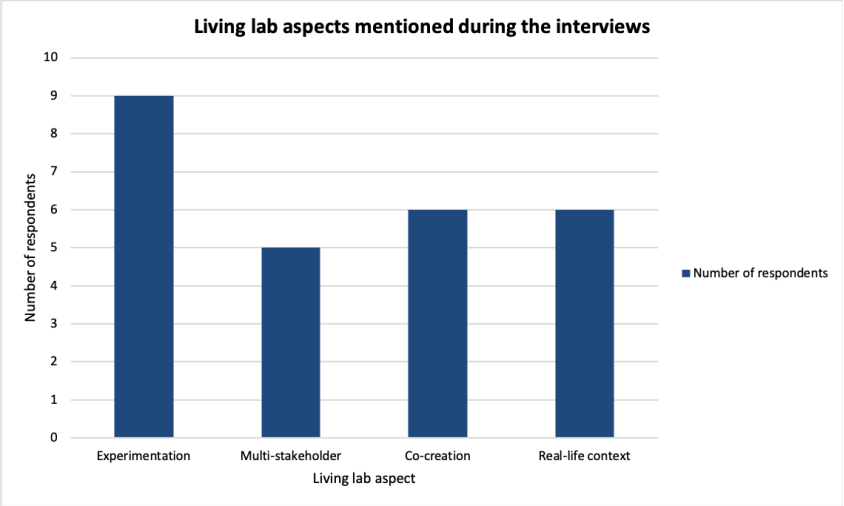

Figure 17: Living lab principles mentioned during the interviews (author)

Figure 17 reveals that experimenting is considered as important living lab aspect, because experimenting helps in selecting tools and start moving, and the philosophical basis and meaning of the word ‘lab’ entails experimentation (Respondent 3; respondent 5; respondent 6). Although all Rijkswaterstaat and Ministry of IenW respondents stated that they were aware of the living lab principles, not all theoretical aspects of chapter 2.2. were mentioned when asking: ‘’*What aspects define according to you a living lab?”.* For example, respondent 8 stated ‘’*I know the principles of a living lab”,* while only co-creation and experimentation were then mentioned. The results show that defining a living lab is not straightforward. As was illustrated in chapter 2.2, a combination of definitions led to the definition used in this research. The definition of living labs in this research is based on multiple articles, explaining why some aspects were not mentioned during the interviews. Moreover, the living lab concept is multi-interpretable (Voytenko et al., 2015).

A remarkable result is that the involvement of citizens in a living lab was only mentioned by five respondents as crucial. This contrasts theory that the role of citizens in a living lab is crucial, but it underlines the observation of Maas et al. (2017) that the role of citizens in living labs is currently limited.

4.1.2 Living lab importance

Completing goals

Different motivations to establish living labs exist in the context of a transition towards circular road infrastructure at Rijkswaterstaat. As respondent 5 stated: ‘’*the collaboration between the private sector, knowledge institutions with for example students who execute assignments, and the involvement of societal parties is an important aspect of living lab. That is one of the most important parts of the mission driven innovation policy to achieve innovation.’’.* Different respondents touched upon divergent reasons to establish living labs, but most reasons correspond with experimentation as crucial aspects of living labs. According to the interviewees, living labs are a powerful tool to complete goals, which is illustrated in figure 18.

Living labs as tool to complete goals at Rijkswaterstaat corresponds with chapter 2.4, in which Wirth et al. (2018) stated that living labs could help to achieve broader goals. Nevertheless, as Wirth et al. (2018) stated, upscaling of innovations is a crucial living lab stage to achieve broader goals. Rijkswaterstaat and the Ministry of IenW consider living labs as useful tools to achieve goals, but establishing living labs should not be a goal in itself (respondent 3; Respondent 8; Respondent 9).

Other reasons to establish living labs

Another main argument to choose for a living lab is to create knowledge and to learn. Living labs provide the opportunity to make mistakes and experiments going ‘wrong’ are often the best experiments (respondent 5; respondent 6). A remarkable argument to choose for living labs was provided by respondent 4, who stated that:

‘’We [Rijkswaterstaat] can start inventing ‘things’, but a large part of the inventions will not be realistic’. We [Rijkswaterstaat] are not constructing asphalt, so we can invent new asphalt but we cannot produce and construct it. Living labs can help with this’’.

By establishing living labs, you create the possibility to collaborate with private parties to start producing the innovations invented by Rijkswaterstaat (Respondent 4). Additionally, living labs help shifting focus from technical innovation to social innovation, create safety since innovations are tested, and enables you to learn things you cannot learn in a closed laboratory (respondent 2; respondent 4; respondent 5; respondent 9).

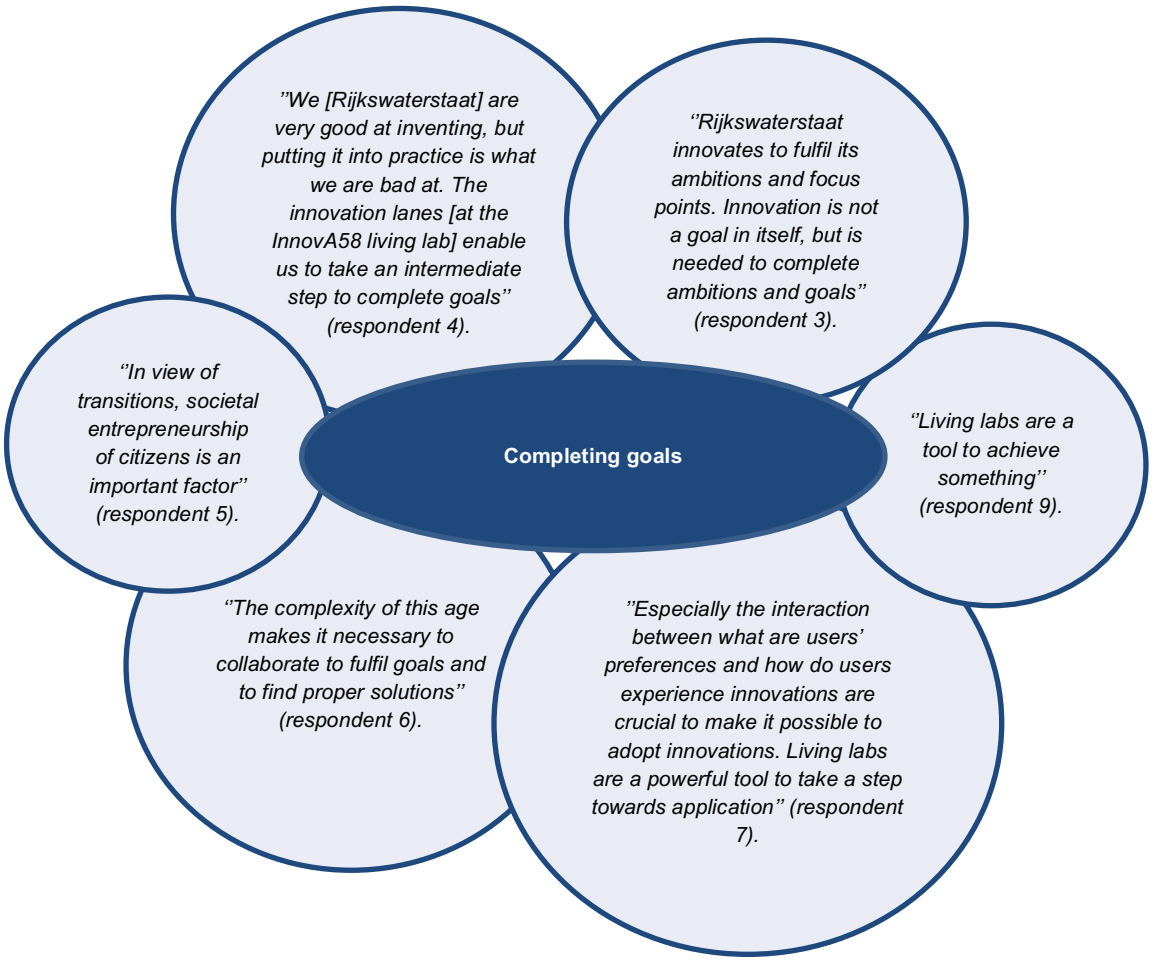

Figure 18: Quotes of respondents about living labs as a tool to complete goals (author)

Critical living lab remarks

Despite the importance of living labs in the transition towards circular road infrastructure, some respondents also criticized the living lab concept. It can be questioned whether there is sufficient exchange between living labs to stimulate learning (respondent 7), whether the living lab concept is persistent or a temporary term (respondent 2), and whether the uncertain outcome of living labs is something Rijkswaterstaat and the Ministry of IenW can deal with (respondent 10).

It is important to take into account these critical remarks when establishing a living lab. As Schuurman et al. (2015) wrote, the European Network of Living labs was established to improve the limited exchange between living labs, as mentioned by respondent 7. In addition, Kressler et al. (2018) explained that the living lab term emerged in the beginning of the twenty-first century, meaning that it is still developing and not a temporary term since it has existed for almost 20 years already. Uncertainty in the outcome should be accepted by the initiator of a living lab since uncertainty underpins the living lab concept and is inherent to innovating (Puerari et al., 2018; Bergvall-Kareborn & Stahlbrost., 2009).

4.2 Citizen participation

This chapter discusses citizen participation in relation to living labs. Consecutively, this chapter discusses the importance of citizen participation in infrastructure development and the roles of citizens in living labs, barriers for citizen participation in living labs, and, finally, conditions to enable citizen participation in living labs.

4.2.1 Citizen participation in general

Participation importance

All respondents from Rijkswaterstaat and the Ministry of IenW, and the citizens agreed that involving citizens in innovation for infrastructure is crucial. Figure 19 illustrates the importance to involve citizens in the co-creation and innovation process of circular road infrastructure, according to citizens. These statements are in line with what Hajer (2011) wrote about the energetic society. Especially in the InnovA58 case, citizens were speaking up with creativity, for example by proposing an aquaduct instead of a viaduct (respondent 10; respondent 11; respondent 12; respondent 14). Moreover, citizens created maquettes to make their plans tangible and reacted with high speeds to the proposals of Rijkswaterstaat (respondent 14). Additionally, Rijkswaterstaat and the Ministry of IenW respondents acknowledged that it is important to involve citizens in innovation, illustrated by respondent 8:

> *'' It seems to me indeed a good idea to involve citizens from a certain area if you want to innovate in a specific area. So, less thinking from a road perspective and more from the perspective of the area in which the road is located''.*

The acknowledgement of the importance of involving citizens in innovation is contradicting chapter 4.1.1 in which it was illustrated that involving citizens in the living lab process is not always seen as a crucial element of the living lab. Nevertheless, it is in line with an energetic government that engages with society to find solutions (Van der Steen et al., 2015).

Although respondent 1 to 9 agreed that co-creation in a living lab with citizens is effective, critical notes also arose. Currently, citizen involvement in the InnovA58 living lab is sparse, because no initiatives for innovation were proposed by citizens. Instead, the private sectors propose better innovations, illustrating that citizens are sometimes unable to develop innovative solutions (respondent 4). Furthermore, respondent 7 stated that *'[…] 'it is not always depending on the citizens to develop. For example, circular neighborhoods really affect citizens, but there are also cases in which citizens are less affected by circular economy innovations"*. In line with respondent 4 and 7, respondent 2 stated that '' *We [Rijkswaterstaat] cannot play Santa Claus, so you have to find a balance. You always have an interest of road infrastructure and the environment"*. Thus, co-creation with citizens is considered as crucial development, however, the creativity of citizens, as mentioned by Hajer (2011), is sometimes lacking (respondent 4), with a fear of a lacking capacity and skills among citizens (Turnhout et al., 2010). Although it becomes increasingly important for Rijkswaterstaat to involve non state actors, such as citizens, in infrastructure, for Rijkswaterstaat it is difficult to say *'' you [citizens]*

are participating [in the co-creation process] but we, Rijkswaterstaat, have responsibility for the outcome" (respondent 1).

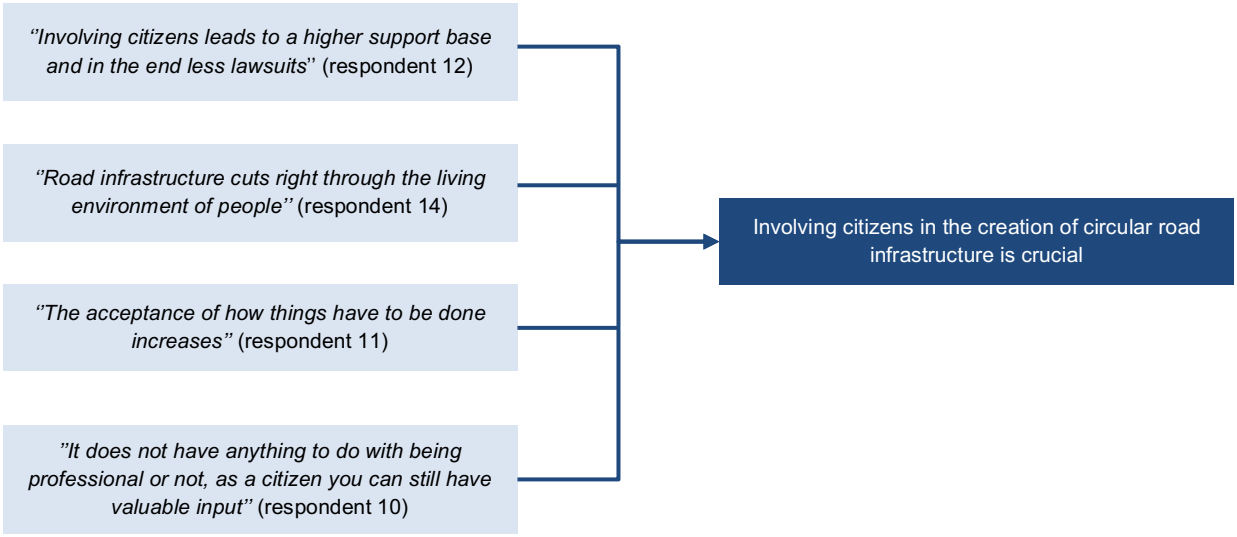

Figure 19: Quotes illustrating the importance of involving citizens in creating circular road infrastructure (author)

Although network governance entails that networks are self-organizing with autonomy from the state (Rhodes, 2007), all interviewed citizens agreed that the government is responsible to enable citizen participation in the co-creation process. The government has substantive goals, for example sustainability, and to achieve these goals you need citizens (respondent 9). As a government you should at least ''*Ensure that people have all the information to make a deliberate consideration''* (respondent 9). As Hajer (2011) argued, greater engagement of businesses and citizens is the most important element of the new style of governance. This style of governance is illustrated by respondent 9, who stated that ''*as a government you need to balance all interests carefully and then you make your decision*''. Nevertheless, participation is complicated. Enabling participation is challenging, uncertain outcomes are problematic, participation can be awkward, and it is not only up to the government but more a shared responsibility, underlining that there are barriers to citizen participation (respondent 1; respondent 9; respondent 8; respondent 3).

Living lab importance from a citizens' perspective

Citizens also provided insights on the usefulness of living labs. According to citizens, living labs enable citizens to imagine what impact certain measures on their living environment (respondent 10; respondent 12; respondent 13). Living labs *''provide people with visuals and show them what it will look like. This provides an opportunity to citizens to experience what will happen in real life and makes things tangible"* (respondent 12). This argument of the citizens is acknowledged by respondent 6, who stated that a living lab helps making things concrete, which contributes to everyone's understanding. Living labs support local problem solving because the contribution of citizens creates a better understanding of the problems in a specific place (respondent 10). Finally, respondent 13 summarized the potential of living labs:

''Local people have nothing to do with circularity or climate adaptivity. The local level is important, you should be able to communicate with each other on an equal level. In this way you can understand each other and make policies. Every citizen thinks different, which is complicated, but by doing things locally this can be fixed.''

Citizen role

Juujarvi & Pesso (2013) and Bergvall-Kareborn & Stahlbrost (2009) argued that the role citizens have in a living lab is crucial. Therefore, the citizen respondents were asked what role they prefer when participating in the InnovA58 living lab or the LLIADB. Although Juujarvi & Pesso (2013) distinguished between the different roles, the interviewed citizens had difficulties with imagining what role they could play and to distinguish between the different roles. An explanation for this is the overlap between the different roles as defined by Juujarvi & Pesso (2013) and Bergvall-Kareborn & Stahlbrost (2009).

Nevertheless, the ideator role, so conceptualizing possible solutions, was mentioned as the most probable citizen role (respondent 11; respondent 12; respondent 14). This role fits citizens, because citizens have local knowledge, citizens know what is important in their living environment, citizens are aware of the intricacies in their living area, and have creativity to create solutions (respondent 11; respondent 12; respondent 14). However, the role depends on citizens' knowledge (respondent 10), the circumstances (respondent 9), and on the substantive goal, so what do you want to achieve in a living lab and what are the boundary conditions for participation (respondent 11).

Additionally, respondent 11 argued that citizens can also help formulate problems, which is the explorer role. Citizens have specific local knowledge about their living area, which helps to define problems. Interestingly, respondent 10 also brought up the diffusion role of citizens in a living lab. The following quote shows how respondent 10 things about the diffuser role: *''There will always be a small group of people that will take the lead for citizens and pull the cart''.*

The preference for an ideator or explorer role is in line with the development of an energetic society, in which citizens' creativity is used to collectively define and influence the direction of the citizens' life. To research the role of citizens in a living lab, formal or informal participation was also discussed. Respondent 10,12 and 14 preferred formal participation, which means that the initiator defines the procedures, participants and steps (Puerari et al., 2018). This helps in creating a clear co-creation process, which is helpful for the participants and provides a stronger position (respondent 10; respondent 14). In addition, citizens also stated that Rijkswaterstaat should be transparent about the role Rijkswaterstaat is playing in the living lab process (respondent 11; respondent 12).

4.2.2 Participation barriers

Theoretical barriers in practice

Based on chapter 2.3.1 and the interviews, figure 20 was created. Figure 20 shows how many respondents from Rijkswaterstaat and the Ministry of IenW, and citizens mentioned a certain

participation barrier. The maximum number of respondents from Rijkswaterstaat and the Ministry of IenW is nine, while the maximum number of citizen respondents is five.

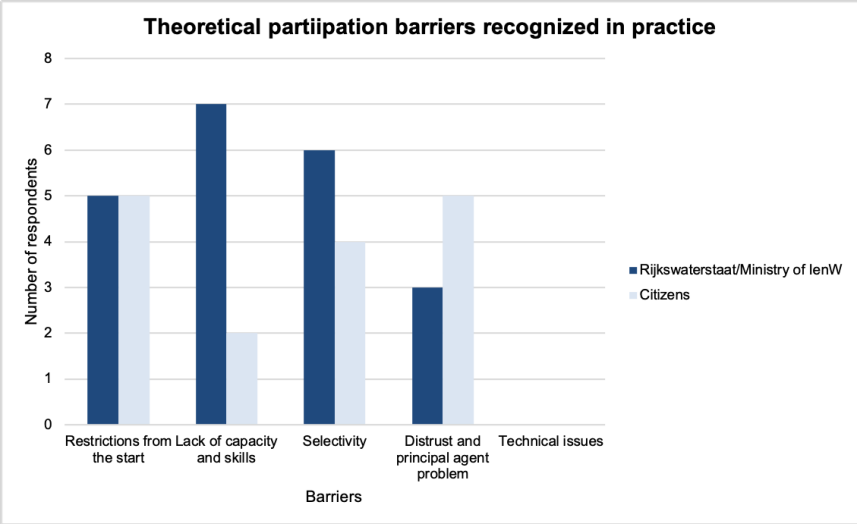

Figure 20: Theoretical citizen participation barriers in practice (author).

Restrictions from the start is a concern of both citizens and Rijkswaterstaat and the Ministry of IenW employees. As respondent 5 stated: *'' The powerful character of the government evokes resistance. When we started contacting citizen initiatives, we asked: how can we help as a government? Citizens then often said: By not interfering with us*''. The government often more powerful and decides, sometimes calls a process co-creation but instead entails informing, there are laws and regulations in place, and innovations have to provide added value for Rijkswaterstaat (respondent 1; respondent 3; respondent 5; respondent 7; respondent 8). The arguments for restrictions from the start as a barrier corresponds with chapter 2.3.1, in which it was stated that the government possesses more power in the co-creation process and pre-defines problems. Rijkswaterstaat is an executing organization, meaning that innovations have to fit current frameworks and the assignment of the minister, causing restrictions from the start. These restrictions concern citizens, as respondent 10 illustrated:

''The reason I think Rijkswaterstaat and citizen participation do not fit in one sentence is because the Minister formulates the assignment and the framework, creating restrictions.''

Turning to a lack of capacity and skills, it is remarkable that it is the most mentioned barrier by experts from Rijkswaterstaat and the Ministry of IenW, and the least mentioned barrier by citizens. A lack of capacity and skills ''*is absolutely a demotivating factor for participants''* (respondent 9), and citizens carry less specific knowledge than private and public actors (respondent 5; respondent 9; respondent 7; respondent 6; respondent1; respondent 4). However, this argument was refuted by citizens, since ''*It is not about time, money, income, knowledge, skills or those kinds of factors. It is about creativity and wanting to contribute''* (respondent 13), which was acknowledged by all other citizens. This contrasts chapter 2.3.1. A lack of technical expertise is a barrier, but solving the barrier is effortless according to citizens, making it less relevant, which is explained in chapter 4.2.

Third, having less time than other co-creating actors is a crucial barrier for citizen participation according to citizens, which is called selectivity. Citizens are busy with their career, have other duties, despite the subject being of interest, and citizens are difficult to organize (respondent 10; respondent 11; respondent 12; respondent 14). This is in line with Turnhout et al. (2010), who stated that citizens often lack time. However, having no money or urgency was not mentioned during the interviews. This illustrates that a lack of money or urgency is a negligible barrier, since citizens are highly motivated to contribute to their living environment (respondent 12). Time is the most constraining factor connected to selectivity (respondent 10; respondent 11; respondent 12). Selectivity also relates to the definition of a living lab. In the case of the InnovA58 living lab, multi-stakeholder participation seems to be overshadowed. There is an emphasis on innovating with the market, while knowledge institutions and citizens are playing a marginal role and have to be invited by Rijkswaterstaat to participate (respondent 4), underlining selectivity as barrier.

Citizens hold a suspicious attitude towards Rijkswaterstaat, caused by Rijkswaterstaat not being open and transparent (respondent 10; respondent 11; respondent 12; respondent 13; respondent 14). This is distrust and the principal agent problem. Respondent 11 stated that *''They [Rijkswaterstaat] keep their cards close to their chest and always keep something back''*. This contrasts the Rijkswaterstaat and the Ministry of IenW respondents, of whom only a few respondents acknowledged distrust and the principal agent problem (respondent 7; respondent 1; respondent 6). Ianniello et al. (2019) and Giering (2011) see distrust and restrictions from the start as separate barriers. However, the interview data shows that these two barriers overlap, since distrust or the principal agent problem creates fear among citizens for restrictions from the start.

Finally, figure 20 shows that technical issues were not mentioned as barrier during the interviews. Two explanations clarify this absence. First, the interviewed citizens were not participating in a living lab yet, meaning that citizens simply cannot have encountered technical issues. Second, Rijkswaterstaat and Ministry of IenW employees were also unfamiliar with technical issues as barrier, which is explained by the fact that technical issues overlaps with a lack of capacity and skills.

Additional barriers to theory

Additional barriers to the theory of chapter 2.3 emerged during the interviews. The first noteworthy barrier identified is difficulties with the privacy of citizens. Information of citizens is not freely accessible to living lab initiators, which blocks approaching citizens who could be interested in participating in a living lab (respondent 5; respondent 8). The privacy barrier connects with the selectivity barrier. Privacy as a barrier challenges reaching out to citizens and creates selectivity, since reaching hard to reach groups becomes increasingly problematic.

Second, citizens are too far away from practice, connecting with a lack of capacity and skills (respondent 13; respondent 12; respondent 4). This entails that citizens are often not interested in innovation and unfamiliar with the goals and practices of Rijkswaterstaat as an organization. As respondent 4 stated: *''For the largest share of citizens, innovation is not approachable. People don't want a new coffee machine; they just want their coffee machine to make good coffee''.*

A final barrier is formal or informal participation. Citizens prefer to be involved in a formal way, which means that the initiator defines procedures, participants and steps (Puerari et al., 2018), however, formal co-creation also forms a barrier. It forms a barrier, since citizens need to be committed and dropping out of the process becomes increasingly challenging, which limits freedom (respondent 10; respondent 14).

4.2.3 Participation enabling conditions

Chapter 2.2.3 illustrated the enabling conditions to solve citizen participation barriers. Table 3 shows the participation enabling conditions, both from theory and new conditions that emerged from the interviews, and how often a condition was mentioned by the respondents.

Table 3: Enabling conditions mentioned during the interviews, with (T) being theoretical conditions and (P) being new conditions from the interviews (author).

Condition	Respondents
Transparency (T)	8
Realism (T)	8
Openness (T)	7
Continuity (T)	3
Allow for feedback (T)	5
True empowerment (T)	6
Trust creation (T)	6
Appreciation (P)	7
Effort (N/P)	4
Expert (P)	3

The first remark is that spontaneity as condition was not mentioned explicitly during the interviews. Spontaneity entails that a living lab fits in the environment and contribute to societal needs (Bergvall-Kareborn & Stahlbrost, 2009). The non-recognition of spontaneity can be explained by the fact that living labs are established in a local context and already focus on problems at that place (Wirth et al., 2018). During the interviews, this led to the assumption that spontaneity is always existing. As table 3 shows, continuity was mentioned by three respondents. Bergvall-Kareborn & Stahlbrost (2009) explained that continuity entails cross-border collaborations. Governments, such as Rijkswaterstaat should not overrule citizen initiatives, instead, *''collaborate with different departments and citizen initiatives to enable citizen participation''* (respondent 5).

As Giering (2011) stated, creating transparency is important to solve restricted participation space and to create trust. Creating transparency entails that Rijkswaterstaat explains the possibilities in the co-creation process to citizens (respondent 12). Realism and openness overlap with transparency. Realism entails that Rijkswaterstaat manages expectations in the co-creation process (respondent 14; respondent 9) and is realistic about the rules of the game

(respondent 2). Openness entails that Rijkswaterstaat is not only realistic about the rules of the game, but also open and transparent in showing for example financial audits (respondent 9; respondent 10). Rijkswaterstaat should simply be ‘*’transparent, open and realistic about how decisions in the co-creation process are made”* (respondent 10).

The interviews illustrate that the conditions mentioned in chapter 2.3.2 are accurate in enabling citizens to participate. Nevertheless, deploying the conditions remains difficult. Creating trust, enabling true empowerment, and allowing feedback are important. However, true empowerment is a basic principle of co-creation, but remains difficult to implement (respondent 7). Trust can be created by direct communication between the different co-creation actors, but trust building takes time and emerges during the process (respondent 14). A living lab initiator should not only allow for feedback, but also provide feedback to citizens about their contribution to the co-creation process (respondent 2; respondent 12; respondent 14). The recognition of the conditions of chapter 2.3.2 shows that citizen participation barriers are solvable. However, it remains challenging to create these conditions to bring the conditions into practice.

The respondents also provided some ‘new’ conditions to enable citizens to participate in a co-creation process of a living lab in addition to the conditions of the theoretical framework. The first one is Rijkswaterstaat showing appreciation. This entails that citizens receive compensation for participating, which could convince them to participate. Different forms of appreciation are possible, for example giving citizen participants a small gift (respondent 7), money (respondent 2) or providing compensation for time and travelling to the living lab (respondent 12). Yet, respondent 7 also acknowledged that providing money is impossible, Rijkswaterstaat should at least show appreciation for citizens’ input.

Second, Rijkswaterstaat needs to show effort to involve citizens. Giering (2011) acknowledged that living lab initiators should put effort into understanding community issues. In addition, governmental organisations should put effort into enlarging the chance of citizens' initiatives to flourish (respondent 13). For example, to overcome the barrier of selectivity, Rijkswaterstaat should try to organize the living lab meetings at the end of the day, which shows their effort of trying to involve the citizens (respondent 7). Moreover, in the co-creation process, governmental organisations should put effort into ensuring that everyone’s contribution to the process is equal (respondent 3). As a final point, it should be clear to the citizens that an organization, such as Rijkswaterstaat, is putting effort into changing frameworks to enable innovation implementation, which also enables citizens to participate (respondent 12).

As a final condition, three citizens came up with the suggestion to involve an expert in the living lab co-creation process (respondent 10; respondent 12; respondent 14). This expert is not co-creating, but helps overcoming a lack of capacity and skills. As stated, citizens do not consider a lack of capacity and skills as a barrier, since it is easy to fix with an expert that increases the capacity and skills of citizens (Respondent 10; respondent 12).

In the end, enabling citizen participation conditions are helpful, but the intrinsic motivation of a citizen is a decisive factor for citizens to decide to participate in a living lab (respondent 13; respondent 5; respondent 9; respondent 7; respondent 2; respondent 3; respondent 12; respondent 11). As respondent 7 stated:

''You have to be really motivated to make that step [to participate]. This is really an issue: from the user perspective you should make it as easy as possible to contribute to creating a circular economy.''

4.3 Innovation upscaling

This chapter consecutively discusses the results from the interviews about upscaling in general, upscaling living lab design barriers and living lab context barriers, and upscaling conditions to overcome upscaling barriers.

4.3.1 Upscaling in general

During the interviews it was discussed what upscaling means in the context of Rijkswaterstaat and why it is important in the transition towards circular road infrastructure.

Definitions

Especially the stages defined by Dijk et al. (2018) and Wirth et al. (2018) were mentioned as forms of upscaling. Figure 21 illustrates the frequency of how many respondents mentioned the stages as defined by Dijk et al. (2018).

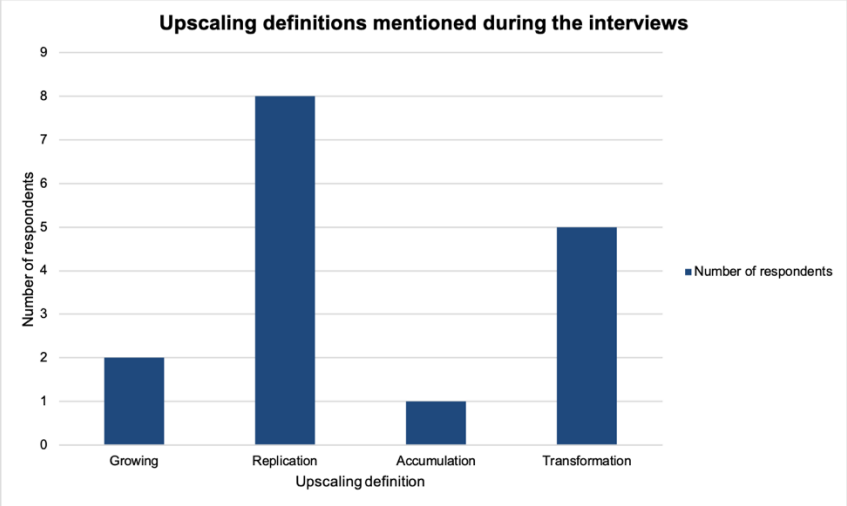

Figure 21: Upscaling definition during the interviews (author).

Replication was mentioned as important upscaling stage, meaning that upscaling is considered as expanding the experiment to other locations. The importance of replicating an experiment as upscaling is in line with Schulz et al. (2020) who concluded that upscaling is especially about enlarging the scale of experiments. Figure 22 illustrates upscaling as replication.

Transformation was also mentioned as crucial upscaling stage. Upscaling relates to changing procedures, upscaling of a business model, changing working methods, changing policy to use the possibilities of the new methods, and using the experiences to change policy (respondent 2; respondent 3; respondent 4; respondent 7; respondent 8). The importance of transformation corresponds with Dijk et al. (2018) that transformation is a crucial part of upscaling. Especially *''transferring innovations to different organizational departments and*

terrains is one of the most difficult steps'' (respondent 5) and it is important to consider whether ''*… an innovation has influence on the whole chain when it comes to business''* (respondent 3). This already illustrates the difficulty of upscaling. Although Wirth et al. (2018) stated that upscaling is sometimes undesirable, all respondents considered it crucial in the context of creating circular road infrastructure, because it enables wider system change.

Comparing the interviews with the harvesting and commotion framework of Schulz et al. (2020) the Rijkswaterstaat and the Ministry of IenW respondents consider upscaling especially as harvesting. The results specifically point at upscaling as growth and using practice as rules. For example, respondent 1 stated: ''*that what is innovated, applying it as a standard and looking at how you can make it a standard production factor*'', while respondent 2,3,4,5, and 8 also referred to upscaling as using practice as rules. Within Rijkswaterstaat, upscaling was not considered as commotion. Rijkswaterstaat is an executing organization and concerned with creating products, such as circular road infrastructure, in which creating destabilization is subordinate. This explains the focus on harvesting instead of commotion.

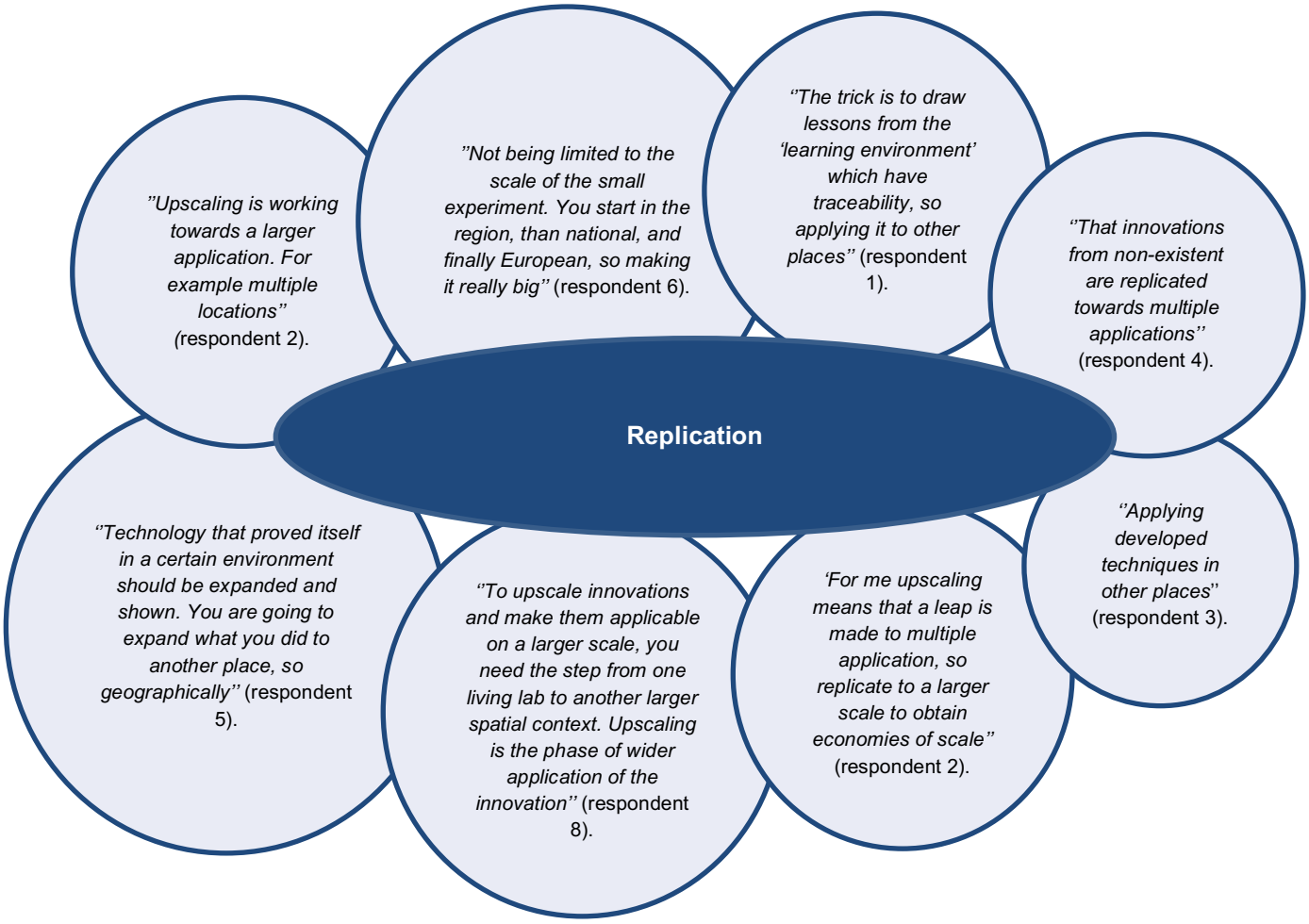

Figure 22: Quotes that consider replication as an important step for upscaling (author).

Upscaling difficulty

Although it was acknowledged that innovation upscaling is crucial to create circular road infrastructure, some respondents also recognized that upscaling is difficult. Respondent 5

stated that *''It [upscaling] is one of the most difficult things'',* while respondent 1 stated that '*'it is very complicated to upscale innovations to standards''*. Respondent 8 clearly stated why innovation upscaling is challenging:

''People are known to do things in a certain way and cannot embrace without a reason renewal. Then, the innovation will be sitting on the shelf''

More than half of the Rijkswaterstaat and Ministry of IenW respondents acknowledged that upscaling is difficult (respondent 5; respondent 8; respondent 7; respondent 2; respondent 1), which is in line with what Gasco (2017) and Da Chio et al. (2019) stated, namely that it is difficult to upscale experiment to a wider scale. In the context of the transition towards circular road infrastructure, this difficulty is also caused by upscaling barriers.

4.3.2 Upscaling barriers living lab design

A remarkable result of the interviews with Rijkswaterstaat and Ministry of IenW employees is that only four respondents stated something about living lab design barriers. Moreover, from these four, two respondents denied that living lab design factors play a role. This contrasts Cellina et al. (2018) and Da Chio et al. (2019) who considered living lab design factors and living lab context factors equally important. Nevertheless, respondent 2 recognized limited learning as living lab design barrier, since the initiator of a living lab often faces the 'urgency or necessary' dilemma.

The absence of recognizing living lab design barriers within Rijkswaterstaat and the Ministry of IenW not automatically implies the absence of living lab design barriers. In practice, living lab design barriers and living lab context barriers overlap. Nevertheless, specific conditions to solve living lab design barriers were mentioned, while living lab design barriers were not recognized, and are further explained in chapter 4.3.4. Additionally, during the interviews it was mentioned that poor-timing often refers to political, cultural and social context which is a context barrier. Therefore, poor timing clearly connects to contextual barriers. Finally, the wait-and-see barrier was not mentioned, even when the interviewer explicitly asked for this barrier. However, a lack of exchange between living labs as a barrier for learning and thus upscaling was recognized, which connects to a wait-and-see attitude, since a lack of exchange equals a lack of diffusing knowledge (Dijk et al., 2018).

4.3.3 Upscaling barriers living lab context

Figure 23 shows the theoretical upscaling living lab context barriers that were recognized in the context of Rijkswaterstaat, as well as contextual barriers that emerged during the interviews. Figure 23 illustrates that the respondents replicated the contextual barriers of chapter 2.5.1. The two most important barriers are discussed below.

Low institutional receptiveness is the main barrier to innovation upscaling in the context of Rijkswaterstaat and a transition towards circular road infrastructure. Figure 24 illustrates the importance of institutional receptiveness. As chapter 4.1 illustrated, the respondents were not entirely familiar with all aspects of a living lab. The difficulty to define living labs relates to institutional receptiveness as a barrier to upscaling. According to Cellina et al. (2018) an upscaling barrier is that policy-makers are unfamiliar with living lab elements, for example co-

creation. According to Cellina et al. (2018) this unawareness of the living lab aspects contributes to low institutional receptiveness. Moreover, as the quotes in figure 24 show, leaving behind a way of working is difficult, which is in line with Ruijer & Meijer (2019).

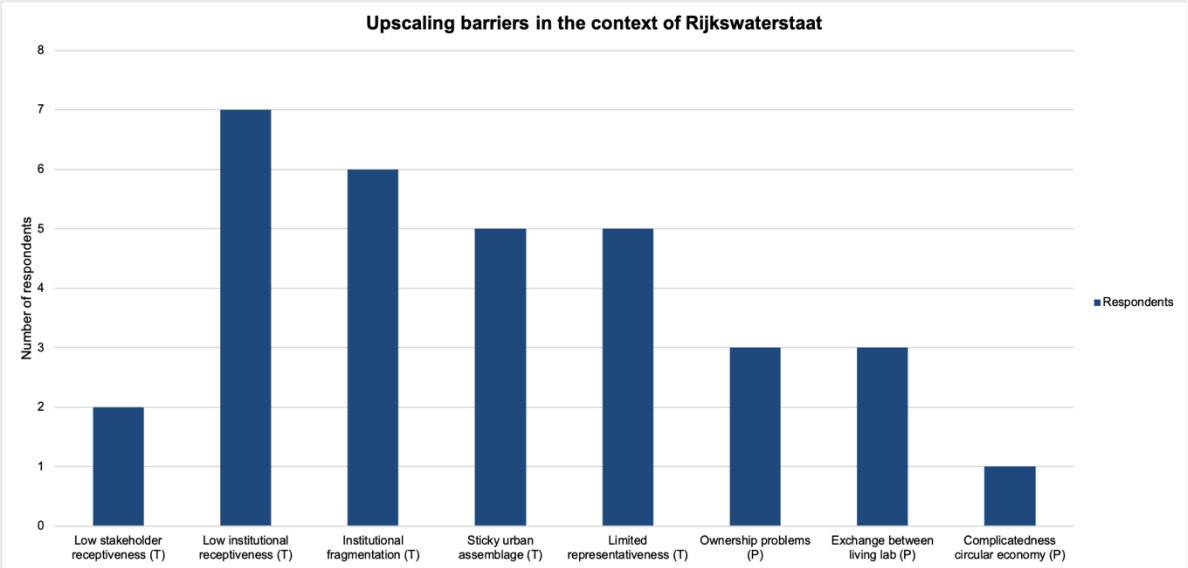

Figure 23: Upscaling barriers in the context of Rijkswaterstaat with (T) being barriers from theory and (P) barriers that emerged in practice and were not stated in theory (author)

Institutional fragmentation is another main barrier blocking innovation upscaling. Although institutional fragmentation plays a role in blocking upscaling, often ‘’*They [innovations] do not fit within current rules and facilities we [the Ministry of IenW] have*’’ (respondent 5). This underlines the importance of institutional receptiveness. Nevertheless, fragmentation within the government plays a role in upscaling:

‘’Rijkswaterstaat is an administrator, so within Rijkswaterstaat you can upscale. However, Rijkswaterstaat is not making laws and regulations, that is up to the Ministry of IenW. There is an enormous distance between Rijkswaterstaat and the parties making regulations’’ (respondent 4).

Chapter 2.5.1 clearly demarcated the different contextual upscaling barriers. However, demarcating the barriers is difficult in practice. As already stated in paragraph 4.3.2 the poor-timing barrier is difficult to demarcate from the limited representativeness barrier and low institutional receptiveness correlates with institutional fragmentation in practice. According to respondent 6, the different parts within the government are focused on their own field, which is fragmentation and causes lower institutional receptiveness. Furthermore, limited representativeness corresponds with citizen participation barriers, since citizen participation barriers decrease the representativity of citizens in the co-creation process and thus increases limited representativeness (respondent 1; respondent 3; respondent 6; respondent 7; respondent 8)

Additionally, the respondents envisioned upscaling barriers in addition to chapter 2.5. One of the main barriers identified by the respondents is ownership and entails the question: *who owns the innovations developed in a living lab?* (respondent 8; respondent 3; respondent 4). Fear of a co-creation actor ‘claiming’ the innovation exists and sometimes only one specific

actor is able to produce an innovation and patents the innovation, blocking upscaling (respondent 3; respondent 8).

Moreover, limited exchange between living labs is considered as contextual upscaling barrier (respondent 8; respondent 7; respondent 4). According to respondent 8, exchange between living labs is something that comes at the second place, while it is crucial for innovation upscaling. In line with respondent 8, respondent 7 questions the coherence between living labs, which also affects upscaling. Additionally, respondent 4 stated that the exchange between living labs is difficult, which also relates to the discussion about ownership and blocks upscaling.

As a final barrier, respondent 1 stated that the complicatedness of the circular economy concept also complicates upscaling. The concept needs extensive explanation to understand it, which makes innovation upscaling to contribute to a circular economy even more difficult (respondent 1).

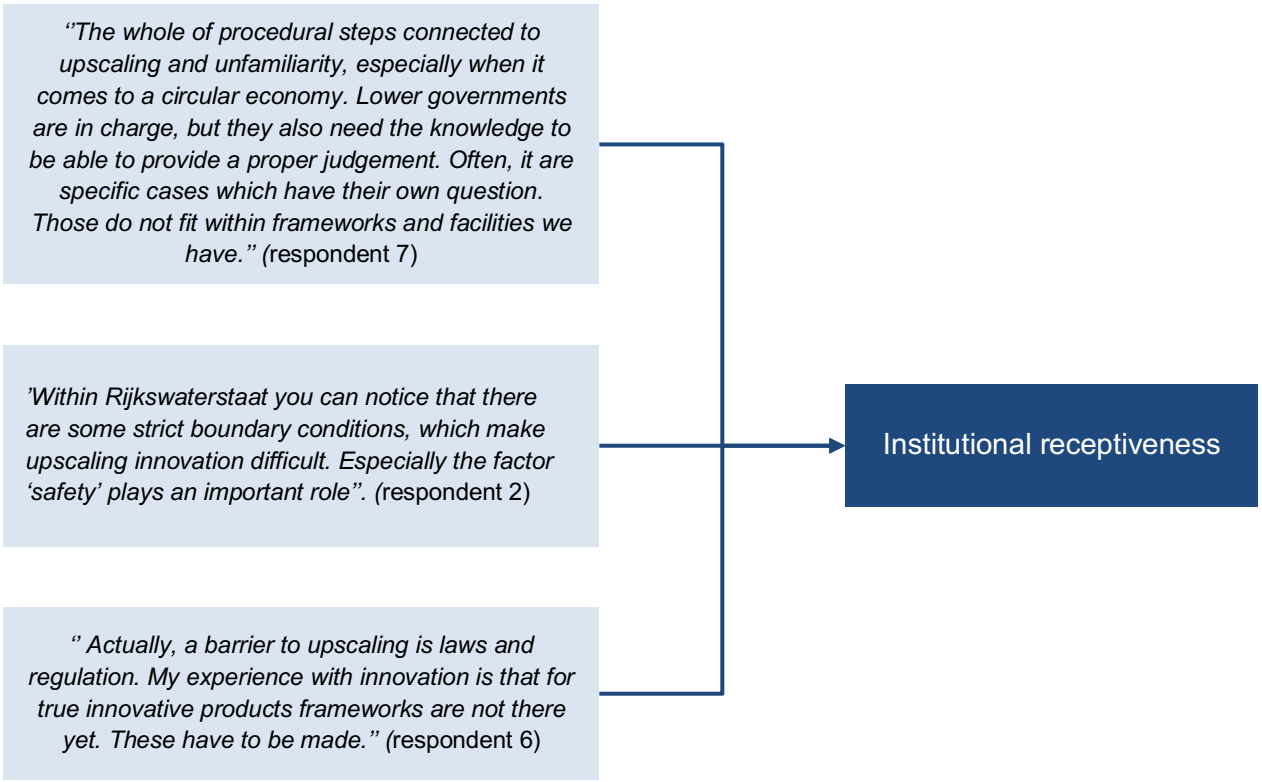

Figure 24: Illustration with quotes of institutional receptiveness as barrier (author)

4.3.4 Upscaling conditions living lab design

Although many barriers for upscaling were mentioned by the respondents, creating conditions for upscaling remains challenging, since upscaling is complex. Cellina et al. (2018) identified that implementing an upscaling strategy is important to overcome the wait-and-see attitude barrier. A wait-and-see attitude was not mentioned during the interviews, however, implementing an upscaling strategy is considered crucial to help overcome upscaling context barriers (respondent 8; respondent 2; respondent 6; respondent 3). *''It is a good idea to*

consider upfront how to upscale and to develop frameworks to enable upscaling" (respondent 6). Respondent 8 and respondent 3 linked the creation of an upscaling strategy to the limited representativeness barrier, while respondent 2 and 6 linked an upscaling strategy to overcome institutional receptiveness. Although a majority of respondents prefer an upscaling strategy, developing an upscaling strategy is also considered unnecessary since *''upscaling is a logical continuation*'' (respondent 5). Developing an upscaling strategy to overcome limited representativeness and institutional receptiveness instead of overcoming a wait-and-see attitude, shows that the clear-cut relationship between the upscaling barrier and condition as described by Cellina et al. (2018) and Dijk et al. (2018) is non-existent in the context of the transition towards circular road infrastructure. The overlap between the different barriers as explained in chapter 4.3.2 justifies the unclear relationship between barrier and condition.

Although limited learning was not identified as an upscaling barrier a learning strategy should be implemented according to respondent 1, 2 and 7. Respondent 7 illustrated the importance of a learning strategy to overcome limited exchange between living labs by stating that ‘*'the assignment to share lessons by implementing a learning strategy to benefit from the innovations.''*

4.3.5 Upscaling conditions living lab context

To overcome institutional receptiveness, Ruijer & Meijer (2019) and Cellina et al. (2018) suggested institutional transformation. Respondent 2 accurately described what institutional transformation means by stating that *''What I think, and this is politically seen as an obstacle, is that you can achieve more by providing the right incentives by changing laws and regulations by establishing specific standards to enable upscaling''*. This illustrates that creating incentives, early starting with changing regulations and laws helps upscaling. Additionally, respondent 1 stated that institutional transformation is also important to overcome institutional fragmentation. This for example entails that the organizational departments are changed to stimulate cross-sectoral collaboration (respondent 1).

To overcome institutional fragmentation, cross-sectoral collaborations should be established. Respondent 2 explained that cross-sectoral collaboration is crucial for upscaling since ‘'*There [the Ministry of IenW] is where the assignment comes from, which we [Rijkswaterstaat] execute. Therefore, cross-sectoral collaboration is indispensable''.* Moreover, respondent 6 stated that *''...true innovations emerge between sectors, not within sectors, so cross-sectoral collaboration should be more stimulated''.* Cross-sectoral collaboration entails that multiple governmental sectors are connected to the living lab, for example road infrastructure- and water departments (respondent 2; respondent 6).

Turning to limited representativeness as a barrier, involving a diverse group of stakeholders is an important condition. Involving a diverse group of stakeholders, so knowledge institutions and citizens and users next to private- and public actors, is crucial to overcome limited representativeness (respondent 8; respondent 7; respondent 1). Moreover, involving a diverse group of stakeholders contributes to solving institutional receptiveness, since involving different governmental departments anticipates on changing rules (respondent 7).

Cellina et al. (2018) considered open participation as early as possible as a condition to overcome low stakeholder receptiveness, but early participation was not mentioned during the

interviews. Stakeholder receptiveness was mentioned only twice as a barrier and according to respondent 5 stakeholder representativeness should be overcome by ensuring that there is a ‘pacemaker’. According to respondent 5 *‘’A pacemaker helps as a person to overcome barriers and to step over this barrier’’*. A pacemaker is someone that pulls the cart and It is also worth noting that ‘low stakeholder receptiveness’ in practice overlaps with ‘institutional receptiveness’. For example, respondent 8 mentioned that a pacemaker helps in pushing the initiative, despite institutional receptiveness.

Respondent 8 mentioned having a short-term focus, not only to enable citizen participation but also to enable upscaling since a short-term focus creates a support base. This contradicts Cellina et al. (2018) who stated that a focus should be created on making innovations fit within long-term contracts. At the same time, a short-term focus on local problems can be combined with concentrating on long-term contracts (respondent 8). Moreover, respondent 7 related the sticky urban assemblage to creating an upscaling strategy. In the end, the interviews do not provide a clear-cut condition that helps overcoming a sticky urban assemblage due to the sticky urban assemblage being a complex barrier (Cellina et al., 2018).

Chapter 4.3.3 illustrated that ownership and the complicatedness of the circular economy also form a barrier for innovation upscaling. Moreover, respondent 4 explained that ‘*’involving a diverse group of stakeholders is important. Sometimes, it is helpful to establish communities of practice*’’ which is supported by respondent 5. Establishing communities of practice entails that a practice-oriented community is established who exchange assignments to stimulate learning. Therefore, a ‘new’ condition in enabling innovation upscaling can be establishing communities of practice.

As a final condition to enable upscaling, ‘customization’ was identified. It is important to customize innovations to enable upscaling (respondent 5; respondent 6; respondent 1; respondent 4). This means that the unique innovations are customized to fit regulations, laws and differing contexts. This could mean that an emergency procedure is put in place to enable upscaling (respondent 7), that you search for contexts in which the innovation can work instead of concentrating on the limits (respondent 4), that you try to align supply and demand (respondent 1) and that Rijkswaterstaat and the Ministry of IenW offer more protection and support to make upscaling possible (respondent 5). Customization as a condition not only relates to ownership and the complicatedness of the circular economy concept, it should also be taken into account to overcome institutional receptiveness and to deal with limited representativeness (respondent 1; respondent 7). Figure 25 connects all upscaling barriers and upscaling conditions in the context of a transition towards circular road infrastructure, based on the results above.

Figure 25: Living lab context barriers and conditions in the context of Rijkswaterstaat (author).

4.4 Citizen participation & innovation upscaling combined

The final question during the interviews addressed the relationship between citizen participation in a living lab and innovation upscaling from a living lab. In total 8 out of 14 respondents were able to state something about the relationship between innovation upscaling and citizen participation. Seven agreed that upscaling and citizen participation are complementary, while one respondent considered upscaling and citizen participation as conflicting. Figure 26 illustrates the complementarity with quotes and shows that citizen participation in a living lab is especially helpful to create a support base, which helps innovation upscaling. This is in line with Cellina et al. (2018), who stated that societal involvement in innovations helps upscaling. Nevertheless, there can be a conflict between citizen participation and innovation upscaling. As respondent 12 and 14 stated, citizens focus on their local problems, which restricts the space for upscaling. In addition, ‘*’Participation can also lead to people saying: can we remove the rest area? Not innovating, but just remove it. In this way, involving citizens forms an obstacle in innovating and innovation upscaling”* (respondent 1).

However, these kinds of difficulties can be taken into account and solved by the upscaling conditions (respondent 1).

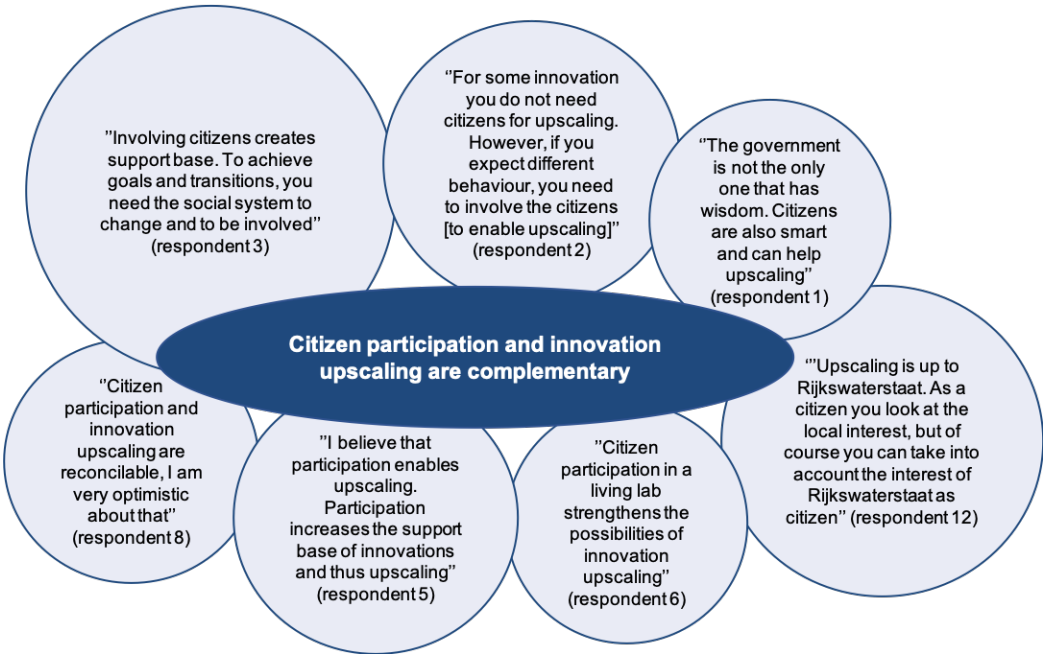

Figure 26: Quotes concerning complementarity of citizen participation and upscaling with the size of the circles not indicating a higher importance (author).

Relationship citizen participation- and upscaling conditions

The interview results illustrate that some citizen participation conditions and upscaling conditions are overlapping. Based on the results, some patterns between conditions for citizen participation in a living lab and innovation upscaling from a living lab can be identified.

First, continuity entails cross-border collaborations (Bergvall-Kareborn & Stahlbrost, 2009), which creates trust and strengthens creativity. In turn, cross-border collaborations help overcoming institutional fragmentation. With creating cross-sectoral collaborations, two targets are hit with one shot: enabling citizen participation and innovation upscaling.

Second, a pacemaker helps overcoming low stakeholder receptiveness but also creates trust in the initiator of a living lab (respondent 5). Therefore, appointing a pacemaker helps to overcome low stakeholder receptiveness, but also distrust in Rijkswaterstaat. Also, the role of appointing a pacemaker among citizens corresponds with the diffuser role in a living lab, which are persons that support and facilitate the adoption of innovations within the population (Scozzi et al., 2017), which helps upscaling (respondent 5).

Finally, involving a diverse group of stakeholders was considered crucial to overcome multiple upscaling barriers (figure 25). This not necessarily corresponds with a citizen participation condition, but underlines the need to implement the different citizen participation conditions to create the involvement of a diverse group of stakeholders and in turn upscaling.

Chapter 5: Conclusions & discussion

To compose a conclusion, the secondary research questions are first answered in this chapter. Then, the main research question is answered by formulating conditions for citizen participation and innovation upscaling, which ends with a general conclusion. In the formulation of conditions, the theoretical framework is compared with the results and analysis, and discusses the differences between theory and the results. The final parts of this chapter contain an interpretation of the results, recommendations for further research and a reflection.

5.1 Answering the secondary research questions

5.1.1 How is the living lab concept defined from a theoretical perspective and how is citizen participation and upscaling connected to the living lab concept?

Literature defines living labs as a multi-stakeholder partnership between public- and private actors, citizens and users, and knowledge institutions, who are together in a co-creation process. Innovations are created and experimentation with the innovation in a real-life context takes place to solve problems.

Citizen involvement in living labs is crucial, because citizens are motivated to change their environment, possess creativity and have significant learning ability. This research focused on top-down living lab establishment by a public administrator, namely Rijkswaterstaat. Creating circular road infrastructure is complex and demands for interactive problem solving between different actors. Living lab initiators need to involve citizens in living labs because citizens possess extensive knowledge about that local living environment in which the living lab is established, which enables citizens to contribute to the co-creation process. Citizens can explore problems, conceptualize solutions, design and implement solutions or support the adoption of innovations within the population.

A final living lab stage is upscaling, which entails the adoption and embedding of innovations into the wider socio-technical system. Living labs emerge as small, local developments, which are niche developments. At the same time, pressure from the landscape occurs, for example with the EU Green Deal prescribing a circular economy. Between the niches and landscapes, the regimes accommodate the broader social groups and activities. To fulfill the transition towards circular road infrastructure, the architecture of elements and linkages in the regimes need to change, which demands the adoption of living lab innovations by the regimes. This process also refers to multi-level governance. The local living lab innovations, developed by local governments, for example, need to be embedded into rules and legislations by other governmental levels, such as Rijkswaterstaat and the Ministry of IenW. Different forms of upscaling exist, such as expanding the experiment to another spatial scale, changing regulations, involving more actors or connecting different living labs. Subsequently, upscaling can be considered as ‘harvesting’, which means that the experiment grows, and is implemented in practice. Upscaling can also be considered as ‘commotion, which refers to destabilizing the status quo. Thus, upscaling is connected to living labs, since upscaling is the

final living lab stage and necessary to create a new architecture of elements of linkages, namely circular road infrastructure.

5.1.2 What barriers to and conditions for citizen participation and innovation upscaling are identified in theory?

Citizen participation barriers explain the moderate involvement of citizens in living labs in the Netherlands. The main living lab citizen participation barriers are restrictions from the start, imposed by living lab initiators, a lack of capacities and skills, limited time or money to participate, distrust in living lab initiators, and a lack of sufficient information, creating unrealistic expectations among citizens. To overcome restrictions from the start, theory states that power should be equally distributed, and living lab initiators should create openness and transparency. Additionally, realism creation is crucial, which entails proper expectation management by living lab initiators. Creating trust helps conquering a lack of capacity and skills, distrust, and the principal agent problem. Furthermore, living lab initiator should put time into understanding community problems to involve hard to reach groups. Yet, overcoming participation barriers by implementing participation conditions remains challenging, because trust-creation and understanding community problems is time consuming.

In theory, different upscaling barriers were identified. First, living lab design barriers were identified. As living lab design barrier, limited learning was identified, which entails limited monitoring of the learning process by the living lab actors. Moreover, a lack of attention to diffusing and learning knowledge (wait-and-see attitude) and ignoring broader dynamics outside the living lab were identified as living lab design barriers. To conquer limited learning, a learning strategy should be developed which states living lab learning goals. Furthermore, living lab initiators should develop an upscaling strategy which states what and how to upscale. Collaboration with a diversity of actors is crucial to solve a lack of attention to broader dynamics.

Second, living lab context barriers were identified. A lack of populational or political support beyond the living lab forms an upscaling barrier (low stakeholder receptiveness). Moreover, institutional receptiveness, which is that policy-makers are not receptive to innovations, forms an upscaling barrier. Third, institutional fragmentation blocks upscaling. Fragmented departments and units within organizations challenges upscaling. Additionally, financial, legal, infrastructural or technical aspects block upscaling, called a sticky urban assemblage. Finally, limited representativeness possibly blocks upscaling, since the developed innovations only applicable in the specific living lab context. To conquer low stakeholder receptiveness and limited representativeness, involving a diverse group of stakeholders is crucial. To overcome institutional receptiveness and institutional fragmentation, cross-sectoral collaboration, transparency, changing regulations and involving policy-makers should be ensured as condition. To solve the sticky urban assemblage barrier, a clear communication strategy and a focus on long-term contracts and legal rules should be established.

5.1.3 How is the concept of living labs defined in the context of Rijkswaterstaat and the Ministry of IenW and why is it an important concept?

The results show that experimentation, co-creation, a real-life context and multi-stakeholder participation, were recognized as defining living lab aspects. While multi-stakeholder involvement, especially involving citizens and users in a living lab, is a crucial living lab aspect according the theory, involving citizens in a living lab was the least recognized principle in the results. Rijkswaterstaat focusses on experimentation in living labs, not necessarily by including citizens, because it is believed that citizens lack capacity and skills to innovate.

Despite the inexperience of Rijkswaterstaat to involve citizens in living labs, it was acknowledged that citizen involvement in living labs is crucial, because citizens have local, space specific knowledge. Moreover, living labs are an important tool for innovation, since the collaboration between public- and private actors, knowledge institutions, and citizens and users creates different perspectives and boosts creativity. Establishing living labs is crucial to complete the goal of creating circular road infrastructure, since innovations are needed. Nevertheless, there are concerns regarding the capability to learn from a living lab and the persistence of the concept.

5.1.4 What barriers to citizen participation and upscaling of innovation can be identified in the context of living labs at Rijkswaterstaat?

Restrictions from the start, a lack of capacity and skills, selectivity, and distrust and principal agent problems are remarkable barriers in the context of Rijkswaterstaat. Rijkswaterstaat and the Ministry of IenW respondents feared a lack of capacity and skills among citizens, but among citizens this is not a barrier to participate. In addition to theory, citizens being too far away from Rijkswaterstaat practices, privacy aspects and formal responsibilities are additional barriers for citizens to participate in a living lab.

Within Rijkswaterstaat and the Ministry of IenW, upscaling is specifically referred to as replication or transformation. This entails changing working methods, changing rules and deploying the living lab results across multiple spatial scales. Upscaling is considered as a difficult process and there is a danger of innovations being limited to a local scale. The difficulty to upscale is especially caused by low institutional receptiveness, institutional fragmentation, a sticky urban assemblage and limited representativeness. Moreover, problems with ownership, which means that upscaling is constrained by a co-creator claiming the innovations, exchange between living labs, and the complicatedness of a circular economy forms a barrier for upscaling. Different barriers overlap. For example, poor timing as barrier corresponds with limited representativeness, since both barriers address ignoring broader dynamics outside the living lab as upscaling barrier.

5.2 Answering the main research question

Based on chapter one to four and the answers to the secondary research questions, an answer to the main research question is formulated. The main research question is:

What conditions enable citizens to participate in a living lab and are necessary for innovation upscaling to progress in the transition towards circular road infrastructure in the Netherlands?

A combination of theory and interview results leads to three conditions for citizen participation and three conditions for innovation upscaling. These conditions are formulated below. The main research question strongly connects with secondary research questions five and six. Therefore, the formulated conditions also provide an answer to secondary research question five and six. This chapter ends with a general conclusion, connecting citizen participation and innovation upscaling.

5.2.1 Conditions for citizen participation in living labs

Although Rijkswaterstaat creates living labs to *''connect ambitions, knowledge and experience of relevant parties'' (*Rijkswaterstaat, n.d.b., p.1), citizen involvement in living labs remains low while citizen involvement forms a crucial living lab aspect. In theory, multi-stakeholder participation is considered crucial in living labs, with a central role for citizens. Nevertheless, Rijkswaterstaat considers citizen participation in a living lab problematic, because citizens lack capacity and skills. However, citizen participation was acknowledged as important living lab element, both by Rijkswaterstaat and the Ministry of IenW, and theory to create a support base for innovations, to tap into creativity, to achieve goals and to practice. Therefore, to overcome citizen participation barriers, the conditions below should be deployed. These conditions are based on a combination of conditions from theory and practice that have overlap.

Condition 1: As a living lab initiator, manage expectations (realism), be transparent about the possibilities (transparency) and clearly define the role of citizens (openness).

First, living lab initiators should manage expectations, which is called realism. From a citizen's perspective, knowing what is expected from you in the co-creation process helps conquering selectivity and restrictions from the start barriers. Second, from the perspective of both citizens and Rijkswaterstaat, the creation of transparency in the beginning of the co-creation process about the solution space is crucial to prevent restrictions from the start. The rules and the framework in which co-creation takes place should be clear to the citizens. These rules and frameworks should be established together with the citizens to create trust. Defining the rules and frameworks together with citizens helps defining realistic expectations. Finally, the role of citizens in co-creation process should be clearly defined. Citizens are especially able to conceptualize solutions and to define problems, since they have knowledge about the local context. Moreover, to overcome distrust, the initiator of a living lab should be open about the initiators' role in the process. In the process of managing expectations, creating transparency and defining the citizens' role, appoint a 'pacemaker' help, which is a citizen that approaches other citizens and 'pulls the cart'.

Condition one illustrates the connection between theory and practice. Creating realism, openness and transparency were recognized in both theory and practice. Nevertheless, in

theory these three factors were separated as isolated conditions. However, for example realism and transparency overlap, since being transparent about the co-creation possibilities also contributes to managing expectations. This illustrates the complementarity of individual enabling citizen participation conditions.

Condition 2: Allow for reciprocal feedback between the living lab initiator and participating citizens and provide citizens with a true possibility to co-create.

Reciprocal feedback and true empowerment are necessary conditions to enable citizen participation in living labs. As chapter 2.3.2. stated, a living lab initiator allowing for feedback from the citizens helps overcoming restrictions from the start and reduces the feeling of citizens having less power than other co-creating actors. However, interview respondents also suggested that the living lab initiator provides frequent feedback to the citizens, which is a difference between theory and practice. This initiator feedback is not necessarily from the role as co-creator, but from the perspective of being a living lab initiator that needs to ensure that the innovations being developed are useful. This shows that an initiator allowing for feedback (chapter 2.3.2.) is not enough. Instead, reciprocal feedback in the co-creation process should be created.

In line with theory, practice illustrated that true empowerment helps in building trust. Building trust is time-consuming and co-creation already entails equal- and true empowerment. Nevertheless, citizens fear other powerful actors, which underlines the need to listen to citizens and to provide citizens with feedback.

Condition 3: As living lab initiator (Rijkswaterstaat) ensure that a form of appreciation is created and that effort is put into involving citizens.

First, as living lab initiator it is important to show appreciation to participating citizens. This entails that citizens, for example, receive a travel allowance, a trifle can be a push for citizens to participate and it means that co-creation sessions are held in the evening. This relates to showing effort as a living lab initiator to involve citizens. Organizing co-creation sessions and showing appreciation helps overcoming the selectivity barrier, which is that citizens lack time or are part of hard to reach groups. Living lab initiators should put effort into understanding the problems of a community. Additionally, the living lab initiator should put effort into involving citizens in the co-creation process, which is currently lacking at Rijkswaterstaat according to the citizens. This also helps in the feeling of being appreciated. Putting effort into involving citizens complements the theory that effort should be put into understanding community issues. In theory, it is assumed that putting effort into involving citizens is a basic principle and therefore not explicitly mentioned. However, this effort is not self-evident in practice.

Discussion of citizen participation conditions

A lack of capacity and skills forms a critical citizen participation barrier. However, the lack of capacity and skills is specifically a fear of Rijkswaterstaat. According to citizens, a lack of capacity and skills is not necessarily constraining participation, since the motivation of citizens to contribute is more important. Moreover, all actors have specific, useful capacities and skills. Citizens especially possess specific knowledge about their living environment. Moreover, if a

lack of capacity and skills occurs, solving it is effortless by hiring an expert that prepares the citizens for the co-creation process.

Compared to theory, technical issues as participation barrier was not identified in practice. The researched living labs were in early development, meaning that technical issues, which is that citizens drop out of a living lab due to lacking technical skills, simply could not occur yet. The non-recognition of technical issues is not a rejection of the existence of the barrier. Instead, it simply did not appear during the interviews due to the early stage development of the cases.

Finally, a living lab that fits societal needs and the local environment is a theoretical condition for citizen participation (spontaneity). Nevertheless, this was not mentioned during the interviews. Spontaneity overlaps with putting effort into understanding community problems as living lab initiator. Therefore, spontaneity as conditions is not rejected but it overlaps with another condition in practice.

5.2.2 Conditions for innovation upscaling

Both chapter 2 and 4 illustrated the challenge to define upscaling. In the context of Rijkswaterstaat, replication and transformation are considered as essential in upscaling. Nevertheless, both theory and practice recognized the complicatedness of upscaling. Upscaling is challenging, but deploying specific upscaling conditions helps overcoming upscaling barriers. By combining theory and interview results, the three conditions below are formulated to enable innovation upscaling.

Condition 1: Create an upscaling- and learning strategy to overcome living lab design upscaling barriers.

Although upscaling is a logical continuation of the living lab process, an upscaling strategy stimulates upscaling. It is unnecessary to create an extensive strategy; however, it is useful to create a strategy that addresses how innovations should be upscaled, what should be upscaled, what upscaling means in a specific context and to start changing frameworks. This strategy should help to overcome institutional receptiveness and limited representativeness. Besides, a learning strategy should be created. This strategy entails how and what you want to learn in the living lab and helps to overcome the barrier of limited learning and exchange between living labs.

In chapter 2.6.2, creating an upscaling- and learning strategy was connected to limited learning and wait-and-see-attitude barrier. However, in the context of upscaling living lab innovations to create circular road infrastructure, the upscaling- and learning strategy are connected to the contextual upscaling barriers of institutional receptiveness, limited representativeness and exchange between living labs. This difference between theory and practice illustrates the unequivocal connection between a specific condition to solve a specific barrier. In theory a specific condition conquers one specific barrier, while in practice one condition is capable of solving multiple barriers. This shows the accuracy of theoretical conditions, but, in addition to theory, a condition connects to multiple upscaling barriers.

Condition 2: Start transforming institutions from the start and establish cross-sectoral collaborations to overcome institutional receptiveness and institutional fragmentation.

Institutional receptiveness and institutional fragmentation are considered as critical innovation upscaling barriers. Therefore, involving policy-makers from the beginning in the living lab is crucial. These policy-makers should be concerned with fitting the innovations within current frameworks and create room for future changes in the policies. Involving policy-makers relates to establishing cross-sectoral collaborations. All sectors affected by living lab innovations should be involved in the process to enable institutional transformation. Different departments of Rijkswaterstaat should collaborate with the Ministry of IenW to enable this transformation. Living lab initiators create a framework for co-creation. Within this framework different departments should collaborate to create awareness of innovations and stimulate spreading of innovations into the organization.

Condition 3: Involve a diverse group of stakeholders in the co-creation process, leave room for customizing innovations and include a short-term focus.

Involving a diverse group of stakeholders supports innovation upscaling. Involving citizens creates a focus on the local context. However, involving citizens also ensures that broader dynamics outside of the living lab are considered. Moreover, involving a diverse group of public- and private actors helps overcoming institutional receptiveness because more institutional actors are connected to the living lab.

In addition, establishing communities of practice with a citizen as pacemaker that helps diffusing innovations into the local community, helps pushing innovations to a wider scale. By including a short-term focus in the co-creation process, the co-creation goals become tangible for participating stakeholders. It is crucial to develop innovations with room for customization to deal with ownership problems, which means that innovations are changed to fit specific regulations, with a concentration on what is possible instead of the limitations for upscaling.

As stated, involving a diverse group of stakeholders corresponds with theory and practice. However, establishing communities of practice, a short term-focus and room for customization were only mentioned during the interviews. This underlines that current upscaling conditions from a living lab are incomplete and underline the knowledge gap as mentioned in chapter 1.

Discussion of citizen participation conditions

In contrast to theory, upscaling conditions to overcome a sticky urban assemblage were not mentioned during the interviews. This underlines the complicatedness of the sticky urban assemblage as upscaling barrier. It illustrates the difficulty to solve a sticky urban assemblage.

A striking difference between theory and practice is the distinction between living lab design barriers and conditions and living lab context barriers and conditions. In theory, the barriers and conditions are clear-cut and divided into design and context factors. However, in practice this distinction is unclear. Complying with the citizen participation barriers and conditions, a clear distinction between different barriers and conditions in practice is difficult. A distinction

is problematic because there is overlap between the barriers and conditions. For example, poor timing as living lab design barrier entails ignoring broader dynamics outside of the living lab, which corresponds with limited representativeness. Therefore, maintaining a distinction between barriers and conditions in practice is problematic and unnecessary.

5.2.3 General conclusions and advice to Rijkswaterstaat

The conditions presented in chapter 5.2.1 and 5.2.3 answered the main research question. The different barriers and conditions for citizen participation and innovation upscaling were treated separately throughout this research. The theoretical model of chapter 2.7 depicted a possible relationship between citizen participation conditions and upscaling conditions. After all, there is overlap between conditions for citizen participation and innovation upscaling conditions. For example, cross-border collaborations conquer institutional receptiveness as upscaling barrier and supports overcoming a lack of capacity and skills as citizen participation barrier. Moreover, involving a diverse group of stakeholders is a condition for upscaling to create support-base for innovations. This underlines the importance of involving citizens in living labs, since citizens are part of the diverse group. Finally, appointing a pacemaker in the co-creation process supports building trust and helps overcoming low stakeholder receptiveness. Despite citizen participation and innovation upscaling being different components of a living lab, citizen participation and innovation upscaling are related.

Eventually, deploying the different conditions for citizen participation and innovation upscaling is crucial. It is advantageous to deploy the conditions simultaneously, because citizen participation and upscaling conditions overlap. Yet, Rijkswaterstaat, as living lab initiator, and citizens have differing interests, possibly creating conflicts. This research demonstrated that theoretical citizen participation barriers and conditions and innovation upscaling barriers and conditions prevail in practice. The conclusions are predominantly in line with theory. Nevertheless, practice reveals that the connection between different barriers and conditions is not straightforward. Practice showed that some conditions conquer multiple barriers or that a specific condition is related to a different barrier compared to theory. Furthermore, the theoretical framework was, according to practice, incomplete, since ‘new’ barriers and conditions emerged during the interviews. This research contributed to the identified knowledge gap by depicting the relationship between innovation upscaling and citizen participation in living labs and formulated conditions to enable citizen participation and innovation upscaling. In the end, innovation upscaling is crucial to progress in the transition towards circular road infrastructure. The conditions for citizen participation and innovation upscaling should help Rijkswaterstaat to progress in the creation of living labs for circular road infrastructure.

5.3 Recommendations for practice

Based on chapter 5.2, eight recommendations for practice at Rijkswaterstaat in the context of establishing living labs to create circular road infrastructure are proposed:

1) As Rijkswaterstaat, create a living lab in which expectations are managed carefully and possibilities of co-creating are clear, with a pre-defined role for citizens;
2) Provide feedback to citizens, allow for feedback from citizens to Rijkswaterstaat and provide true possibilities to co-create to citizens.;

3) As Rijkswaterstaat, show appreciation for citizen participation and put effort into involving citizens;
4) Establish an innovation upscaling strategy and a learning strategy;
5) Start the process of institutional transformation as soon as possible and create cross-sectoral collaborations;
6) Ensure that a diverse group of stakeholders is involved in the co-creation process;
7) Leave room for a short-term focus and customization of innovations;
8) Deploy recommendations 1-7 simultaneously because there is overlap between the conditions and the recommendations are complementing each other.

5.4 Recommendations for further research

Besides the recommendations above, some recommendations for further research are provided. The research question was framed and focussed on circular road infrastructure to manage this research within the time allowed. It is recommended to enlarge the scope outside the transition towards circular road infrastructure and to include living labs that address other spatial problems. It should be researched whether the barriers and conditions for both citizen participation and innovation upscaling are also encountered in other living lab subjects.

Second, it is recommended to widen the scope outside of Rijkswaterstaat. Living labs are popular phenomena and established in different sectors. Therefore, it could be interesting to research barriers and conditions for citizen participation and innovation upscaling at different governmental levels, for example living labs established by provinces or municipalities. It is also suggested barriers and conditions for citizen participation and innovation upscaling outside a living lab. Living labs are one specific way to achieve innovation, but innovation upscaling also plays a role in different forms of experimenting. Therefore, it could be interesting to research upscaling barriers and conditions in other experiential contexts.

A final suggestion for future research is researching the connection between the different conditions. As was recommended, this research recommends deploying all conditions. However, it could be interesting to research what combinations of citizen participation conditions and innovation upscaling conditions lead to the best result and whether they can be merged.

The results are limited generalizable. The different barriers and conditions were researched in the context of a circular road infrastructure. However, the theoretical barriers and conditions, which emerged for example in living labs for smart mobility, correspond with the case study results. Therefore, it is probable that the barriers and conditions and the relationship between them also apply to living labs outside circular road infrastructure. Nevertheless, as stated above, the context of Rijkswaterstaat is specific. Rijkswaterstaat is a large organisation and part of the Ministry of IenW, which increases the chance of, for example, institutional fragmentation compared to smaller, local governments. Therefore, the barriers and conditions seem generalizable to living labs initiated by national governments, but it can be questioned whether this is also the case with living labs established by other levels of governments.

5.5 Reflection

Despite the careful research process and deliberate research approach, some critical reflection points can be generated. First, 14 respondents participated in this research, which is a relatively small group. This group consisted of citizens and professionals from Rijkswaterstaat and the Ministry of IenW. However, the limited time reserved for this research and the insensitivity of transcribing, coding and analysing the interview justifies this ‘small’ group. Due to the relatively small number of interviewees, the influence of an individual respondent is significant. To prevent a powerful influence of one respondent, the responses of all interviewees were compared with each other and with theory.

A second critical remark is the process of selecting the respondents. Since the researcher was an intern at Rijkswaterstaat, it can be challenging for an independent researcher to select the same respondents and repeat the process likewise. Nevertheless, the researcher ensured that a chain of evidence was maintained and appendix 2 provides a list of the departments of Rijkswaterstaat and the Ministry of Ienw that were involved in the interviews. Yet, the respondents from Rijkswaterstaat and the Ministry of IenW also proposed other possible interviewees, which can create personal bias. Still, the addition of these respondents created useful information since those respondents possess specific knowledge concerning the subject.

Another critical remark, which is connected to the first one, is that the researcher analysed the interviews to come up with results. The researcher interprets the research, which means that it is a personal interpretation while another researcher may interpret the results differently. To ensure that this personal interpretation was minimised, the interviews were literally transcribed and coded and analysed on the basis of a predetermined coding scheme. Nevertheless, a personal interpretation of the results always remains.

What could be improved is keeping track of the read literature and documents. This relates to maintaining a chain of evidence. The researcher, especially in the beginning of this research, sometimes forgot to write down how a document or article was found and on which date. Moreover, a small part of introduction and methods is based on internal documents. This reduced the transparency of this research.

Epilogue & acknowledgements

To mark the end of this research, I will shortly touch upon what I learned and experienced during this research and say thank you to some people. First, the combination of doing academic research with an internship at Rijkswaterstaat provided useful insights into how theories are brought into practice at Rijkswaterstaat. The combination of doing research and an internship increased my knowledge about spatial planning practice.

Second, conducting interviews improved my practical research skills. Throughout the period of conducting research, the quality of interviews improved. After each interview and after transcribing interviews, I learned at what moment I should dig deeper. Moreover, writing a master thesis in a period of nine months taught me to keep focussed, plan ahead and organize working at Rijkswaterstaat combined with studying.

In the end, writing a master thesis taught me to bring the theoretical course material into practice. Especially subjects such as multi-level-governance and transitions are explained extensive throughout the master. By doing this research, I experienced how these concepts emerge in practice.

Of course, I also want to thank some people. Without these people I would not have been able to finish this research. First, I want to thank Wim Leendertse for supervising me during the process. Without Wim's sharp and critical view, suggestions, and his enthusiastic way of supervising, bringing this research to an end would be complicated. Second, I want to thank Stan Kerkhofs, who provided me with the possibility to be an intern at Rijkswaterstaat and gain experience outside of the academic world. The enthusiasm and helpful attitude of Stan helped me get through the research process. I also want to thank the Low-Tech Campus team, Liesbeth, Jessica, Sjoerdsje and Simone, of Rijkswaterstaat since they all provided me with useful insights. I also want to say thank you to all the respondents of the interviews for making time for an interview. Without the interviews, I would not have been able to formulate the results. Finally, I would like to thank everyone that is involved in the I&W annotation team. The I&W Annotation meetings were helpful to discuss difficulties with writing a thesis and doing an internship. To end the thesis, I of course would also like to say thank you to my friends and family: without your support I would not have been able to get through this research process.

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Appendices

Appendix 1: Interview questions

Appendix 1.1 Citizen interviews

- Jezelf voorstellen, bedanken voor medewerking & rechten opnoemen.
- Introductie uit uitnodiging voorlezen.

Ik zou vandaag graag een aantal onderdelen met u bespreken. Deze onderdelen relateren aan uw kennis over living labs, de verschillende rollen binnen een living lab, wat voor u mogelijk barrières zijn om deel te nemen aan dit project en wat er volgens u nodig is om deelname mogelijk te maken. Dit interview is semi-gestructureerd, wat betekent dat ik vragen heb voorbereid maar er ook ruimte is om andere afslagen te nemen. Als eerste zou ik graag van u weten:

1) Wat is uw relatie tot het opzetten van de LTC bij Kloosters?

Burgerparticipatie in het algemeen

2) In het algemeen hebben burgers weinig inspraak gehad in infrastructurele projecten, welke in het verleden vaak top-down werden uitgevoerd. Inmiddels komt er steeds meer inspraak van burgers en is er bottom-up ontwikkeling. In hoeverre vindt u burgerparticipatie in infrastructurele ontwikkeling belangrijk?
    a. Wat is er volgens u nodig om u als burger meer te betrekken bij bijvoorbeeld de ontwikkeling van wegen?
3) Bij wie ligt de verantwoordelijkheid om burgers te betrekken in infrastructuur ontwikkeling? Die van de burger zelf, die van de overheid of is dit een natuurlijk proces zonder verantwoordelijken?
    a. En waarom ziet u dit zo?
    b. Wat voor rol ziet u voor de overheid, bijvoorbeeld Rijkswaterstaat?

Living lab

4) In hoeverre bent u bekend met het concept van Living labs?
    a. Uitleggen indien nodig wat living labs inhouden.
    b. Als u mee zou doen aan het living lab, wat voor rol ziet u dan voor uzelf?
        i. Iemand die verkent, dus ontdekken en definiëren van de problemen waaraan gewerkt moet worden?
        ii. Iemand die oplossing bedenkt?
        iii. Iemand die de oplossingen ontwerpt en implementeert?
        iv. Of als iemand die het implementeren van innovaties binnen de gemeenschap support en faciliteert?
    c. Zou u op een meer informele manier mee willen doen of op een meer formele manier?
    d. Hoe ziet u het proces van co-creatie en wat denkt u te kunnen bijdragen aan het living lab?

Barrières voor participatie

In dit gedeelte van het interview laten we even los of u wel of niet bereid bent om mee te doen aan het living lab en uw rol hierin. In plaats daarvan nemen we aan dat u bereid zou zijn om mee te doen aan het living lab.

5) Wat voor factoren kunnen er volgens u voor zorgen dat u niet zou meedoen aan een living lab?
    a. Zou u stoppen met participeren als blijkt dat u te weinig kennis heeft van het innovatieproces in het living lab?
    b. Denkt u dat Rijkswaterstaat vanaf het begin al restricties oplegt wat betreft de inbreng van burgers? En ziet u bijvoorbeeld actoren met meer power, zoals Rijkswaterstaat en bedrijven, als obstakel om mee te doen aan het living lab?
    c. Is het een probleem als het probleem al gedefinieerd is door Rijkswaterstaat?
    d. En de houding van Rijkswaterstaat?
    e. Zou u niet deelnemen als u het gevoel heeft dat u specifieke vaardigheden en capaciteiten nodig hebt om deel te nemen?
    f. En wantrouwen? Zou u zich laten stoppen door een wantrouwige houding richting Rijkswaterstaat?
    g. Speelt informatievoorziening van tevoren een rol?
    h. Denkt u dat het nodig is om veel tijd en geld te hebben om mee te doen aan experimenten in een living lab?

Naast dat er barrières zijn, zijn er ook factoren die ervoor kunnen zorgen dat u juist wel meedoet aan het living lab.

6) Welke factoren kunnen er volgens u voor zorgen dat u wel zou meedoen aan het living lab.
    a. Kunt u dit relateren aan de eerdergenoemde barrières?
7) In hoeverre kunt u zich voorstellen dat de volgende factoren ervoor zorgen dat u wel meedoet aan het living lab?
    a. Transparantie van Rijkswaterstaat dat technische skills niet per se nodig zijn?
    b. Wat als Rijkswaterstaat verzekerd dat u echt invloed heeft, realistisch over de verwachtingen is en laat zien dat iedereen evenveel power heeft?
    c. Helpt het als Rijkswaterstaat open en spontaan is? Helpt het als RWS-moeite doet door de tijd te nemen om lokale problemen in de community te begrijpen?
    d. Hoe kan Rijkswaterstaat vertrouwen creëren?
    e. Wat is er volgens u nodig om u van genoeg informatie te voorzien?

Opschalen van innovaties

8) In hoeverre zou u er rekening mee houden tijdens het innovatieproces dat Rijkswaterstaat innovatie moet opschalen en gebruiken in andere gebieden.

Oftewel: zou u er rekening mee houden dat ontwikkelde methodes niet alleen hier van toepassing kunnen zijn maar ook ergens anders?

9) Heeft u zelf nog aanvulling die u graag wilt delen en mogelijk van belang kunnen zijn?

Bedankt voor uw tijd en moeite. Herhalen van afspraken over gebruik van interview in scriptie. Transscriptie opsturen voor fouten en voor goedkeuring.

Appendix 1.2 Rijkswaterstaat/IenW interviews

- Jezelf voorstellen, bedanken voor medewerking & rechten opnoemen.
- Introductie uit uitnodiging voorlezen.

Voordat ik begin met de interview vragen zal ik eerst even vertellen hoe dit interview is opgebouwd. Ik zal beginnen met wat vragen over living labs en de circulaire economie. Vervolgens zal het specifiek gaan over innovaties die bijvoorbeeld in een living lab worden ontwikkeld en hoe deze opgeschaald kunnen worden. Hierin zal ik mij concentreren op bepaalde barrières en condities. De interview vorm is semigestructureerd wat betekent dat ik een aantal vragen heb voorbereid, maar er is ook ruimte om andere afslagen te nemen. Als eerste zou ik graag van u weten:

1) Wat is precies uw functie bij Rijkswaterstaat/IENW?
    a. Welke prioriteiten en verantwoordelijkheden kent deze functie?
    b. In hoeverre bent u bekend met het InnovA58 project?
        i. Nee? Vertellen wat het is.
    c. In hoeverre bent u bekend met het living lab concept?

Living lab bij InnovA58

2) Normaal gesproken wordt een living lab gedefinieerd als een plek waar innovatie en leren centraal staat door te experimenteren. Dit vindt plaats in een real-life context, met verschillende stakeholders (publiek, privaat & burger) die co-creëren.
    a. In hoeverre bent u het eens met deze definitie en zijn er onderdelen van deze definitie die volgens u belangrijker zijn?
    b. Waarom denkt u dat living labs belangrijk kunnen zijn in innovatie en zijn public-private partnerships bijvoorbeeld niet voldoende?

3) In hoeverre is burgerparticipatie belangrijk om innovatie te bereiken?
    a. Wat is de rol van de overheid volgens u in de ontwikkeling van burgerparticipatie?
    b. Hoe kijkt u aan tegen de ontwikkeling van publiek-privaat-burger partnerships en hoe past de ontwikkeling van living labs hierin?
    c. Op wat voor manier dragen living labs bij aan het invullen van de omgevingswet?

4) Burgerparticipatie is een belangrijk onderdeel van het living lab concept. Toch zijn er ook redenen voor burgers om niet mee te doen aan living labs. Wat kunnen volgens u redenen zijn dat burgers niet participeren in een living lab?
    a. Niet bekend met ontwikkelde technieken, restricties vanaf het begin, andere actoren die meer power hebben, te weinig capaciteiten en skills van burgers, burgers die geen tijd of geld hebben of wantrouwen in de overheid?

5) Wat moeten overheden zoals RWS doen volgens u om burgers wel te betrekken in het living lab proces?
    a. Transparantie, openheid, gelijke power, realisme en 'true empowerment', vertrouwen creëren, openheid, investeren in het oplossen van informatie deficits?

Opschalen van living lab innovatie

Zoals omschreven in de achtergrondinformatie kan er spanning zijn tussen burgerparticipatie en innovatie opschaling. Om doelen zoals de circulaire economie te behalen is innovatie nodig. Deze innovaties vinden vaak op lokale schaal plaats maar moeten uiteindelijk opgeschaald worden om bijvoorbeeld circulaire weginfrastructuur te creëren.

6) In hoeverre bent u bekend met innovatie opschaling en wat betekent opschalen volgens u?
    a. Bent u het met mij eens dat innovatie opschalen betekent dat een innovatie wordt uitgerold van een kleine schaal naar de grotere sociale-technische schaal? Dit kan zijn bijvoorbeeld op een grotere ruimtelijke schaal of naar beleid bijvoorbeeld. De innovaties worden geïntegreerd in de organisatie. Institutionele verandering?

7) Kunt u zich voorstellen dat er bepaalde barrières zijn om innovatie op te schalen? En wat voor barrières zijn dit dan?
    a. Contextueel:
        i. Ruimtelijke/institutionele context
        ii. Geen support van de community of van de politiek?
        iii. Beleidsmakers en instituties zoals RWS staan niet open voor innovatie? Is het living lab een alibi activiteit > oftewel: we doen alsof iedereen meedoet maar ondertussen bepaalt RWS nog steeds?
        iv. Fragmentatie binnen de overheid? Dus gefragmenteerde departementen?
        v. Moeilijk om ruimtelijk veranderen op een brede schaal doordat infrastructuur er al voor een langere tijd ligt?
        vi. The gegenereerde innovatie past eigenlijk alleen binnen de plek van het living lab doordat de bredere context wordt genegeerd?
    b. Living lab ontwerp:

i. Leren is gelimiteerd doordat de mensen die betrokken zijn bij het living lab ook nog ander werk doen en daardoor maar gelimiteerd tijd hebben?
ii. Wordt er wel rekening gehouden met opschalen voordat het living lab wordt gebouwd?
iii. Wordt er wel rekening gehouden met bredere ontwikkelingen in de community, cultureel of politiek? Is het belangrijk dat een lab aangepast is aan de specifieke context?

8) Wat is er volgens u nodig om opschaling mogelijk te maken? Dus wat voor condities moeten aanwezig zijn om innovaties op te schalen en de transitie naar een circulaire economie mogelijk te maken?
   a. Helpt het om:
      i. Zo vroeg mogelijk participatie mogelijk te maken?
      ii. Beleidsmakers die van begin af aan betrokken zijn?
      iii. Transparantie en samenwerking tussen verschillende departementen?
      iv. Communicatiestrategie?
      v. Te denken aan effecten buiten het gebied van het living lab?
      vi. Door goed te monitoren wat er aan innovatie gecreëerd wordt?
      vii. Door van het begin af aan flexibel te zijn en duidelijk te hebben wat opgeschaald moet worden?
      viii. Door naast technische innovatie ook formele regels en informele normen te veranderen?
   b. Heeft u buiten de genoemde condities nog aanvullingen? Of vind u dat een bepaalde conditie extra belangrijk is?

9) In hoeverre is burgerparticipatie volgens u belangrijk om het opschalen van innovaties mogelijk te maken? Is de rol van de burger hier überhaupt belangrijk in?
   a. Zo nee:
      i. Waarom is de rol van de burger niet belangrijk in opschaling?
   b. Zo ja: Waarom is de rol van de burger juist belangrijk in opschaling?

10) In hoeverre denkt u dat er spanning zit tussen innoveren met burgers en het opschalen van innovaties?

11) Heeft u verder nog aanvullingen die interessant kunnen zijn voor mijn onderzoek of misschien mensen waarvan u denkt dat die een bijdrage kan leveren aan mijn onderzoek?

- Bedankt voor uw tijd en moeite. Herhalen van afspraken over gebruik van interview in scriptie. Transscriptie opsturen voor fouten en voor goedkeuring. Ook formulier opsturen waarop kan worden aangegeven of iemand anoniem wil blijven.

Appendix 2: overview of respondents

Code & interview date	Organization & Organizational unit / Citizen	Department/ function	Information
Respondent 1 6 May 2021	Rijkswaterstaat Water, Verkeer en Leefomgeving	Directie Leefomgeving	The Leefomgeving department is concerned with three main subjects. These three subjects are: The New Environmental Planning Act, sustainable living environment and circular infrastructure. These three topics are connected to the InnovA58 project.
Respondent 2 11 May 2021	Rijkswaterstaat Zuid Nederland	Smartwayz	Smartwayz is a collaboration program in which Rijkswaterstaat participates. The program is directly involved in the InnovA58 project. Since the InnovA58 project is located in the South of the Netherlands, the project belongs to the 'Zuid Nederland' department. This department is directly involved in the InnovA58 project. The interview with this department is especially useful to discuss the barriers and conditions connected to innovation upscaling and the tension between innovation upscaling and citizen participation.
Respondent 3 6 May 2021	Rijkswaterstaat Grote Projecten en Onderhoud	Innovatie en Markt	Directly involved in the InnovA58 project. The ''Innovatieloket'' selects initiatives to participate in the InnovA58 living lab. Therefore, the interview with someone from this department is useful to discuss to what degree innovation upscaling plays a role in selecting the initiatives and what conditions and barriers are in play in relation to upscaling.
Respondent 4 26 May 2021	Rijkswaterstaat Grote Projecten en Onderhoud	Projectsturing	The department 'projectsturing' is directly involved in the InnovA58 project. The department is responsible for managing the project.
Respondent 5 20 May 2021	Rijkswaterstaat Corporate Dienst	NOVA discovery	Concerned with citizen participation and innovation and the challenge of how to involve citizens in innovations and transitions.
Respondent 6 10 May 2021	Ministry of IenW Directie Duurzame Leefomgeving en Circulaire economie	Innovatie in Mobiliteit	The Innovatie in Mobiliteit department is concerned with fostering innovations in mobility in the Netherlands. The department is doing pilots and experiments to achieve innovations, which need to be implemented into policies at the Ministry of IenW.
Respondent 7 18 May 2021	Ministry of IenW Directie Duurzame Leefomgeving en Circulaire Economie	Directoraat-generaal Milieu en Internationaal	Concerned with pushing the circular economy and ensuring that innovations are embedded into policies at the ministry of IenW.
Respondent 8 7 May 2021	Ministry of IenW Directie Kennis, Innovatie en Strategie	Innovatie	The KIS Department focuses on long-term policy at the ministry of IenW. The department collaborates closely with Rijkswaterstaat to make policies executable. Especially the Innovation unit within KIS is concerned with infrastructure renewal.
Respondent 9 19 May 2021	Ministry of IenW Directie Participatie	Participatie	An interview with the Directie Participatie is used to research the barriers and conditions for citizen participation. This department of the Ministry of IenW is concerned with fostering citizen participation in infrastructure project.
Respondent 10 26 May 2021	Citizen	[redacted]	Citizen who is connected to the LLIADB or the InnovA58 living lab and possibly wants to participate. Accessed through the 'omgevingsmanagement' of Rijkswaterstaat.
Respondent 11 3 June 2021	Citizen		Citizen who is connected to the LLIADB or the InnovA58 living lab and possibly wants to participate. Accessed through the 'omgevingsmanagement' of Rijkswaterstaat.
Respondent 12 2 June 2021	Citizen		Entrepreneur who is connected to the LLIADB or the InnovA58 living lab and possibly wants to participate. Accessed through the 'omgevingsmanagement' of Rijkswaterstaat.
Respondent 13 30 April 2021	Citizen		Farmer who is connected to the LLIADB or the InnovA58 living lab and possibly wants to participate. Accessed through the 'omgevingsmanagement' of

		[redacted]	Rijkswaterstaat.
Respondent 14 2 June 2021	Citizen		Citizen who is connected to the LLIADB or the InnovA58 living lab and possibly wants to participate. Accessed through the 'omgevingsmanagement' of Rijkswaterstaat.

Appendix 3: Coding scheme

The table below shows the coding scheme that was used to analyze the interviews. Atlas.ti was used for coding. The column 'category' in the table corresponds with a code group in Atlas.ti. The column code corresponds with the different codes that were part of the code group. The definition shortly defines the code and provides some sub-codes that were used in Atlas.ti.

Category	Code	Definition
Living lab	Definition	Statements regarding what a living lab is, such as co-creation, experimentation, real-life context, multi stakeholder participation.
	Living lab importance for innovation	Statements about the importance of establishing living labs to achieve innovation, such as completing goals or Rijkswaterstaat is unable to innovate on its own.
Upscaling in general	Definition	Statements regarding what upscaling is, such as replication, transformation or diffusion.
	Upscaling difficulty	Statements regarding the difficulty of upscaling living lab innovations.
Upscaling barriers living lab design	Limited Learning (D)	Statements regarding the limited learning in a living lab, such as people having other duties.
	Poor timing (D)	Statements regarding the poor timing of a living lab, such as assuming that the experiment takes place in a vacuum.
Upscaling barriers living lab context	Stakeholder receptiveness (D)	Statements regarding the stakeholder receptiveness of innovations from a living lab, such as political support.
	Institutional receptiveness (D)	Statements regarding the institutional receptiveness, such as a specific way of working or frameworks in the organization which do not allow implementation of innovation.
	Fragmentation (D)	Statements regarding fragmentation within Rijkswaterstaat or the Ministry of IenW, such as different departments being involved.
	Sticky Urban assemblage (D)	Statements in relation to legal, financial, infrastructural and technical aspects, which make upscaling difficult.
	Limited representativeness (D)	Statements about the representativity of innovations of a living lab, for example producing knowledge that is only applicable to one specific living lab or the specific scale of the living lab.
	Exchange between living labs (I)	Statements regarding the lack of exchange between living labs which makes innovation upscaling difficult.
	Complicatedness of circularity (I)	Statements regarding the complicatedness of the circularity concept, which makes upscaling difficult.
	Ownership (I)	Statements in relation to the ownership of the innovations created.
Upscaling conditions living lab design	Learning Strategy (D)	Statements regarding implementing a learning strategy, for example ensuring that everyone knows what to do with the innovations or ensuring everyone is busy with learning on the front side.
	Upscaling strategy (D)	Statements regarding implementing an upscaling strategy, such as in the beginning deciding what you want to upscale.
	Visuals (I)	Statements that mention the importance of creating visuals that are understandable to a large audience to enable upscaling.

Upscaling conditions living lab context	Institutional transformation (D)	Statements about for example changing regulations and working methods to enable innovation upscaling.
	Cross-sectoral collaboration (D)	Statements regarding cross-sectoral collaboration, such as inviting employees from different departments and organizations.
	Diverse group of stakeholders (D)	Statements mentioning inviting a diverse group of stakeholders to enable innovation upscaling.
	Pacemakers (I)	Statements mentioning the importance of having a pacemaker in the living lab that is able to spread the innovations.
	Customization (I)	Statements about customizing the context to enable upscaling, for example requesting an emergency procedure.
Citizen participation	Importance (D)	Statements regarding the importance of involving citizens in infrastructure planning via a living lab, such as increasing creativity.
	Responsibility (D/I)	Statements regarding the responsibility of who should facilitate participation, for example a shared responsibility or the government, but also the role of the government in participation.
	Citizen Role (D)	Statements regarding the role that citizens can have in a living lab, for example an explorer, ideator or diffuser.
Participation barriers	Restrictions from the start (D)	Statements mentioning restrictions from the start as barriers for participation, such as Rijkswaterstaat having frameworks for participation or a set problem.
	Selectivity (D)	Statements mentioning selectivity as a barrier for participation, such as having no time or money.
	Capacity and skills (D)	Statements mentioning having no knowledge or skills in relation to the subject of the living lab.
	Distrust and principal agent problem (D)	Statements mentioning factors such as distrust in Rijkswaterstaat or other parties and having not enough information as barriers for participation.
	Privacy (I)	Statements mentioning privacy as a barrier for participation, which makes it for example difficult to approach participants.
	Other (I)	Statements mentioning other barriers for participation, for example having formal responsibilities, cold water freeze, citizens being too far away from practice or having false expectations.
Participation enabling conditions	Transparency (D)	Statements mentioning transparency as an important enabling condition for participation, such as being transparent about the possibilities of co-creation.
	True empowerment (D)	Statements mentioning true empowerment as a condition, such as having equal power and the ability of citizens to make decisions.
	Openness (D)	Statements mentioning openness as a condition, such as the possibility for everyone to participate.
	Realism (D)	Statements mentioning realism as a condition, such as managing expectations and being realistic about the possibilities of innovating.

	Continuity (D)	Statements mentioning continuity as conditions, such as having short lines between the initiators and the citizens and collaboration between different stakeholders.
	Trust creation (D)	Statements mentioning trust creation as an important condition for participation.
	Appreciation (I)	Statements mentioning the initiator showing appreciation for participation, for example providing money or food.
	Giving feedback (I)	Statements mentioning the importance of giving feedback to citizens as condition for participation, such as letting citizens know afterwards what happened with the innovations but also
	Intrinsic motivation (I)	Statements mentioning that the conditions for participation are not only important, but also intrinsic motivation as important conditions for participation, such as entrepreneurship.
	Independent experts (I)	Statements mentioning the importance of having an independent expert leading the process instead of the initiator.
	Governmental effort (I)	Statements mentioning the effort of governmental organisations as important conditions for participation, such as having equal time investment and the government showing effort to allow co-creation.
Other	Combination citizen participation and upscaling (I)	Statements about the relationship between upscaling and citizen participation, such as strengthening the transition, creating support base, an indispensable relationship or increasing representativity of innovations.
	Interesting quotes	