The influence of Urban Living lab characteristics on the co-creation between science and policy in the Kenniswerkplaatsen Rotterdam

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Abstract

Contemporary assemblages of multiple actors seeking to intervene and address current urban challenges, are popping up in cities all over the world. These so-called 'Urban Living labs' differ widely in contexts, yet all sharing the same goal of 'co-creation' between public and knowledge institutions, private bodies and civil society. The aim of this research is to understand the influence of the diverging characteristics of Urban Living labs on the co-creation between science and policy. A multiple case-study is conducted, researching three cases in Rotterdam where science and policy interact, called 'kenniswerkplaatsen', each case with different research contexts and participant constellations. The Urban Living lab characteristics of Steen & van Bueren (2017) (context, aim, participants and activities) have been used as overarching characteristics. Which, in combination with the co-creation phases (co-design, co-production and co-dissemination) of Mauser et al. (2013) serve as foundation to gain insight in the process of co-creation in the 'kenniswerkplaatsen'. The governance network theory on complexities of Klijn en Koppenjan (2016) thereby added an extra layer of understanding by exposing the dynamics and integration between interdependent participants in a collaboration whilst co-creating.

The research comes to show that the characteristics 'aim', 'research context' and 'finance' substantiate who is considered an (end) user in the Urban Living lab and, building subsequently, which level of ownership and roles the participating groups have in the different phases of co-creation. In a Triple Helix model of innovation, where interaction takes place between the university, industry and government, both the composition of participants - especially the inclusion of businesses - and the research context of engineering - which seems to have less affinity with the policy realm and tradition in actor orientation - have a diminishing role on the co-creation between science and policy. By adding actors of the civil society as participant, the Urban Living lab in the Quadruple Helix model of innovation in the research context of social sciences, achieves the highest level of co-creation by including the civil society as end-users in all co-creation phases. However, the most complexities occur in this collaboration as well. A general reasoning can be that including citizens in an Urban Living lab is a difficult endeavour. Moreover, partially case-specific reasons are found in the coordination of the Urban Living lab, in not being allocated financial compensation for carrying out the research and in the implications of being entirely dependent of an external subsidy giver. In the Urban Living lab with solely science and policy actors, also operating in the research context of social sciences, more integration and less complexities are found. However, in this science-policy interface there is less co-creation and no collaboration with civil society and their expected user, being citizens, by which it is questionable if this Urban Living lab adequately serves the aim of an Urban Living lab being user-centred. These and other debates are touched upon in the final chapter of the research, giving insight in the implications and limitations of the research, and providing suggestions for further research.

Preface

Last year, dating November 2020, I was at a conference for my student job at the 'LDE-minor Smart and Shared Cities'. Here, I attended a presentation of the project 'Evaluating Societal Impact' at the Erasmus University, which caught my interest. During my bachelor Industrial Engineering (Technische Bedrijfskunde) I learned a lot on steering mechanisms and indicators for industrial business process. At the time my interest in the public sphere drove me to commit myself more to contributing to civic goals also in my studies. Firstly within my bachelor, for instance by doing an internship in a hospital, and later through a pre-master and master in Public Administration. To my surprise, I learned the public sector often applies similar steering mechanisms including causing the perverse implications of them. Raising questions on how this should be done different and better for the public sector, led me to where I am now; presenting my master thesis which combines my interest for collaboration in general and specifically in the public sector, organisational sciences, science and education, public policy and urban societal challenges.

Yours sincerely,

Naomi

Table of Contents

Introduction

The urban realm is increasingly confronted with multidisciplinary and intertwined societal problems, such as urbanisation and climate change. These problems are complex and not easily solved since information and knowledge on the nature of the problem is lacking and perceptions on the nature of the problem itself can differ. To tackle these compound problems, innovative solutions ought to be sought and various resources owned and controlled by different actors are needed (Klijn & Koppenjan, 2016). Collaboration between actors across institutional boundaries is beneficial as it improves coordinating activities, knowledge management and the acceptance of policies (Emerson & Nabatchi, 2015). Along with recognition of the benefits, networks in which interdependent actors interact and collaborate are increasingly present in the urban sphere (Torfing, 2012).

In line with the increase in demand for (evidence of) valuable research from policymakers and society on complex societal issues, collaboration between academia and policy makers has become salient (Smit & Hessels, 2020). According to Mauser et al. (2013) contact between academia and other societal actors has traditionally not been close, due to which no blueprint exists for the integration of knowledge between academia and other societal actors. The past ten years, the city of Rotterdam increasingly seeks collaboration in the so-called 'kenniswerkplaatsen'. These are set up with the intention to bring science and practice closer to each other and underpin municipal policy with more knowledge. The 'kenniswerkplaatsen' are a plurality of networks, organised around diverging contemporary urban challenges, with multiple actors, in different research contexts.

Contemporary assemblages of multiple actors seeking to intervene and address current urban challenges are often designated as 'Urban Living labs (ULLs)' (Burkeley et al., 2016). These spaces of collaboration are popping up in cities all over the world (Steen & van Bueren, 2017) and differ widely in for instance target groups, use of methods and research contexts in which it operates (Hossain et al., 2019). Yet their shared primary focus is on learning and knowledge generation through so-called 'co-creation' between public and knowledge institutions, private bodies and civil society (Puerari et al., 2018). Co-creation describes the process in which a constructive exchange takes place of knowledge, resources, competences and ideas between multiple participants in order to solve a shared problem, challenge or task (Torfing, Sørensen & Røiseland, 2019).

Despite their rapid development, it remains unclear how different properties of ULLs influence the process of co-creation. And notwithstanding some significant theoretical and empirical explorations of the ULL concept, the question of how co-creation actually takes place within ULLs remains understudied (Puerari et al., 2018).

This calls for an exploration of the relationship between the context of the ULL, its participants and the meaning structures at play within them (Hossain et al., 2019). Also, to systematically explore their variation and effects, a comparative perspective on the concept and the process of co-creation by ULLs is warranted (Jukić et al., 2019).

Considering these knowledge gaps and calls for research, this study aims to catalogue and explain the influence of ULL characteristics on the co-creation between science and policy that happens within them. This implies systematically identifying the relationships between the contexts and the processes of co-creation in the ULL. To reach these aims, the main research question guiding this thesis is formulated as follows.

"How do the characteristics of Urban Living labs in Rotterdam (Kenniswerkplaatsen) influence the co-creation between science and policy that happens within them?"

The research question is split up in the following theoretical and empirical sub questions on the characteristics of Urban Living labs and the process of co-creation:

Theoretical sub questions:
1. What are the characteristics of Urban Living labs?
2. How can the process of co-creation between science and policy be defined?

Empirical sub questions:
4. How do the ULL characteristics manifest themselves in Rotterdam practice?
5. How does the process of co-creation between science and policy manifest itself in Rotterdam practice?

By studying the influence of the context of ULLs with its characteristics on the primary goal of co-creating knowledge, this research seeks to contribute to our lack of understanding (Voytenko et al. 2015) of the role that ULLs can or should play in urban governance. Furthermore, this study provides a much needed nuance in our understanding of ULL design across diverging research contexts (Franz, Tausz & Thiel, 2015). This nuance is achieved by conducting a multiple case-study that enables us to explain the influence of the research context, as one of the ULL characteristics, on the co-creation between science and policy.

By unravelling the implications of the context, this thesis can help the city of Rotterdam to deploy ULLs (kenniswerkplaatsen) more effectively as a means of tackling urban challenges. But it can also provide insights for other cities interested in evidence-based policies. Furthermore, this research will explain the development and diffusion of knowledge between academia and parts of society, by which central activities in today's knowledge-based economy can be better understood (Mascarenhas et al., 2020).

In accordance with these objectives, this thesis is structured as followed. The next chapter will set out the theoretical framework of this research. Thereafter, the research methods used will be elaborated upon. Whereafter, the research results on Urban Living lab characteristics in the 'Kenniswerkplaatsen' in Rotterdam will be set out and co-creation process therein. Followed by an analysis on the influence of the characteristics on co-creation. In the final chapter, the conclusion will be drawn and a discussion will take place.

2. Theoretical framework

This chapter explores the theoretical concepts used in this research, answering to the two theoretical sub questions as defined in the introduction. Firstly, the characteristics of ULLs are explicated, after which the concept of co-creation is further expanded upon. From the theory, it will become clear that co-creation is not a linear nor straightforward concept, as it consists of interaction, people and (im)balances of power. Three phases of co-creation are distinguished - co-design, co-production and co-dissemination - which can be seen as prerequisites for a holistic approach to co-creation. Achieving co-creation in all three phases brings with it certain complexities. Even though these complexities will always be present to some extent, the types and levels of complexity vary. To understand how the variation in characteristics among ULLs affect co-creation, specifically zooming in on science-policy relations later on in this report, it is useful to distinguish which types of complexity exist, and how they may be understood with reference to better or worse functioning of co-creation networks.

Co-creation in the New Public Governance paradigm

Public administration experienced three paradigms of execution from the late nineteen century onwards, namely Traditional Public Administration, New Public Management and New Public Governance (Hughes, 2003; Milward & Provan, 2000; Osborne, 2006; Torfing, Sørensen & Røiseland, 2019; Klijn & Koppenjan, 2016; Levi-Faur, 2012). New Public Governance suggests a holistic answer to critics of the other paradigms (Osborne, 2006). The premise is that societal problems we are facing today cannot be solved solely by the government as it did in Traditional Public Administration. Different participants with various resources are required to find solutions to these problems (Klijn & Koppenjan, 2016). To prevent the possible perverse effects and accountability problems of New Public Management, the New Public Governance paradigm does not place the government at a distance but plays a role in the implementation by means of collaborating in a more horizontal cooperative manner (Lynn, 2012). Nowotny, Scott & Gibbons (2001) argue that knowledge has changed in character, from reliable knowledge to relational and process-oriented knowledge; the so-called socially robust knowledge. By the increased focus on social robustness in research, new institutional designs have come to a rise, often transdisciplinary in character and thus including multiple stakeholders (Wehrens, Bekker & Bal, 2010).

The concept 'co-creation' expresses the core aspects of New Public Governance, being the collaborative interactions in networks and partnerships which comes with a shift in the preservation of policy making and public service delivery (Torfing, Sørensen & Røiseland, 2019). According to Levi-Faur (2012) the concept "governance" manifests itself in the literature in at least four meanings: as a structure, process, mechanism and strategy. The concepts of Urban Living labs and co-creation can be placed within the paradigm of New Public Governance, in which the structure of the Urban Living lab influences the process of co-creation between science and policy. Hereafter, this theoretical framework will set out characteristics in the Urban Living lab structure. Next, the dynamics between science and policy actors whilst co-creating will be delved into and drivers and barriers will be defined.

2.1. The characteristics of Urban Living labs

David Guston, in 1999, coined the interface between science and policy as a 'boundary organisation' to mediate, address and meet multiple accountability demands of both the sides of science and policy. The concept does however not refer to any specific form of organisation and does not per se give any guidance about how to organise science-policy interplay (Gustafsson & Lidskog, 2018). Therefore, this research further explores the concept of Urban Living labs, which is both specifically used for the science-policy interface and considered an expanding concept for collaborative forms where connections among actors can be established and boundaries between sectors, interests and contexts can be bridged. Puerari et al. (2018) also used the concept Urban Living lab to research organisational forums between science and policy in Rotterdam.

The term "Living Lab" was for the first time used to indicate the *in situ* nature of different types of research which takes place in a live context. In this initial definition a research methodology for complex solutions in real life contexts is included. Furthermore, (end) users are seen as co-producers who give shape to the context (Ballon & Schuurman, 2015). Bergvall-Kåreborn et al. (2009) therefore conceptualise a living lab as a methodology and an environment in which user participation is organised for innovation processes. Academia however acknowledge the diversity in conceptualisations, since it has been considered a methodology, an environment and a governance approach (Bergvall-Kåreborn et al., 2009; Hossain et al., 2019; Voytenko et al., 2015; Steen & van Bueren, 2017). Therefore, Hossain et al. (2019), Voytenko et al. (2015), Steen & van Bueren (2017), McLoughlin et al. (2018), conducted a systematic literature review, from which insights will be further elaborated upon.

Voytenko et al. (2015) suggest ULLs as spaces where context and research processes interact. The characteristics the authors describe are "geographical embeddedness, experimentation and learning, participation and user involvement, leadership and ownership, and evaluation and refinement" (Voytenko et al., 2015). Hossain et al. (2019) similarly view ULLs as spaces where various stakeholders come together for collaboration, collective ideation and social innovation. Even though Hossain et al. (2019) state that living labs differ widely in their use and methods, their literature review revealed eight characteristics (i) real-life environments; (ii) stakeholders; (iii) activities; (iv) business models and networks; (v) methods, tools and approaches; (vi) innovation outcomes; (vii) challenges; and (viii) sustainability. Steen & van Bueren (2017) have done a literature review on Urban Living lab articles as well as an empirical study assessing 90 innovation projects in the city of Amsterdam. The authors found that many articles adopt existing definitions as the one of the European Network of Living labs (ENoLL): "Living labs are defined as user-centred, open innovation ecosystems based on systematic user co-creation approach, integrating research and innovation processes in real life communities and settings" (ENoLL, 2016). Steen & van Bueren (2017) define four dimensions in which ULL characteristics can be placed, namely; context, aim, participants, context and activities.

When comparing the three sets of characteristics, the one by Steen & van Bueren (2017) is considered the most overarching. Characteristics of the other two sets are subordinated to this set. The distinguished characteristics will each be considered below.

Context

The context in which ULL activities exist in the context of innovation, can firstly be territorial or space-bound (Steen & van Bueren, 2017; Voytenko et al., 2015; Hossain et al., 2019). Also, the scientific orientation and knowledge object of the ULL creates the context (Franz, Tausz & Thiel, 2015). In other words, the context is largely made up of the physical place, location, and scientific domain of the Urban Living Lab.

Aim

Living labs are typically discussed under the open innovation and user innovation paradigms (Hossain et al., 2019). Open innovation suggests that organisations acquire knowledge from external sources since they cannot entirely rely on their own research and development alone. In open innovation networks different stakeholders come together to collaborate and innovate jointly. In this spirit, ULLs facilitate collaboration between actors. User innovation indicates a shifting of innovation towards the users, thus co-creating with them (Hossain et al., 2019). Both the open innovation and user innovation paradigm can be recognised in the widely adopted ENoLL definition. Furthermore, the aim of specifically "Urban" Living labs, is to find local sustainable solutions addressing wicked problems that tend to be universal within cities (Steen & van Bueren, 2017).

Participants

The concept of ULLs assumes that innovation takes place between the various participants, rather than only focusing on innovation activities within an organisation (Hossain et al., 2019). Co-creation between participants is therefore a core activity to enable innovation and involvement of stakeholders, an integral part of the development and innovation process in living labs (Steen & van Bueren, 2017). Some authors see Urban Living labs as partnerships where universities play a key role in co-creation between sectors (Mascarenhas et al., 2020; Evans & Karvonen, 2010, in Voytenko et al., 2015), whereas others consider living labs more as supportive tools for private actors and industry to help their services, products and technology further.

The Triple Helix model of innovation identifies the interactions between three sectors, also called the "helices" university, industry and government (Crayannis & Campbell, 2012). An extension of the Triple Helix model is the Quadruple Helix model in which the fourth helix 'civil society' is added. In this model, government, academia, industry and civil society as key actors promote a democratic approach to innovation which results in "socially accountable policies and practices" (Crayannis & Campbell, 2012, p.1). By which user involvement, meaning the involvement of citizens as users has

become more central in this model (Menny et al., 2018). By focusing on civic or urban innovation, the public elements of urban innovation are strengthened (Voytenko et al., 2015).

This research focuses on the role of science and policy in co-creation; therefore, it is useful to understand these roles in ULLs more in-depth from a theoretical angle. A study by Heijden (2015) shows that the role of the municipality is crucial and makes the difference between "good and bad performance" in a network (van der Heijden, 2015, p. 304, in Kronsell & Mukhtar-Landgren, 2018). Kronsell & Mukhtar-Landgren (2018) specifically researched the role of municipalities in multi-actor collaborations and concluded that the municipality has the capacity and will to organise the funding, and to initiate and sometimes govern the collaboration in Urban Living labs. The roles municipalities take up differ between Urban Living labs but also within Urban Living labs over time and between parts in the municipality. Nevertheless, Kronsell & Mukhtar-Landgren (2018) defined three ideal roles the municipality can take up being the promoter, enabler and partner. The promoter is the most active role of the municipality, in which initiation and facilitation lays with them. The municipality has a credible and legitimate role and therefore the role of promoter is mostly seen when the policy area in place is related to urban affairs or commitments (Kronsell & Mukhtar-Landgren, 2018). The enabler role is different from the promoter role in terms of how actively tools are applied. In this role the municipality can open up, enable, opportunities of collaboration without having an explicit leading role. In the role of partner, the municipality does not have authority or a leading role in the collaboration, but is an equal partner in relation to other actors. The authors also found the municipality in some cases as non-role. This happened when the context was not clearly related to the municipal nature, such as technical innovations. Secondly, this can happen when private, or regional or state institutions substituted the role of the municipality.

Activities

Since the primary focus of Urban Living Labs is on learning and knowledge generation through co-creation between public and knowledge institutions, private bodies and civil society (Puerari et al., 2018), the activities are also centred on learning and knowledge generation between the participants of Urban Living labs. Co-creation within the development process is the key element of the activities in ULLs (Steen & van Bueren, 2017). Voytenko et al. (2015) specify experimentation as a key process in which innovation and learning are explicit, specified and directed rather than secondary effects. This sets urban laboratories apart from more general policy experiments (Bulkeley & Castan Broto, 2013, in Voytenko, 2015).

Hossain et al. (2019) distinguish two categories in diverse innovation activities, namely exploration and exploitation. Exploitation activities concern, amongst others, targeting efficiency and implementation, whereas exploration is about capturing, discovering and creating new knowledge and competences. These are important activities since complex urban challenges are encountered,

information and knowledge on the nature of the problem is often lacking and furthermore, perceptions on the nature itself between participants can differ. Participants should develop problem definitions and solutions in ULLs.

Multiple authors stress the importance of the development process being iterative. Voytenko et al. (2015) define it as an Urban Living lab characteristic 'evaluation and refinement' from their empirical analysis. The argument is that by evaluating, goals, methods and visions can be refined and better in line with the needs of the user. Torfing Sørensen & Røiseland (2019) state this can be done through continuous improvement of outcomes of the collaboration or through innovative step-changes.
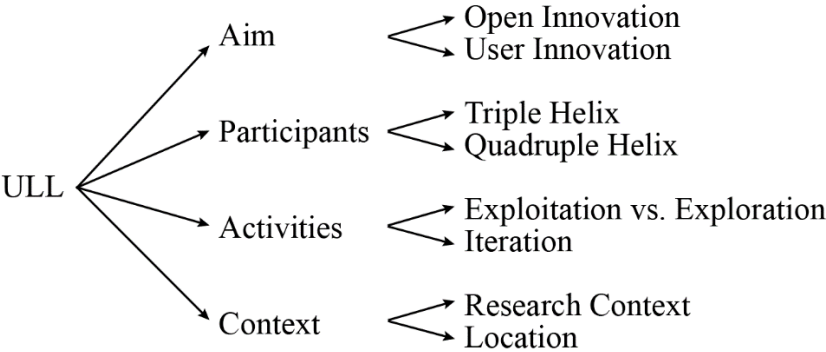
Figure 1: Tree of Urban Living Lab Characteristics

2.2. The process of co-creation between science and policy

As indicated previously, co-creation is a core activity in Urban Living labs, for which the characteristics are presented in the previous paragraph (Steen & van Bueren, 2017). Torfing, Sørensen & Røiseland (2019) define the emerging phenomenon as follows, the defined characteristics of Urban Living labs are added in the definition within brackets:

"*a process through which two or more public and private actors* (participants) *attempt to solve a shared problem, challenge, or task* (aim) *through a constructive exchange of different kinds of knowledge, resources, competences, and ideas … , either through continuous improvement of outputs or outcomes or through innovative step-changes* (activities)*" (Torfing, Sørensen & Røiseland, 2019, p. 802*).

The concept of co-creation is often entangled with the concept of co-production. Voorberg et al. (2014) conducted a systematic review to increase understanding of the literature on co-creation and co-production and concluded that the two concepts are used interchangeably in literature. The concepts are not easily distinguishable thus, both empirically as well as theoretically. Nevertheless, nuance can be found with co-production, as a substage of co-creation, focusing more on the appliance of different resources and capabilities of users and providers rather than a broader range of actors who interact and

develop new disruptive ideas and create public value (Torfing, Sørensen & Røiseland, 2019). As such, both concepts will be used in the empirical study hereafter.

Science and policy

Science and policy are domains which are increasingly intersecting, before one considered the domains of science and policy more as two separate domains, isolated from each other (Van den Hove, 2007). Researchers and therefore knowledge institutes are increasingly asked to deliver "socially robust knowledge" by also considering the demands from societal actors (Wehrens, Bekker & Bal, 2014). Policymakers are increasingly asked to conduct evidence-based policy-making (Mascarenhas et al., 2020). The domain of policy expects scientists to perform the task of producing policy-relevant knowledge in a specific way for a specific issue. Simultaneously, the policy domain and actors within are expected to facilitate constructive research possibilities for the science domain (Gustafsson & Lidskog, 2018). Science and technology studies (STS) is an interdisciplinary research field which perceives science and society as intersecting entities. The idea is that the socio-political and institutional setting shapes the science produced, validated and used, whereby simultaneously science also stabilises these contexts. Within STS, co-production is considered the theoretical lens through which these relationships between science and governance are examined.

Phases of co-creation

Mauser et al. (2013) underline the need for interactive processes when co-creating knowledge and articulate the following three stages to do so: co-design, co-production and co-dissemination.

In the first stage, co-design, participants create a common understanding of, and an agreement on the sort of knowledge questions that need to be addressed. By which an establishment takes place of common understanding of the research goals. Furthermore, the role of different groups in the further process to reach the research goals are agreed upon. Mauser et al. (2013) use the term sectoral integration through which the research agenda is set. Mutual and joint framing is herein important. In the second step, the co-production phase, the actual research is conducted. In this phase a continuous dialogue and exchange takes place between researchers and the other participants. The authors call this scientific integration through which the societal relevance of the research and scientific quality is ensured. Arriving at the last phase of co-dissemination in which results are spread among different societal groups. Hereby, it is important that the results are translated in a comprehensible manner with accessible language, by which information is useful for the different stakeholders. On the value, usefulness and applicability an open discussion should take place among groups with various and possibly conflicting interests. From this discussion new research questions will derive, on which common understanding needs to be sought, creating input for the next research cycle and co-design phase within. Therefore, making the process iterative.

Dynamics and complexities co-creation

Often not adequately attention is paid to the power within science-society relations when co-creating (Cleaver & Whaley, 2018). Torfing, Sørenson & Røiseland (2019) agree that a risk of co-creation is that certain groups can gain more influence by attaining more resources, knowledge and time. According to the authors especially in public problem solving, where a dispersed range of stakeholders interact in a context with not a lot of routine and structure. Thus, the dynamics between participants, in this case primarily science and policy actors, can influence co-creation. The aim, (research) context and activities create the structure in which co-creation takes place and may influence the dynamics between participants, co-creation itself or both. Since collaboration and interaction foster co-creation, theories on network governance will be explored to better understand these dynamics and complexities that may occur when participants collaborate.

Participants who collaborate in a network when solving wicked problems have various perceptions and interests whilst interacting with each other. These different interests and perceptions can cause complexities during interaction, collaboration and decision-making processes (Klijn & Koppenjan, 2016). To get insight in the various complexities that can occur when a wide diversity of interdependent actors interact, Klijn & Koppenjan (2016) differentiate three complexities, namely substantive, strategic and institutional complexity. Substantive complexity occurs when collaborating actors have diverging perceptions on the problem at hand or have difficulties with understanding the nature of the problem in the first place. Problems are formulated according to perceptions of actors on what makes a situation problematic and can therefore be seen as a social construct and be subject to discussion. The definition of the problem determines the scope in which solutions are sought and therefore allocates power. When collaborating actors have divergent perceptions, the problem definition can therefore become subject to conflict (Klijn & Koppenjan, 2016). The co-design phase of co-creation of Mauser (2013), where the knowledge agenda and questions are formulated, is therefore an important step not only in the further course of the phases but also on the power and ownership different participants have. Buuren & Edelenbos (2004) also consider the process of formulating the research question as great importance for the outcomes of the research and acknowledge that the research agenda and the research design is not something that has been set in advance but is the result of a process of discussion and negotiation between different participants. To have a successful co-design phase, common understanding and agreement on the research goals and knowledge questions between participants needs to be reached. Alignment of perceptions are therefore necessary and can be reached by awareness of each other's perceptions and the perceived input of one another (Klijn & Koppenjan, 2016). Besides it being difficult to reach mutual agreement when diverging perceptions are in place, strategic complexities can occur when various interdependent parties interact, each with their own objectives and strategies. What direction the interaction process takes is hard to predict since each participant constantly reacts to strategies of other participants before positioning themselves. When there is a growing consciousness of one another's involvement and their mutual dependencies, predictability

can be enhanced. Growing consciousness can become visible in the perceived benefits of the collaboration and the perception of the interdependency between actors in the network (Klijn & Koppenjan, 2016). All these participants come from their mother organisations, all functioning according to their own formal and informal rules. As an illustration Buuren & Edelenbos (2004) state that every knowledge institute already has their own epistemological system in which is set how they perceive serving the user of knowledge, how they perceive their image of interdependence and credibility in the academic community. When interacting with other knowledge institutes and actor groups, this can cause institutional complexities when their rules are conflicting with each other or the rules are unclear. Since participants need to make joint rules to let the collaboration function. The way in which these complexities are overcome can be seen in the degree in which parties have developed enduring relations, joint perceptions and institutional rules to support their interactions in the ongoing future (Klijn & Koppenjan, 2016).

Figure 2 shows the conceptual framework of this thesis. The characteristics of Urban Living labs (Steen & van Buuren, 2017) influence co-creation process and their different phases (Mauser, 2013). When interdependent participants with diverging perceptions, goals and institutional rules interact complexities can occur, which can have an effect on co-creation processes and vice versa (Klijn & Koppenjan, 2016).
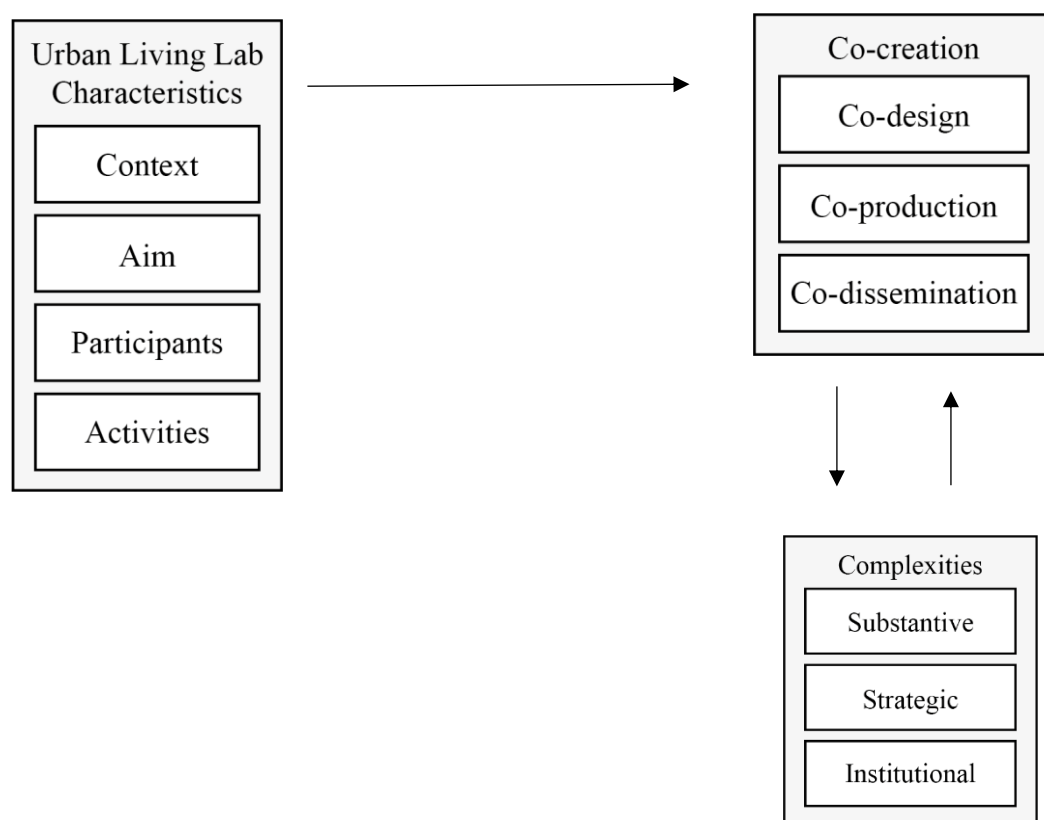

Figure 2: Conceptual framework

3. Methodology

The methodology of this study is mainly qualitative. Understanding the processes of co-creation and the influence of the Urban Living lab characteristics is closely related to researching the dynamics of different visions of the main stakeholders involved. To apprehend the mechanisms behind the visible surface it seems most suitable to do an in-depth analysis; on the basis of document analysis and qualitative open-ended interviews. This chapter provides further methodological justification of these choices. The decisions made regarding case selection, respondents and data collection methods are elaborated upon. Furthermore, this section will reflect on the validity, reliability and ethical aspects of the research.

3.1 Research design: multiple case study

This research will use a multiple case study as the prime medium for analysis. According to Yin (2009) a case study should: concern a contemporary phenomenon within its real-life context and have unclear boundaries between a phenomenon and context. Additionally, the researcher should not have influence on the events studied. This research fits these criteria. Urban Living labs and the science-policy interplay, is a current day phenomena. Thereby, the research question aims to explain the phenomenon (co-creation) in a context (kenniswerkplaats Rotterdam) between which the boundaries are not clearly distinguishable. Finally, the researcher in question cannot influence the characteristics of the Urban Living labs of Rotterdam in the course of conducting the research, which makes case study research relevant to observe the current situation. Amplifying the study to multiple cases then, gives the opportunity to compare and give insights for explanation and generalisation (Bryman, 2012). Furthermore, a case-study allows to explore perceptions and motivations of actors and their experiences (Van Thiel, 2015), this is relevant in this study since this is the key to understand different characteristics and interaction patterns between science and policy actors.

3.2 Case selection

The overall unit of study is the knowledge infrastructure of the municipality of Rotterdam and the Erasmus University of Rotterdam. The research method applied is however considered a multiple case-study instead of a single one, since a wide range of Urban Living labs (kenniswerkplaatsen) appear within this knowledge infrastructure, see figure 3. The chosen case-studies within the knowledge infrastructure have been given a red circle; Leefbare Wijken, ST-RAW and Smart Port. These cases are chosen because they have existed for roughly the same amount of time, preventing their difference in organisational maturity to have an influence, making them comparable. At the same time, their diversity in research context enables to study their differences too. The assumption is that different sciences may lead to different ways of co-creation. The central unit of analysis may have implications for the co-creation process of knowledge. The unit of analysis of Leefbare Wijken is neighbourhoods and the

science domain is urban sociology, geography and public administration. For ST-RAW, youth and the support organisations around youth care is the unit of analysis and the science domain is predominantly pedagogics and sociology. For Smart Port, the transport chain and transport technologies are the unit of analysis, within the science domain of logistical engineering.
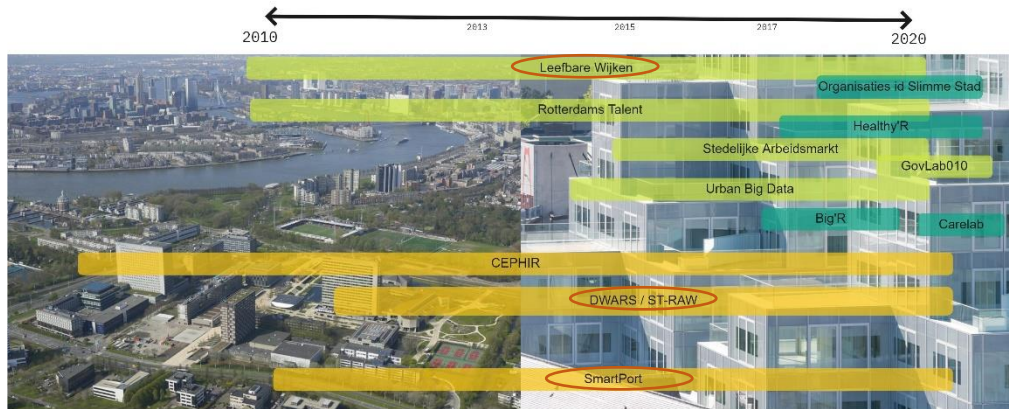
Figure 3: Case selection

3.3 Respondent selection

Respondents were selected according to criteria. When selecting the respondents, their role in the 'kenniswerkplaats' were taken into account. Of every 'kenniswerkplaats' a minimum of one representative of the municipality and one of the Erasmus University was interviewed. In Appendix A, an overview of all respondents is found.

3.4 Data collection

In this research a document analysis and twelve in-depth interviews were conducted to gain detailed information about the characteristics of the 'Kenniswerkplaatsen' and experiences of the actors participating in the multiple 'Kenniswerkplaatsen'. The indicators described in the theory section were used as guidelines for obtaining documents and structuring interviews.

By means of a document analysis, information was gained on the specifics of the multiple 'Kenniswerkplaatsen'. This information and the operationalisation of concepts, formed the basis for the topic list for the open-ended interviews.

By discussing the experiences and perceptions of respondents in detail, an attempt is made to uncover what characteristics are determining the co-creation in the science-policy interface. The interviews are set up in a semi-structured manner. A preliminary topic list with important concepts is set up to discuss during the interview. A semi-structured interview lends as a guideline but still enables

the possibility to ask further questions. The interviews are recorded with a mobile voice recorder and transcribed.

3.5 Data analysis

This research has used the data analysis spiral, which describes the steps in which data can be analysed (Creswell, 2013). The first step in this process is data managing. The audio-records were organised within a database and converted into a transcript to start the analysis. The next step in this process is reading and memoing, notes were placed in order to structure the exploration of the transcribed data. Then, the transcript has been analysed according to the characteristics of ULL, co-creation phases and complexities which appeared. The coding of the data was done with the software programme Atlas.ti. Quotes that appeared to be interesting were translated into English.

3.6 Validity & reliability

Since this research was conducted under the name 'evaluating societal impact', in which more 'kenniswerkplaatsen' were analysed, the chance was in place that respondents gave socially accepted answers in fear of losing their ULL. The risk that respondents had this perception could have hindered the validity of this research. Mentioning the name 'evaluating societal impact' helped however in the willingness to cooperate with the research and it is also ethical to be straight about it. When the researcher suspected socially desirable answers, questions were reformulated. That the interviews were recorded, transcribed and encoded, increased the validity since it enabled close monitoring when the measurement corresponds with the intended.

The internal validity is ensured by triangulation, different kinds of data collection such as desk research and qualitative research. Applying these research methods reduces the researcher bias. Furthermore, the transcripts of the interviews will be sent back to the respondent, by which they can check the content.

The reliability was intended to be guaranteed by drawing the theoretical framework on the basis of theoretical concepts derived from literature, which formed the conceptual framework and operationalisation scheme making replication of the study feasible and ensuring. These steps ensured that it has been closely monitored whether what it is intended to measure corresponds with the literature.

3.7 Ethical aspects

When conducting research it is important to anticipate ethical issues (Creswell, 2013). Here we will consider the anonymity of respondents and the confidentiality. This research has taken into account the interview data acquired. At the start of the interview, researchers were given information of the aim of the study and furthermore the researcher were asked permission to record the interview and use the recordings as research data. The respondents signed a consent form. The data was made confidential by using anonymisation, which was also used while reporting the results.

4. Empirical findings 'kenniswerkplaatsen' Rotterdam

In order to be able to answer the empirical research questions on the ULL characteristics and processes of co-creation manifestation in the Rotterdam practice of Kenniswerkplaatsen (KWP), the findings of the three cases 'Leefbare Wijken', 'Smart Port' and 'ST-RAW' will be elaborated upon in this chapter.

This chapter firstly sets the scene of the Kenniswerkplaatsen in Rotterdam. Secondly, the characteristics per KWP will be set out. Thereafter studying how co-creation manifests itself within each of the respective cases. Subsequently, the next chapter will compare the three cases and attempt to elevate them beyond the individual level. The goal there will be to answer the empirical research questions and ultimately analyse how the distinct characteristics contribute to co-creation in Urban Living labs.

4.1 'Kenniswerkplaatsen' Rotterdam

The first concretised collaboration between science and the city of Rotterdam started in 2005 the form of a so-called 'academische werkplaats CEPHIR', initiated from a national level. Thereafter, the 'Rotterdam Desk' has been initiated by the Erasmus School of Behavioural Sciences (ESSB) and the municipality of Rotterdam to visualise scientific research in and around Rotterdam in the name of valorisation of science. In 2010, the municipality and Erasmus University decided to collaborate more actively and collaborate through the first collaboration agreement. It promised to bring science closer to practice, and to underpin municipal policy with more knowledge. It was renewed in 2017 and also now, in 2021, the municipality and the university are about to review the cooperation agreement. In the cooperation agreement the KWP 'Leefbare Wijken' is incorporated formally. As stated in the cooperation agreement besides the incorporated KWPs which are financed by the Erasmus University and the municipality of Rotterdam, other partnerships exists between faculties of the Erasmus University and municipal clusters. These are mostly financed by third parties, but have the working method and character of a KWP. Though not formally included in the collaboration agreement Smart Port (financed by port businesses, the municipality and the Port Authority) and ST-RAW (financed by ZonMw, a national research subsidy organisation) are mentioned in the agreement as KWPs financed by third parties.

4.2 Urban Living lab characteristics in the 'Kenniswerkplaatsen'

In this section the three cases and their characteristics will be explained and compared.

4.2.1 Case 1: Leefbare Wijken

Context

The 'Kenniswerkplaats (KWP) Leefbare Wijken' is a collaboration between primarily the Erasmus University and the Municipality of Rotterdam in which the subject 'liveability' is central. The research context of the KWP Leefbare Wijken is Public Administration and Sociology.

The KWP has a steering board in which representatives of both the municipality and the Erasmus University are seated, who come together once in the three weeks and decide what research will be conducted for the KWP. In normal circumstances, the meetings take place at the town hall of the municipality of Rotterdam. The steering board has two coordinators both from the faculty Social and Behavioural Sciences (ESSB) from the Erasmus University. Besides the coordinators, five actors are from the Municipality of Rotterdam and one from the Erasmus University, also from the faculty ESSB. A clear coordinating role lies with the Erasmus University here. The municipality actors have a prominent role in this KWP, but do not conduct the central coordination. Furthermore, the KWP has a programme board, with primarily researchers.

Aim

The formal goal of the KWP is to jointly produce relevant and useful insights with science, policy and practice in principle of co-creating knowledge (Kenniswerkplaats Leefbare Wijken, 2021). This formal goal seems to reflect the aim of 'open innovation' (Hossain et al., 2019) where organisations acquire knowledge from external sources and different stakeholders to innovate jointly. In the interviews however, respondents emphasised that the KWP is 'demand-driven', seeing the municipality as the user and the University who provides answers in the form of research. The coordinators see the 'demand-driven' approach as distinctive from other KWPs who, according to them, set up a knowledge agenda beforehand. This focus is a rather recent development according to one of the coordinators: *"I know that four years ago zero questions came from the municipality."* In the past, the programme board with primarily researchers who initiated research opportunities was also more dominant. Presently, this is according to the coordinators not in line with the intention to be 'demand-driven' by responding and answering questions from the side of the municipality. This demand-driven goal and approach therefore seems to be very deliberate in the current set up of the KWP. Innovating jointly as implied in the open innovation paradigm seems to take on the form of user innovation in this case, with the municipality as the user.

Participants

The stakeholders mentioned in the formal goal insinuate innovation in the Quadruple Helix model, where government, academia, industry and civil society innovate what results in 'socially accountable policies and practices' (Crayannis & Campbell, 2012, p.1). In practice however the Erasmus University and the actors of the Municipality of Rotterdam predominantly collaborate, leaving actors from 'practice', including citizens, in the background. By which innovation in practice does not take place in the Quadruple Helix but more in a science-policy interface.

Activities

The activities that take place in the ULL are formally described as (1) generating knowledge by conducting practice-relevant research on urban neighbourhoods, safety and citizen participation (2)

sharing knowledge between researchers, policy officers and practitioners (Leefbare Wijken, 2021). According to a municipal participant of the steering board *"knowledge needed to properly substantiate your policy is now on the foreground";* another municipal representative gives an illustration of a case where the results indeed confirm the observation of the municipality on vulnerability in certain neighbourhoods. The activities in the KWP also seem to be focused on the confirmation of observations in the municipality since the co-design phase, where the establishment takes place what questions will be answered in the co-production phase, is demand-driven from the municipality and the co-dissemination activities are mostly focused on civil servants who are working with the specific subject. Since these activities focus on generating and capturing new knowledge, the activities seem to focus on exploration (Hossain et al., 2019).

It has become apparent that many of these activities are in line with the phases of co-creation as described in the theoretical framework. Therefore, we will come back to them in the next chapter.

4.2.2 Case 2: Smart Port

Context

Smart Port is a collaboration between the Port of Rotterdam, Deltalinqs, an association of undertakings of port and industrial companies is Rotterdam, the Municipality of Rotterdam and the knowledge institutes TU Delft, TNO, Deltares and the Erasmus University. The collaboration between the parties is formalised in a cooperation agreement. In the cooperation agreement the organisation of Smart Port is also formalised namely, a director 'without scientific ambitions', communication and secretary staff and three portfolio managers. The portfolio managers serve as an umbrella above the three roadmaps, which symbolises programmes and projects on the following distinct port related subjects: energy and industry, logistics and infrastructure.

SmartPort is governed by a board, with one or two representatives of all parties of the collaboration. Three to four times a year board meetings take place. Smart Port itself has a cooperation agreement in which is stated that the board has an advising and a supervisory. In the board meetings the director on the on hand justifies and on the other hand is advised on the strategic and substantive course Smart Port needs to go. Furthermore, actors of Deltalinqs, an association of undertakings of port and industrial companies in Rotterdam, and the Port of Rotterdam take place in a smaller board to whom financial and organisational reporting is done. The reason why these parties have this supervisory role is because a large part of the budget on which Smart Port operates, comes from these actors.

Smart Port is housed in the building of Deltalinqs in the Waalhaven. Before Smart Port was housed at the Erasmus University. The shift of location to Deltalinqs reflects according to a researcher of Erasmus UPT a broader *"radical change of direction"* in which the business community became the focus of Smart Port instead of the university community. As the respondent of the municipality says, the location reflects where the aim lays: *"Physically yes, that is a very big difference which also radiates that their*

priority lies with the businesses. So the wishes of the business community in the field of research are now leading, and before it was consolidating the strength of the academic network for the port, so it has gone more form supply-driven to demand-driven".

<u>Aim</u>

The aim is formulated as follows in the cooperation agreement of Smart Port 2018-2022: *"Knowledge development for ports in general and the port of Rotterdam in particular, generating, coordinating and implementing innovative strategic research projects through Smart Port, aimed at application, effect and embedding of knowledge development in the port innovation ecosystem".* Where the port innovation ecosystem is stated in the cooperation agreement, in the interviews however the businesses are primarily mentioned as the target group of Smart Port. The intention therefore seems to be to operate in the open innovation paradigm, in practice however operation seems to be done in the user innovation paradigm with the industry as user (Hossain et al., 2019).

<u>Participants</u>

Within Smart Port, the businesses play a prominent role, mostly as "*knowledge buyers*". Knowledge institutes are mostly the *"knowledge providers*". The terms knowledge buyer and provider are used by a project leader of Smart Port. Formally the municipality of Rotterdam also plays a role in Smart Port, the director of economics and sustainability of the municipality takes place in the board. Therefore, the role of the municipality could formally be signed as a partner in which they do not have authority or a leading role in the collaboration but have an equal relation to other actors in the network. Smart Port operates in the Triple Helix model, with industry, knowledge institutes and the municipality.

Whether the role of the municipality is really equal in relation to other actors can be questioned, since reporting in the 'smaller board' does not take place with the municipality and the activities organised by Smart Port are not targeted to civil servants. Furthermore, a portfolio manager typically does not come into contact with actors of the municipality. A reason for this could be the financial structure. The proportions in which participants financially contribute differ, which makes it not an equal playing field in decision-making according to the respondent of the municipality: *"Financing structures behind this often are also important, isn't it, because yes, who pays determines."* Also a project leader of Smart Port endorses this by mentioning that dependent on the context: *"whoever contributes a lot therefore also determines more".* According to the project leader there are contexts in which it is very logical that a certain party pays more when for instance a research is about quays and a certain actor has a lot of quays in their possession. The project leader also mentions: *"Sometimes it is still important that a party that does not pay for it is still on board because, for example, they are the permit issuer or, for example, they are an area owner or something similar. And then companies are inclined to have them on board because without them it won't work anyway*".

Smart Port works according to three roadmaps which symbolises the long-term thematic agenda. Within these themes activities are organised and designed to produce knowledge which is relevant for 2030 to 2050. Therefore all activities focus on exploration (Hossain et al., 2019).

4.2.3 Case 3: ST-RAW

Context

ST-RAW is, in contrast to most KPWs in Rotterdam, initiated on a national level by a subsidy of 'The Netherlands Organisation for Health Research and Development' (ZonMw). The KWP relies entirely on external subsidies to maintain the network and therefore need to adjust to a large extent to the demands and wishes of the subsidy giver. The KWP in this form started from 2015 and is now in their second 'term'. A term is four years, at the beginning of every term a subsidy plan, in the form of a knowledge agenda, needs to be handed in with the subsidy provider ZonMw. The coordinator forms the central level, subordinated to this level there are projects, each with a project leader. The contact between the subsidy giver and the functioning and activities within the KWP is done by one coordinator. Also the coordinator monitors if the KWP meets the subsidy conditions and goals set by ZonMw and if the subsequent tasks are being performed in the projects. The coordinator is a senior researcher at the municipality of Rotterdam. After obtaining a doctorate in prevention of overweight of children in Rotterdam, the coordinator kept a hospitality agreement at the Erasmus Medical Centre (Erasmus MC).

The knowledge agenda with four themes is leading for ST-RAW and set up at the beginning of a term. In the first term there was also a steering group and an advisory group. The steering group functions did not come together yet in this term. The advisory group has been accommodated in the different projects now, in this way timelier advice can be given according to the coordinator. Besides the individual projects, there is one project group who keeps track of developments in the themes of the overall knowledge agenda of the KWP.

Psychology and pedagogics are the central research contexts of this KWP with youth and parents as research objects.

Aim

The formal goal is formulated as follows: "We establish and strengthen the knowledge foundation by translating and disseminating existing knowledge for practical use; generate new knowledge aimed at supporting policy and implementation practice" (ST-RAW, 2021). The goal for what knowledge translation and dissemination and generating new knowledge takes place is described but not by whom these activities take place. Therefore, this KWP does not operate according to the open innovation paradigm in which the aim is that different stakeholders innovate jointly. This KWP seems to work more according to the user innovation paradigm (Hossain et al., 2019). In which the coordinator designates the users as follows: *"Ultimately, of course, young people and families are parents and I think you can*

also appoint many professionals, professionals in the youth domain, policy makers in the youth domain. And from ZonMw there is also an explicit wish that municipalities are supported in shaping effective youth policy and setting up a good youth system.". In this quote you see the reason that the aim is to operate according to the user innovation paradigm is also because the subsidy giver asks for it.

Participants

Since citizens are defined as users and societal organisations, the municipality and knowledge institutes collaborate, this KWP operates in the Quadruple Helix model of innovation (Crayannis & Campbell, 2012, p.1).

Activities

"I think you can consider that as the overarching goal of all activities, so to speak. Because we are only concerned with improving the existing practices and policies", says the coordinator. The KWP tries to achieve this by working in projects where *"you work really closely with policy and practice"*. Furthermore, the minimal role or basic activity of the network is seen as engaging in knowledge sharing and offering a platform for knowledge sharing and therefore putting emphasis on activities in the co-dissemination phase of co-creation. How they operationalise these different phases will be elaborated on more in the next section. Since the activities focus on generating and capturing new knowledge, the activities seem to focus on exploration (Hossain et al., 2019). As of yet there is no evaluation strategy formulated for the activities in the KWP, according to the coordinator.

4.2.4 Characteristics of ULLs in practice

This paragraph answers the first empirical research question:
"How do the ULL characteristics manifest themselves in practice?"

In all three cases knowledge institutes and the municipality are involved as participants. In the case of Smart Port, businesses are additional prominent actors and in the case of ST-RAW additional participant are societal organisations and the youth. Therefore one could state that Smart Port operates in the Triple Helix model, ST-RAW in the Quadruple Helix and Leefbare Wijken in the science-policy interface.

The three cases also differ in the main target group, namely the municipality of Rotterdam in Leefbare Wijken, the business community in Smart Port and youth, parents and youth-care workers and societal organisations in ST-RAW. When considering the formal goals of Leefbare Wijken and Smart Port they operate in the open innovation paradigm and ST-RAW in the user innovation paradigm (Hossain et al., 2019). However, the clear focus of Smart Port to serve port businesses and Leefbare Wijken to answer questions from the municipality with research does not reflect an equal playing field between all participants in the collaboration as insinuated by Hossain et al. (2019) in the open innovation paradigm. Since they focus on one of the partners in their KWP, one could state they take on a form of the user innovation paradigm (Hossain et al., 2019) in practice. Leefbare Wijken with the municipality as user

and Smart Port with businesses as user. The meaning of user innovation paradigm is however the end user of the research and not one specific partner in the collaboration. The end-users in the public sector are citizens (Voorberg et al., 2014). Since ST-RAW and Leefbare Wijken fully operate in the public sector, one would also expect more of a focus on citizens in the KWP Leefbare Wijken. Smart Port has a clear focus on businesses and therefore does not operate fully in the public sector, what could give an explanation why they focus on businesses and not on citizens.

The research context could also influence who is considered the user and how user involvement is operationalised. The research context of the three cases are as follows: Leefbare Wijken operates in Public Administration and Sociology, Smart Port in logistical engineering and ST-RAW in Sociology and Psychology. When categorising, ST-RAW and Leefbare Wijken operate in the research context of social sciences and Smart Port in engineering. Referring back to the theoretical framework, in the ULL in which social sciences is central, the objects researched are people. Within Smart Port however, different objects rather than people are mentioned to be researched, such as quay walls and the heat development when scaling up hydrogen.

Since all cases are about creating new knowledge, all activities are focused on exploration (Hossain et al., 2019).

An overview of the general characteristics per case is shown in table 2 below.

Table 2: Overview characteristics per researched ULL

	Leefbare Wijken	Smart Port	ST-RAW
Aim	Open innovation / User innovation towards municipality	Open innovation / User innovation towards industry	User innovation
Participants	Science-policy interface (Research + Erasmus University, Haagse Hogeschool, Municipality = Rotterdam)	Triple Helix (Research = UTP-Erasmus, Deltares, TNO, Municipality = Rotterdam Business = Deltalings)	Quadruple Helix (Research = Erasmus University, Hogeschool Rotterdam, Municipality = Rotterdam, Societal organisations, = ..)
Activities	Exploration	Exploration	Exploration
Context	Social sciences (Sociology and Publlic Administration)	Engineering & Technology (Logistics engineering)	Social sciences (Psychology and Pedagogics)

4.3 Co-creation between science and policy

This section aims to understand to what extent co-creation is achieved within the individual cases. As described in the theoretical framework, co-creation in ULLs unfolds itself in three phases; co-design, co-production and co-dissemination (Mauser et al., 2013). All of these phases of co-creation are present in the different ULL cases, though their implementation differs per case. The comparison will be done at the end of this section.

4.3.1 Case 1: Leefbare Wijken

<u>Co-design</u>

The activity of co-designing happens in the steering-board, where a representative of a department of the municipality comes with a question, then a discussion follows and the coordinator representing the Erasmus University tries to translate this into a knowledge question.

The coordinators see it as their task to translate the action-oriented questions from the municipality into "academically interesting" questions, which is not considered as an easy task. A case given by the coordinators which can serve as an example how they come to a knowledge question: *"Look, the municipality just wants an argument of urbanisation, either allotments are phased out or have a great added value for the city... The municipality then wants arguments why one and why the other. That question then comes to us. We had a discussion about this before this conversation, if you want to map out then you are going to talk about impact assessments and that is methodologically a very complex issue where quite a few steps can also be taken from an academic point of view. So that in this way you actually match a very concrete question from the municipality to a more academic development field and so you try to put that together."*

With a good research question "the two worlds of policy and academics" are sought to be connected. There is a big emphasis in this KWP on the co-design process, which takes up a big part of the steering board meetings according to the coordinator. By focussing on the step from translating a practical question to a research question, the coordinators seek to connect these *"two worlds"* by facilitating the conversation and give clarity where needed. By doing this *"we do leave a mark on it",* which reflects the high influence the coordinators have on the decision making. When policy and science are considered two worlds, it can be difficult to align perceptions and can therefore cause substantive complexities. Since the coordinators of the KWP however mention it themselves and are actively trying to bridge these differences in the laying emphasis on the co-design phase, the chance for substantive learning is in place.

When asked what the benefit was of the KWP for the participants, the coordinators and researcher emphasised the benefit of a big network with informal contacts. This network came into play when at the beginning of the pandemic research needed to be conducted on the liveability in the city, because of this network setting up the research went fast.

<u>Co-production</u>

When the knowledge question is set in the steering board, the coordinators search for matching actors to conduct the research. According to the coordinators the ones who conduct research sometimes: *" are really Erasmus researchers, sometimes they are Erasmus researchers in teams with researchers from other universities or universities of applied sciences and sometimes they are also an independent researcher or a research bureau who can be deployed".* Researchers of the University of Applied

Sciences in Rotterdam and the Hague for instance are *" a sort of knowledge providers who do research for us"*, according to the coordinator of the KWP.

According to the researcher the role of the municipality is sometimes difficult to establish for them, since they are co-financer, it is unclear for actors of the municipality to what extent they have a say in the content of the report. The researcher however is very clear about being an independent research institute and also says to have made clear arrangements about this: *you are a partner, we draw up a report in consultation"*. If roles and decision making power between partners are not aligned, strategic complexity can occur. The mentioned arrangements however can be a sign of strategic learning since it is a way to grow consciousness of one another's involvement and mutual dependencies.

According to the researcher, the role the municipality does take is being involved when the concept version of a research is ready and help with finding responding respondents for a research for instance. According to a municipal member of the steering board however there are more checks in the research process, two or three, to check if the knowledge question is still followed correctly and then *"suddenly the research is ready."* According to the respondent the check on the concept version is concerning the question if the research is readable for their organisation since: *"the vocabulary of the researchers is completely different from the municipality. With some terminology we have a completely different world of experience"*. This different world of experience shows a substantive complexity between the participants, since perceptions seem to lay apart.

Next to who conducts the research, the coordinators also organise the finance of the research. When the knowledge question is set: *"the question is what is possible with financing from the municipality, what are the financing options from the KWP itself. If an initiative is close to us, it also means that the KWP automatically invests a little more money in it. If it is a very practical question from and for the municipality, it is logical the financing comes more from their side."* Also financing is sometimes sought with the subsidies by conducting financing application with for instance NWO or the European Commission. The budget itself also seems to have implications for the choice of actors who will conduct research. This became clear when the coordinators gave an example of a research: *"this was a very small study, also in terms of budget and what you actually see is that it is difficult to mobilise researchers at the Erasmus University, since it is too small of a budget to buy someone off, for example of teaching or appointing someone for a few months, a junior researcher or something."* Thus, the coordinators consider the cost and benefits for researchers to conduct research for the KWP. The university creates the institutional context for researchers where they have other obligations then participating in the KWP. If researchers are not compensated by the KWP, institutional complexity would occur. However the coordinators are aware of this and consider it in their budgeting, showing institutional learning.

The research context of Public Administration and Sociology has implications for the practicality of the research as mentioned by a steering board member representing the municipality: *"the practical*

significance for a lot of people, especially if you are in Public Administration, perhaps also in sociology, also has something to do with what we are going to do with it. So that also just makes the way they think about it a bit more practical". Furthermore, the coordinator of the KWP mentions that specifically research on liveability cannot be conducted without including citizens. In practice, the citizens are the object researched in the co-production phase. When formulating the research question in the co-design phase however, citizens are not included. By which one could state that the formal goal of the KWP to jointly produce relevant and useful insights with science, policy and practice could be better achieved by putting the practice side more on the foreground. For instance by including citizens in the co-design phase and more in the co-dissemination phase.

Co-dissemination

After the research is conducted the results will be shared in the co-dissemination phase. *"By seeking to expand the productivity of knowledge gathering and sharing the aim is that people work more knowledge driven"*, a municipal representative of the steering board said reflecting the aim of the co-dissemination phase of the KWP 'Leefbare Wijken'. In this KWP it is mostly done in the form of plenary meetings where researchers present their research and discussion thereafter takes place. Civil servants are the target group for these meetings, sometimes civil organisations are also there and citizens when they contributed to the research. Most of these meetings are according to the coordinators *"the end product of the research"* but sometimes researchers outside the KWP who did research on the same subject also get the stage in these meetings.

The meetings are officially organised by the KWP itself, the two respondents of the Municipality say however that the Erasmus University is in charge here, since this is in line with their expertise. The added value of the knowledge workshops is seen by a representative of the municipality as a place where *"you bring theory and practice closer together and that you can make it mutually meaningful for each other"*. Freely interpreted as a place where one becomes more aware of each other's complexities and a place where substantive complexities are overcome. Furthermore, the two representatives of the municipality see the website as an asset in knowledge sharing, hereby knowledge is made accessible for sharing and serves as well as a backlog for recordings of meetings and publications. Once in the three weeks the steering board comes together in which the events are evaluated and ongoing research and new ideas for research are discussed.

According to a municipal participant of the steering board the basic shared financing between the municipality and the Erasmus University enables at least a number of these meetings and the website, by doing so the communication is well arranged according to the respondent. Also the coordinators see the budget of the KWP itself as a sort of seed money which can give an extra impulse and enables the organisation of an event or the design of a report.

4.3.2 Case 2: Smart Port

<u>Co-design</u>

Smart Port organises calibration and community sessions. In the calibration sessions the roadmaps are discussed and calibrated on the basis of discussions with around twenty companies, which take place once in the three years. In advance of these sessions companies will be interviewed. At the moment these sessions are not organised with actors from the municipality, the following reasons are given by the director: *So there is good will from a personal level, but in the eh the available time or eh so finally taking action yes that yes yes that does not always work".* Which reflects a difference in participants and has an influence on the activities that take place. The difference in available time reflects an institutional complexity and the difference in action taking reflects a different way of workings in combination with different perceptions and therefore a substantive complexity.

The director of the municipality did however not mention the role of the municipality as the municipality themselves perceive it, which creates a strategic complexity since the partners do not seem to be fully aware of the interdependencies and motives. The director mentions however explicitly to be aware of the different interests at the table and sees their neutral role to bring those interests together. If they do not do that, you are not able to steer your organisation, the director says. This awareness shows a form of strategic learning.

<u>Co-production</u>

Different knowledge institutes are considered *"knowledge suppliers"* according to the project leader. The different knowledge institutes are TNO, an independent expertise centre of the Erasmus University (UPT) and Deltares. These so-called knowledge suppliers do not work together and work on request of two or more "demand-setting clients", which are almost always companies. These actors who ask for research are barely involved in the research process. For instance the researcher of UPT told that they get a quotation with a research question, then UPT says this is the time-schedule, when Smart Port agrees UPT sends the bill and delivers the research at the end of the agreed time. In this phase co-creation occurs to be low.

<u>Co-dissemination</u>

Community sessions are organised after a research report is released to inform 'the community', share the results, invite some speakers on the same theme and have a discussion. This session mostly also creates input for follow-up research. There are no policies to actively share knowledge outside Rotterdam, except that all information and community sessions are openly accessible and research can be accessed on request. Since this phase is mostly in sharing instead of discussing, this phase of co-creation is set on medium.

4.3.3 Case 3: ST-RAW

<u>Co-design</u>

At the beginning of a term, a knowledge agenda is set up and send to the subsidy giver. In the knowledge agenda the themes and projects are formulated for the coming four years. This process is therefore considered the co-design phase. This is executed by organising meetings with, according to the coordinator "*the municipality, the board, policy makers and again the target groups*". Also, a questionnaire has been sent out before the knowledge agenda was set. According to the researcher a very important step that is taken to easily now: "*it is the person with the biggest mouth and the most assertiveness that is very decisive for such a knowledge agenda. So I think setting up a democratic knowledge agenda is a very important first step because it also determines the rest of the project.*". This difference in power in the decision-making is only mentioned by a researcher and not by other actors, implying an unawareness of each other's interdependencies and therefore creating a strategic complexity. Furthermore, which actor one is seems to matter for influence one has on decision-making.

The overall knowledge agenda is considered as something that gives grip and focus since it set up with all the partners. The knowledge agenda seems to help to overcome substantive complexities when they occur since discussions about different perspectives are held from the start and aligned, formalised and providing focus. Which can help with overcoming substantive complexities that may occur.

<u>Co-production</u>

Most of the research is done in the different project groups. At the moment there are five running projects. In these projects different kinds of research is conducted such as participative action research, design focused research and impact studies. The researchers in the project groups primarily conduct the research. The Hague University of Applied Sciences is a central knowledge actor in this network. Furthermore, the research unit of the municipality is involved and the Erasmus University faculty of social sciences and Erasmus Medical Centre. The Erasmus University does not seem to do research with other actors in the network. The Hague University of Applied Sciences and the research unit of the municipality do work together sometimes. Besides these knowledge actors, there is a group who represent youth in the KWP who is also co-researcher by conducting interviews and collecting data. These representatives are experience experts of youth care themselves and represent a broader group who have been in touch with youth care.

The difference between the time in which policy makers want questions and researchers can provide answers can cause that you get out of step according to the coordinator,: "*Sometimes policy choices are made, say, with which all research results are thrown away.*" Therefore creating an institutional complexity, since way of doing and practices are not aligned.

"All participants invest their own time to go to project meetings, possibly participate in knowledge workshops and possibly give a presentation there, but good that yes, a podium for your research results

or telling about a pilot that you are doing in your practice organisation, which is of course nice for everyone to have such a podium". The coordinator mentions here their view on the benefits for researchers to participate in the KWP. The researcher of the Erasmus University however sees their participation as something that does not always outweigh the costs. Time invested in the KWP is at the cost of their research time. The work done at the KWP is furthermore not appreciated in the performance interview at the Erasmus University and does not count in the publication list. This makes it difficult, according to the researcher, to get colleagues to participate as well, creating an institutional complexity since the workings of the mother organisation conflict with the working of the network.

Co-dissemination

When research is done, the KWP organises knowledge ateliers where knowledge from practice and professionals is combined with knowledge of research where subsequently discussion takes place. In the knowledge ateliers the target group has got "a place", according to the coordinator. In these sessions it is important according to a researcher of the municipality that: "about the scientific justification that all kinds of methodology are discussed, people should do that, but you shouldn't do that with civil servants". Showing the substantive differences between researchers and municipal actors.

Furthermore, ST-RAW has organised a community of practice with parents and youth as experience experts and healthcare professionals, in which they got to work with problems in youth care that parents face. Also, dissemination takes place by making yearbooks with the research results of that year. According to the researcher of the Erasmus University, greater emphasis could lay on this dissemination to the target group, such as the formal goal of the KWP suggests. Like this practice and research comes more together. Besides, this is typically something the researcher of the Erasmus University would like to do more of but finds it unfortunate that this is not directly in the package of responsibilities as a university researcher.

Furthermore, the specific location, at the municipality, creates the feeling for the researcher as if the primary decision making power and influence is also at the side of the municipality*: "Yes yes the moment when it is every time in the town hall, no matter how delicious the coffee and cookies are, yes you have the feeling that you have to conform to their agenda".* Since no other actor in the KWP mentioned the location as creating a feeling of imbalance in decision making power, it creates a, creates strategic complexity.

4.3.4 The process of co-creation between science and policy in practice

This paragraph answers the second empirical question:

"How does the process of co-creation between science and policy manifest itself in practice?"

Co-design

The co-design phase of ST-RAW and Leefbare Wijken resemble each other the least. Within ST-RAW

the knowledge agenda and the financing are set for four years, whereas Leefbare Wijken conducts research in accordance with the questions from the municipality. The academic potential of each question from the municipality in Leefbare Wijken is considered, for which thereafter financing for research is sought. The three roadmaps of Smart Port resemble a more long-term thematic knowledge agenda, just like ST-RAW. The research projects subordinated to the roadmaps in Smart Port are however only formulated when there is a request of two or more so-called "knowledge buyers", mostly being businesses. Thus the financing is sought when a research question for a project is formulated, just as in Leefbare Wijken, whereas in ST-RAW the financing is sough at front. The way and time-span in which research is organised is schematised in figure 4.

Leefbare Wijken and Smart Port organise their co-design phase in such a way that the KWP can respond to questions coming from their defined 'users'. Research activities are carried out according to the demand from their 'users' and finance opportunities thereafter. Leefbare Wijken the municipality and the Erasmus University both contribute an equal amount. In Smart Port the participants also finance a set amount regardless of the demand, not all participants contribute the same however. The finance of ST-RAW is set every four years, therefore being less flexible.

The unequal contribution between participants has implications for the ownership of Smart Port; "who pays decides". The ones who pay for research indeed have "consortia meetings" in which is decided what is exactly researched. Furthermore, in the co-production phase researchers present their in-between results to these participants. Within Leefbare Wijken the "steering board meetings" are similar meetings in which the knowledge questions for research are set. The participants who are present in these meetings have a lot of ownership in the KWP. Notably the same who finance the KWP. In ST-RAW the financing does not come from partners in the network but from the external subsidy giver who also has ownership in the working of the KWP by the requirements set. Participants have ownership in the knowledge agenda which is set for four years by filling in a questionnaire and by the meetings which are organised. The participants can contribute in different ways and contribute "where possible" to the research conducted. This is not in a financial way but more in investing their time in projects.
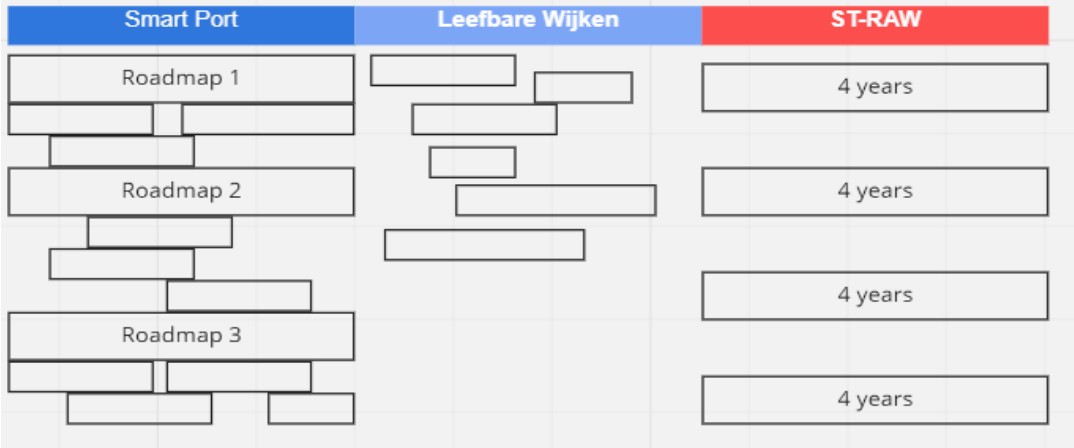

Figure 4: The research projects structure schematised

Co-production

Since ST-RAW asks to invest time, participation in ST-RAW as an actor of a knowledge institute, the Erasmus University, can be difficult. Investing time is at the cost of research time and the work does not count in the publication list and is not rewarded in one's performance interview. The coordinators of Leefbare Wijken see this problem for researchers of the Erasmus University as well. Nevertheless, the difference with ST-RAW is that the coordinators of Leefbare Wijken recognise this institutional complexity and therefore make sure the financing of a research compromises for the costs of the researchers. Note that this institutional complexity has not been felt by a respondent researcher from the University of Applied Sciences in Leefbare Wijken. Before, the respondent worked at the Erasmus University. Now at the University of Applied Sciences the researcher feels more freedom to translate knowledge in other ways than the publication list. In Smart Port the "knowledge buyers" fully cover the costs made for conducting research in which no such institutional complexity for researchers is found. Therefore, covering the research time invested for a researcher, at least from the Erasmus University, seems to be a condition for these researchers to fully participate in a KWP.

In the co-production phase of all three cases research is primarily done by an actor of a knowledge institute. Within Smart Port the knowledge institute mostly conducts the research alone. Within Leefbare Wijken actors of different knowledge institutes sometimes but not always collaborate. Therefore, it is questionable if we can speak of co-creation in these cases at all, since someone gives the task to conduct research "the knowledge buyer", which is subsequently executed by one actor "the knowledge provider". Reasoning could be because of the independent role knowledge institutes seek to take, such as explicitly said by the researcher of Leefbare Wijken. That said, the knowledge institutes conducting research in the projects of ST-RAW collaborate with different institutes and youth actors and societal organisations while conducting the research, therefore reaching a higher level of co-creation.

Co-dissemination

In all three cases the co-dissemination primarily takes place in the form of a meeting with different participants. In these meetings the research results are displayed, and discussion occurs thereafter. Within Leefbare Wijken and Smart Port we see that the actor group who had the most ownership in the co-design phase, also remains the main target group for the co-dissemination meetings. For ST-RAW the main target group for these activities are practitioners in youth care, researchers and youth and parents.

In table 3 the participants per phase of co-creation are set out.

Table 3: Overview of co-creation in the researched ULLs.

	Leefbare Wijken	Smart Port	ST-RAW
Co-design	Science-policy interface (steering board with coordinators EUR, 5 members municipality, 1 EUR)	Businesses in calibration and community sessions with businesses	Subsidy giver and questionnaire
Co-production	Knowledge institutes (Haagse Hogeschool and/or Erasmus University)	Knowledge institutes (EUR UPT or Deltares or TNO)	Knowledge institutes + youth experts (Erasmus MC, Hogeschool inholland and/or Erasmus Universtiy)
Co-dissemination	Plenary meetings for civil servants	Community sessions for businesses	Knowledge ateliers for practitioners and researchers and community of practice for youth and parents

Complexities

Drawing from the above, the complexities are recognised in all cases. Considering the different complexities that come up during these phases there is a rough distinction to be made between the cases. The arising institutional complexities have already been mentioned in the paragraph about co-production. Compared to the other cases, the respondents of ST-RAW mention the institutional differences the most, specifically between the municipality and other participants and with the institutional rules of the subsidy giver to which the KWP needs to comply. Strategies to overcome these complexities have not explicitly been mentioned by the respondents.

Within Leefbare Wijken, the biggest focus is on the substantive differences between science and policy, by laying emphasis on the co-design phase and adequate translation from the practical question coming from the municipal practice to a researchable knowledge question. In Smart Port there is the most consciousness and focus on the strategic incentive and different interdependencies and benefits for all participants, i.e. on the strategic complexities. The director explicitly mentions that she is aware of the different interests at the table and sees her neutral role to bring those interests together. If they do not do that, you are not able to steer your organisation, she says.

5. Analyse

This chapter seeks to further analyse the results derived from the three 'kenniswerkplaatsen' in Rotterdam, as described in the previous chapter. The answers on the two empirical research questions will be connected and the different cases will be compared further to exceed the individual cases and look at the influence of varying characteristics within Urban Living labs on co-creation between science and policy. First this will be done by considering the influence of every Urban Living lab characteristic. Thereafter, every co-creation phase and the influential factors will be highlighted, to see the interwovenness and influence between characteristics and co-creation phases.

All three cases differ or have a different take on the characteristics described by Steen & van Bueren (2017), except for the characteristic 'activities'. The activities in the cases do not have distinct categories and therefore the influence will not be further analysed. The characteristic finance however has been added. Note that this characteristic has not been mentioned by the literature as a characteristic but appeared in the cases as prominent factor by which its influence will be further analysed.

5.1 Influence of Urban Living characteristics

Aim

The theoretical framework showed two main paradigms within the aim of ULLs; the open innovation and user innovation paradigm (Hossain et al., 2019) and user involvement as central part of Urban Living labs (Steen & van Bueren, 2017). All three ULLs take on a form of user innovation in practice. Only one however, ST-RAW operating in the Quadruple Helix without industry, applies the user innovation as Hossain et al. (2019) meant by including their users, youth. The other two, Leefbare Wijken and Smart Port, formally state to function in the open innovation paradigm in which stakeholders come together and innovate jointly (Hossain et al. 2019). In practice however one of the participants in the collaboration appear to be treated like users, Leefbare Wijken with the municipality as user and Smart Port with businesses as user. This does not reflect the equal playing field between participants as meant by Hossain et al. (2019) in the open innovation paradigm. The meaning of user innovation paradigm is the end-user and not one specific partner in the collaboration. The end-users in the public sector are citizens (Voorberg et al., 2014).

Context

Since ST-RAW and Leefbare Wijken fully operate in the public sector and in the research context of social sciences one would expect more focus on and involvement of citizens in Leefbare Wijken. When considering the co-creation phases, citizens are only involved in the co-production phase as research unit, whereas ST-RAW includes youth in all three co-creation phases of Mauser (2013). The results show that when users are involved, exemplified by the case ST-RAW, the degree of co-creation is higher, yet at the same time it seems that it increases the complexities of the process. Compared to other

cases, ST-RAW focuses the least on the strategic and substantive complexities that may occur when collaborating according to Klijn & Koppenjan (2016). A more general reasoning why more complexities occur could be that including citizens is a difficult endeavour (Torfing, Sørensen & Røiseland, 2019). However, not including citizens as users at all, when the ULL is clearly serving a public policy goal, translates to inadequately serving the aim of an ULL. Torfing, Sørensen & Røiseland(2019) insist that the ultimate goal of co-creation is the involvement of citizens and private stakeholders in all aspects of the process. Notably, the Urban Living lab in the Quadruple Helix includes citizens as users more, including in the co-production phase, where the other forms of ULLs do not. The reason why Smart Port does not identify users as citizens, can also be explained by their research context. In this Triple Helix Urban Living lab, engineering is the central research context. Within this research context there is a less traditional role for people than in the research context of social science. In practice, the industry has got a prominent role in especially the co-design and co-dissemination phase. According to Voorberg et al. (2014) co-creation in the private sector tends to define end-users as the ones who can take up activities in the production chain. Although not fully operating in the private sector, this line of thought is also seen in Smart Port. The businesses are seen as the ones who need to implement the research in the end to really make an impact, therefore, even though it may not coincide with the users as defined by theory, the ULL considers them deliberately as users and specifies the activities to their needs.

Participants

When considering the participants, the case of Smart Port distinct themselves from the other cases by having the industry as additional actor besides policy and science actors, therefore operating in the Triple Helix (Crayannis & Campbell, 2012). As stated above, considering the characteristics of the research context social sciences and their full operating in the public sector context, one would expect for Leefbare Wijken to define citizens as users. Smart Port also does not identify citizens as users and does not include them in the phases of co-creation, for which the research context of engineering was given as an explanation in the prior paragraph. Also, when considering the participant constellations of Smart Port this can be explained due to the difference between the Triple Helix model of innovation and the Quadruple Helix, the latter placing citizens as users as a central part of the model, by adding 'civil society' in the mix and the former does not (Menny et. al., 2018).

On the policy side, the role of the municipality is least visible in Smart Port. According to Kronsell & Mukhtar-Landgren (2018), who identified different roles of a municipality in multi-actor collaborations, the municipality can take up a non-role when the context is not clearly related to the municipal nature, such as technical innovations and private or other actors who substitute the role of the municipality. Both reasonings can be applied to Smart Port. The context of Smart Port is not fully in line with policy realm and therefore the municipal nature. Furthermore, the municipality financially contributes a small amount compared to other actors and therefore municipal actors have less ownership in Smart Port. Within ST-RAW, the Quadruple Helix, the leading coordinator comes from the

municipality and therefore having a promotor role. In Leefbare Wijken the coordination lays with the Erasmus University, therefore the role of the municipality is enabling (Kronsell & Mukhtar-Landgren, 2018).

What you see in the Triple Helix of Smart Port, where the municipality has a non-role, most substantive differences mentioned were between researchers and businesses. Smart Port serves as an independent actor to overcome these differences, especially by focussing on strategic complexities meaning ones interdependencies and costs and benefits to collaborate. Within the Quadruple Helix, in ST-RAW, mostly institutional differences were mentioned between the municipality and other actors in the network, including the subsidy giver. For Leefbare Wijken, acting in the science and policy interface, mostly substantive differences have been mentioned between, quite logically, science and policy actors.

On the science side, the role of the knowledge institutes is in all cases the most prominent in the co-production phase. In the Triple Helix Smart Port, they only conduct research on request in the co-production phase with minimum collaboration with other actors. The role of researchers in Leefbare Wijken, in the science-policy interface is similar. Most of the time research is conducted on request and without a lot of collaboration. The difference is that there is a place for knowledge institutes in the co-design phase and that university actors also organise co-dissemination activities. In ST-RAW, the Quadruple helix without industry, actors from knowledge institutes have a place in all phases but however need to invest their own time. This creates an institutional complexity for the researcher of the Erasmus University since time invested in the ULL does not count as research time and does not count in their publication list. Potentially, this could be different for actors from a University of Applied Sciences, as a researcher in Leefbare Wijken indicates this difference between the two knowledge institutes. Also, Buuren & Edelenbos (2004) state that all knowledge institutes have their own epistemological values such as serving the user of knowledge and maintaining the image of independence.

Finance

An additional factor, namely the financing of the Urban Living lab, has appeared to influence the process of co-creation in the cases analysed. Note that financing has not been defined as a particular characteristic by literature, yet it has shown to be very dominant in the way participants cooperate in practice. Here the differences in financing between the cases will be elaborated and in the next paragraph the implications in the co-creation phases will appear. In the case of Leefbare Wijken, the two prominent actors science and policy actors equally contribute, which forms the basis financing of the ULL. With this basis financing the co-design process can take place, where the actors together formulate a knowledge question, by which finance for the actual research is sought in various ways thereafter. Occasionally, the research itself is also funded via this basis financing. Furthermore, the activities in the co-dissemination phase are financed by the basis-financing. Smart Port also has a basis funding, however not every participant contributes equally to this. When two or more actors in the network want research

to be conducted, these actors also need to finance the research project. This form of financing results most clearly in, as mentioned by the respondents themselves and in previous chapter: "who pays decides". In other words, not only do the finance structures between different ULLs differ, but the manner of financing also catalyses divergent degrees of influence and ownership. The different participant groups in the network have different levels of ownership. ST-RAW functions entirely on external subsidies of subsidy giver ZonMw, the participants collaborating within the ULL contribute by investing their time.

5.2 Influence on co-creation phases

<u>Co-design</u>

In the co-design participants create a common understanding of, and an agreement on the sort of knowledge questions that need to be addressed (Mauser et al., 2013). The statement of Buuren & Edelenbos (2004) on the research agenda not being something that has been set in advance but being a result of a process of discussion and negotiation between different participants, applies for all three cases. However, differences are seen here primarily influenced by the finance structure. Because of finance structure of ST-RAW being relying on an external subsidy giver, the knowledge agenda needs to be set for four years. Although ST-RAW includes as only case citizens in the formulation process by setting out a questionnaire and organising meetings in the beginning of four years, this finance structure creates less room for negotiation and discussion on the short term. According to Torfing, Sørensen & Røiseland(2019) bridging expectations, commitments and perceptions is hard and therefore costly in terms of resources needed. Smart Port and Leefbare Wijken seem to be able to put more emphasis on this phase since they get a basis financing from their participants. In practice also more emphasis is put on this phase in the short-term compared to ST-RAW, however executed with a far more select group of people. Furthermore, they have more room for this step since they get a basis financing from their participants. Between Smart Port and Leefbare Wijken also a difference can be seen in which the coordinators of Leefbare Wijken really facilitate the discussion in the steering board, where the co-design phase takes place. In this facilitation they try to bridge different perceptions and therefore focussing on the substantive complexities that may occur. In Smart Port however, the coordination is more a linking pin between researchers and businesses to coordinate the different interests and align these, to overcome strategic complexities that may occur. Since the coordinators broker, less discussion takes place between the researchers and businesses in the co-design phase.

Buuren & Edelenbos (2004) also consider the process of formulating the research question as great importance for the outcomes of the research and Klijn & Koppenjan (2016) see the process of defining the problem as a process that allocates power. In the cases, the level of ownership between participants also seems to be set in the co-design phase, ones again determined by primarily the financing. According to Torfing, Sørenson & Røiseland (2019) certain groups can gain more influence by attaining more resources, knowledge and time. In Smart Port this is seen the most where participants

contribute unequally and the implication of this is: "who pays, determines". Not only in formulating the research question but also further in the process. In ST-RAW, participants need to invest their own time when participating. There you see that certain groups can gain more influence in terms of time available, making participants also reliable on the recognition the mother organisation gives to the Urban Living lab. In Leefbare Wijken a shared ownership is felt between the two participants who together formulate research questions in the co-design phase and also in terms of money contribute equally to the Urban Living lab. Only these two participants however are included in the co-design phase, where one can say there is a shared ownership felt but it is quite a closed group.

Co-production

In the Triple Helix Urban Living lab Smart Port, two or more actors who are mostly businesses set out a quest for a knowledge institute to conduct research. Collaboration between knowledge institutes and the people who requested the research, is minimal. Therefore it is questionable if one can speak of co-creation in this phase. Within Leefbare Wijken, in the science-policy interface, a knowledge question is set in the co-design phase by which after finance for research is sought. The research is mostly conducted as well by one knowledge institute, but also sometimes in collaboration with other research institutes. Collaboration with other actors, in this case only municipal actors, is minimal. Bringing the co-creation in Leefbare Wijken in the co-production phase on a minimal level. In ST-RAW, the Quadruple Helix, research is conducted in projects with multiple actors. Therefore reaching the highest level of co-creation.

Finally, analysis of the participants leads to the following critical observation; it is questionable if the participation of merely one knowledge institute, conducting the research, can be actually called co-creation. Co-creation, as per the definition stated in chapter 2, needs the constructive exchange of different kinds of knowledge, resources, competences and ideas. Having multiple participants present in the designated ULL is necessary, ideally in a Quadruple Helix with user-involvement.

Co-dissemination

Arriving at the last phase of co-dissemination in which results are spread among different societal groups. In all cases this is done quite similar, in the form of meetings where results are presented and discussion takes place. What you see is that these meetings are targeted in accordance with the users distinguished in the characteristic 'aim' and for Leefbare Wijken and Smart Port the target group who has the most ownership in the co-design phase. The meetings in ST-RAW do not seem to target one specific group. According to Mauser et al. (2013) the open discussion in the co-dissemination phase can count as input for a new research cycle. This iterative character is only mentioned in the Urban Living lab Smart Port and is not clear in other cases. Furthermore, no general evaluation processes have been formulated in all cases.

6. Conclusion and discussion

This last chapter aims to conclude the research by answering the research question: "*What is the influence of the characteristics of ULLs on the co-creation between science and policy?*", followed by a discussion about the implications and the limitations of the research and recommendations for future research.

The aim of this research is to explain the influence of the characteristics of Urban Living labs on the co-creation between science and policy. A multiple case-study is conducted, researching three cases in Rotterdam where science and policy interact, called 'kenniswerkplaatsen'. The ULL characteristics of Steen & van Bueren (2017) (context, aim, participants and activities) have been used as overarching characteristics. According to the co-creation phases of Mauser et al. (2013) the process of co-creation in the 'kenniswerkplaatsen' have been indicated. The governance network theory on complexities of Klijn en Koppenjan (2016) has been used to get insight into the dynamics and integration between different participants in a collaboration.

The first case is the 'Kenniswerkplaats (KWP) Leefbare Wijken', a collaboration between primarily the Erasmus University and the Municipality of Rotterdam in which the subject 'liveability' is central. The research context of the KWP Leefbare Wijken is Public Administration and Sociology and can therefore be categorised in social sciences. The second case, 'ST-RAW', is initiated on a national level by a subsidy of 'The Netherlands Organisation for Health Research and Development' (ZonMw). This KWP also has social sciences as research context, specifically psychology and pedagogics. In ST-RAW, actors from the municipality, universities, universities of applied sciences, societal organisations and youth collaborate in research projects together. Thirdly, Smart Port facilitates research in engineering. This KWP operates in the Triple Helix model of innovation; industry, government and university.

All three cases differ or have a different take on the characteristics described by Steen & van Bueren (2017), except for the characteristic activities in which the cases are alike. Therefore, this characteristic has not been further analysed. Next, the characteristic finance was not mentioned by the literature as a characteristic but appeared to be an influential factor. As a result, the influence of finance has also been studied in this research. The characteristics 'aim', 'research context' and 'finance' substantiate who is considered the user in the Urban Living lab and what ownership and roles the participant groups have in different phases of co-creation. Subsequently, these characteristics have substantial influence on the manner and degree of co-creation in the ULL.

In a Triple Helix participant constellation, in this research exemplified in the case of Smart Port, both the composition of participants - especially the inclusion of businesses - and the research context of engineering– which seems to have less affinity with the policy realm and tradition in actor orientation - have a diminishing role on the co-creation between science and policy. The role of the municipality is not prominent in this Triple Helix Urban Living lab and the knowledge institutes conduct research on

demand with little to no collaboration with other knowledge institutes or actors. Therefore, it is questionable if the participation of merely one knowledge institute, conducting the research, can be considered co-creation. Co-creation, as per the definition, needs the constructive exchange of different kinds of knowledge, resources, competences and ideas. Since co-creation is the central part of an Urban Living lab, we can also be critical if the Urban Living lab model is the correct model to analyse this Triple Helix collaboration.

Compared to the Triple Helix model, the Quadruple Helix model of innovation places the users as a central part of the model by adding the civil society as participant. The case of ST-RAW exemplifies this, since collaboration takes place with science, policy and societal organisation actors. Furthermore, the case seeks to include users in all co-creation phases. When compared to the other cases, the co-creation is the highest in this Quadruple Helix model. The municipality plays a coordinating role and researchers conduct research in projects with all participants. However, what one sees as well is that most complexities occur in this collaboration. Reasoning could be that coordination is not as central as in the other cases and does not focus as much on the substantive and strategic complexities that may occur when collaborating. Secondly, a more general reasoning why more complexities occur in this Quadruple Helix model could be that including citizens is a difficult endeavour. Thirdly, the way of financing can be a reason. Most of the time the coordinator is seeking financing and communicating with the subsidy giver, instead of focusing on the participants within the Urban Living lab. The subsidy giver furthermore asks to set a knowledge agenda upfront for a term of four years. This makes the Urban Living lab less flexible and furthermore makes it difficult to align research goals between participants in the co-design phase, which appeared to be very important in other cases to overcome substantive and strategic complexities. Furthermore, in the other cases the costs participants make in the co-production phase are compromised. When participants need to invest their own time, exemplified in ST-RAW, co-creation appeared to be difficult for researchers since participation is not rewarded by their university and does not count in their publication list as such.

In resemblance to the Urban Living lab ST-RAW, the case of Leefbare Wijken operates in the public realm and in the research context of social sciences. Within this case there is however no collaboration with civil society and their expected user, being citizens. The two actors in this collaboration are solely actors from the municipality and university and therefore operating in a science-policy interface. The complexities between participants seem to surface less, for which the reasoning could be that the coordinators emphasise the co-design phase with careful translation of municipality questions to research questions. As stated above, considering the characteristics of the research context, one would expect a ULL in the field of social sciences which fully operates in the public sector context, to define citizens as users. However, the case of Leefbare Wijken has shown this does not always hold true. Therefore, although integration is high, not including citizens as users at all, when the ULL is clearly serving a public policy goal, translates to inadequately serving the aim of an ULL.

Reflection and discussion

One important amplification of characteristics has been made here. The results of this study have shown that co-creation within ULLs is largely influenced by the factor of finance. Therefore, in addition to the four characteristics of ULLs as defined by literature, analysis of the results induced that 'finance' needs to be taken into account the moment one is talking about co-creation between science and policy specifically. One could carefully draw the conclusion that they ought to be added as co-creation-specific characteristics of ULLs, though further research should be done to see if that holds true for ULLs beyond the geographic context of Rotterdam and beyond the scientific context researched in this paper.

Secondly, it would be interesting to investigate the management style as characteristic, to research its influence on co-creation processes in the Urban Living lab context. Arguably, different management styles could play a role in the ownership and power and on the co-creation process. For instance, literature on collaborative governance (Ansell & Gash, 2007) and network governance (Klijn & Koppenjan, 2004) does consider managerial strategies as an influential factor for collaborative processes. This research did not include this factor, since the literature on Urban Living labs thus far does not incorporate the management style as a characteristic.

Thirdly, for the Urban Living lab characteristic 'activities' the distinction has been made between exploration and exploitation activities in this research. Since all cases focused on research and knowledge generation, all were most fitting in the exploration activity category. This made further comparing analysis hardly possible. Besides, the category on 'exploitation' appeared not applicable to the 'kenniswerkplaatsen', since all focus on conducting research and therefore not on targeting efficiency and implementation, mainly applicable to physical products. For future research, the operationalisation of the characteristic 'activities' should be specified more to research focused Urban Living labs and their activities. Conducting observation in these Urban Living labs, in addition to in-depth interviews and document analysis, would be a recommendation for future research as well. In this way the researcher can observe which activities, methods and tools are carried out. By using this research method also a more in-depth analysis can be done of the implications of different research contexts.

Fourthly, in the data collection researchers were seen as one actor group, without distinguishing actors from applied sciences and universities. This research however showed signs that participating in an Urban Living lab may be different for researchers from these different knowledge institutes. Therefore, it would be valuable if future research does make this distinction in the respondent selection.

A final point of discussion is that after the literature review on Urban Living labs the concept seemed to have quite a commercial, market-oriented focus. For instance, when considering the characteristic 'exploitation' mentioned above which focuses on the development and implementation process of mostly objects. Also, the Quadruple Helix model of innovation exists only in the literature with private actors as participants. The implication for this research has been that the analytical categories were not

always as nuanced considering the cases studied. Therefore, this research showed the limitation of these concepts and the quest to be more open for alternative, non-private assemblies of Urban Living labs.

This research has shown that a difference in the character 'finance' has implications on the power and ownership in the 'kenniswerkplaatsen'. Below, the different implications of the various financing strategies are laid out and a final practical recommendation is given. In Leefbare Wijken shared ownership and power seems to be achieved between the two participant groups by equally contributing to the 'kenniswerkplaats'. The question is however if this is feasible when more and divergent participants collaborate actively. In ST-RAW, where more divergent participant groups interact without financially contributing, we see another discrepancy in power namely the time one can invest. In turn, for Smart Port where different participant groups contribute, different amounts of money, one sees that the amount of money has an effect on the power and ownership in the collaboration. Without giving one practical recommendation on the ideal financing structure, the recommendation to the 'kenniswerkplaatsen' is to carefully consider which financing strategy is applied and what implications the strategy has on the power and ownership.

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Appendix A – Overview respondents

Leefbare Wijken 1	Coordination – Erasmus University
Leefbare Wijken 2	Municipality
Leefbare Wijken 3	Municipality
Leefbare Wijken 4	The Hague University of Applied Sciences
Smart Port 1	Coordination
Smart Port 2	Municipality
Smart Port 3	Erasmus University UPT
Smart Port 4	Project leader Smart Port - Deltares
ST-RAW 1	Coordination - Municipality
ST-RAW 2	Researcher - Municipality
ST-RAW 3	Researcher – Municipality
ST-RAW 4	Researcher – Erasmus University

Appendix B – Operationalisation tables

Concept	Dimensions	Sub-dimension	Definition	Indicators	Values
Urban Living lab characteristics	Aim	Open Innovation	Stakeholder organisations acquire knowledge from external sources, thus stakeholders collaborate and innovate jointly in ULL (Hossain et al., 2019).	Formulated goal towards collaborating and innovating jointly	Which goals are being pursued in the KWP and to whom do these goals relate?
		User innovation	Shifting of innovation towards the user, thus co-creating with the user (Hossain et al., 2019).	Formulated goal towards a specific user	

	Participants	Triple Helix	University–industry–government relations (Carayannis & Campbell, 2009)	Participants and their resources	What actors participate in the KWP?
					In what way are users, target groups or citizens involved in the KWP?
		Quadruple Helix	University–industry–government relations-society (Carayannis & Campbell, 2009)		
					What knowledge institutes are involved and what role do they take in the KWP?
		Role municipality	Municipalities can take up different roles in multi-actor collaborations in Urban Living labs; the municipality can organise funding, initiate or govern, thus different roles are the municipality as a promoter, enabler, partner or sometimes a non-role (Kronsell & Mukhtar-Landgren, 2018)		In what way is the municipality involved in the KWP?

Activities	Innovation and development stages	Research, development, testing, implementation, commercialisation (Steen & van Bueren, 2017)	The innovation stage the ULL is in, the goal for which activities are executed, the level of iteration in the ULL and methods, tools and approaches used.	What central activities in the KWP? In what way do you evaluate these activities?
		Exploration	"Capturing, discovering, generating and creating new knowledge and competences" (Hossain et al., 2019, p. 982).		
		Exploitation	"Activities targeting efficiency, implementation, execution, production, selection, choice and refinement" (Hossain et al., 2019, p. 982).		
		Iteration	The feedback and evaluation gathered to further develop and improve (Steen & van Bueren, 2017)		

Context	Scientific domain	Real-life context is a territory or a space-bound place (Steen & van Bueren, 2017).	Research context and object	What scientific subject is central in the KWP?
				What would you consider the research object of the activities that take place in the KWP?
	Real-life context of innovation	How and by whom activities in the ULL are financed	Location	Since when does the KWP exist?
				Is the KWP located at a specific location? Is there a fixed place to work or meet?
				?

Co-creation	Co-creation phases	Co-design	Participants create a common understanding of, and an agreement on the sort of knowledge questions that need to be addressed. By which an establishment takes place of common understanding of the research goals. Furthermore, the role of different groups in the further process to reach the research goals are agreed upon through sectoral integration (Mauser et al., 2013)		Who decides the agenda and how are activities subjects set? How and who initiates activities?
		Co-production	The actual research is conducted through continuous dialogue and exchange between researchers and the other participants, called scientific integration." (Mauser et al., 2013)		Who conducts the research? How is the collaboration when conducting research?
		Co-dissemination	In the co-dissemination phase results are spread among different societal groups, the information should be in accessible language and useful for stakeholders. An open discussion should take place among various groups, from which new questions arise, creating input for the next research cycle and co-design phase within (Mausdfsder et al., 2013).		How are results disseminated? For whom are results disseminated?

Complexities	Cognitive	Cognitive learning	Aligned perceptions and intertwined of goals and solutions	Intertwinement of goals and perceived input	What are the most important activities and goals of the KWP?
		Substantive complexity	Diverging perceptions and vision on goals and solutions (Klijn & Koppenjan, 2016: 247).		How do you perceive the added value of the collaboration?
		Strategic learning	'Consciousness of one another's involvement and their mutual dependencies"	Perceived benefits of collaboration and perception of interdependency	Do you know everyone involved? Is there a good view of this? Which actors are the least/most active?
		Strategic complexity	Unawareness on one another's involvement and mutual dependencies(Klijn & Koppenjan, 2016: 250)		How do you perceive the contribution in activities of different participants?
		Institutional learning	"the degree in which parties have developed enduring relations, joint perceptions and institutional rules to support their interactions in the ongoing future"	Formal and informal institutional rules	Do the working methods differ between different parties in the KWP? Do you have a joint rules and accountability structure as KWP?
		Institutional complexity	Diverging ways of working and institutional rules between participants(Klijn & Koppenjan, 2016: 253)		Do you have the feeling that there is support for the KWP from your organisation?