Regenerating Post-Industrial sites through Circular Area Development: A Case Study of the Werkspoorkwartier in Utrecht

A qualitative study into the perceived effects of circular area development as a regeneration strategy.

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Master Thesis Spatial Planning
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March 21, 2021

Preface

This thesis is the product of my final scientific endeavor for the master Spatial Planning at the Utrecht University. I was granted the opportunity by the Utrecht Sustainability Institute where I wrote this as part of my research internship. Therefore, I would like to thank the USI for this opportunity, the partners of the EFRO project team, and especially the project manager Tony Schoen for his sustained support and constructive feedback. Lastly, I would like to thank my supervisor Mathias Koepke for his feedback, enthusiasm, and support.

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1. Introduction

1.1 General Introduction

In many European cities, post-industrial areas can be found relatively near to city centres. They mark the remains of an economic system that was primarily based on heavy industry but shifted towards a service-based economy in the second half of the 20th century (Loures, 2015; Roberts & Sykes, 1999). Due to their often-advantageous locations, they become of interest for redevelopment and integrating them into the surrounding city (Loures, 2015). However, challenges like contamination, scattered landownership, aging buildings and infrastructures, and uncertainties in costs hamper their redevelopment (Roberts & Sykes, 1999; Loures, 2015). While there are many tried and tested redevelopment strategies (e.g., promoting housing, cultural development, business parks, mixed-use), a multi-case study in the Netherlands showcased that the measures that were taken often did not lead to the desired outcomes, rendering their effects non-significant (Ploegmakers & Beckers, 2012). Nonetheless, a novel redevelopment strategy called Circular Area Development (CAD) is now utilised as a regeneration strategy in many post-industrial areas across the Netherlands[1]. In CAD, place-specific policies are used to transition areas into circular hubs by the means of additional funding, knowledge, and cooperation to stimulate the development of circular businesses (ERDF, 2020; Van den Berghe & Vos, 2019). Whilst this strategy is also encouraged by national policies to reach the goal of a fully functional Circular Economy (CE) by 2050, CAD has only been covered in a single scientific publication yet, and its potential effects are often derived from related concepts like Eco Industrial Parks (EIPs), and smart cities (Petit-Boix & Leipold, 2018; Van den Berghe & Vos, 2019). Therefore, the potential of CAD to contribute to CE agendas, as well as its potential as a regeneration strategy are largely unknown to science.

Thereby, the aim of this study is to deepen the understanding of CAD as a strategy of stimulating circular businesses and as a potential regeneration strategy for post-industrial sites. As CAD is often not the only utilised regeneration strategy, a more holistic approach is needed to adjust for the effects of other measures and shed a light on the interrelations of various strategies. This is also backed by regeneration scholars who argue that the lack of context and single dimensional approaches of past research failed

[1] Exempels: Merwe4Havens (Rotterdam), Binckhorst (Den Haag), Buiksloterham (Amsterdam) & Werkspoorkwartier (Utrecht).

to encompass the complex nature of regeneration (Ling, Handley & Rodwell, 2007; Loures, 2015). Therefore, this study is operationalised by using the single case study of the Werkspoorkwartier in Utrecht. The Werkspoorkwartier is a former heavy industrial park, that is currently subject to area-specific programs to stimulate creative and circular regeneration (ERDF, 2020; Gemeente Utrecht, 2012). With these policies it attracted a variety of circular start-ups and artists, next to the light industries and offices it was already housing (Van den Berghe & Vos, 2019). To gather a deeper understanding of how cultural and circular strategies redevelop the area and affect one another, a qualitative thematic analysis is used wherein the important actors such as practitioners, entrepreneurs, start-ups, artists, policymakers, and project managers are being interviewed about their experiences. Thereby, this thesis sets out to answer the following research question:

To what extend can circular area development contribute to business-led regeneration of post-industrial sites at the Werkspoorkwartier in Utrecht?

Furthermore, to gather a deeper understanding of how circular businesses can be stimulated through programs, and eventually judge CAD on how it affects those, it is important to encompass the various ways in which specifically circular economic activity can be stimulated and which action areas need to be addressed. In scientific publications this is often referred to as the drivers and barriers for circular initiatives (Russell, Gianoli & Grafakos, 2019; Acceleratio, 2015; Kirchherr et al., 2018). Therefore, this study utilises a sub-question that seeks to understand this relation:

Which drivers and barriers are experienced by circular initiatives at the Werkspoorkwartier, and how does circular area development affect those?

1.2 Scientific Relevance

To date, economists and industrial ecologists tend to dominate the debate and research on the CE (Williams, 2019). However, an increasing body of literature is pointing out that the current urban systems and organisation of space needs to chance to accommodate further CE development (Obersteg et al., 2019; Prendeville, Cherim & Bocken, 2018). Therefore, scholars argue that urban planning research on CE holds a great potential, especially when linked to certain strategies of urban planning and policy (Petit-Boix & Leipold, 2018). In addition, empirical case studies are needed to enable comparative case

studies and the transferability of strategies in the future (Remøy, Wandl, Ceric & van Timmeren, 2019). Therefore, this study contributes to the planning research on the CE through the experiences of local CE initiatives and policy makers on CAD. Also, recent studies attempt to disclose the drivers and barriers for CE initiatives and unravel which steps can be taken to further enhance CE development (Russell, Gianoli & Grafakos, 2019; Acceleratio, 2015). By operationalising these drivers and barriers, this thesis seeks to contribute to this recently developing research field, specifically by approaching it though the urban planning domain.

1.3 Societal Relevance

The Netherlands formulated the ambitious goal to have a fully functioning CE by 2050 (Rijksoverheid, 2016). While currently the economy is somewhere between 5% and 10% circular, there is still much work to do to achieve the goals for 2050 (PBL, 2019). Therefore, one of the priorities for the first years of this transition is to set up pilots and experiments, and to take lessons for future projects (Rijksoverheid, 2016; PBL, 2019). This is also reflected in the goals of the city of Utrecht, where the strategy is to learn by experimenting until 2023, so afterwards the pace of implementation can be increased to become 50% circular by 2030 (Gemeente Utrecht, 2020). Also, both the municipality of Utrecht and the national government insist that CAD needs to be further enrolled, while specific measures and goals related to CAD are not specified (Gemeente Utrecht, 2020; Rijksoverheid, 2016). Therefore, the aim of this study fits the municipal and national CE agendas as it provides substantial empirical insights into current practices, as well as emphasising on the regenerative potential of CAD.

2. Literature Review

2.1 Introduction

In this section a theoretical framework will be developed to assess the potential for CAD to regenerate post-industrial areas. This section will build up to eventually identify five main categories that are of importance for urban regeneration through CAD, and are the empirical foundation this studies relies on. However, first an introduction into post-industrial regeneration is given to provide background information and a definition. Then, the CE is discussed into greater detail. Besides a definition, this section will elaborate on the relation between the CE and cities through the lenses of proximity and value retention. Eventually, those concepts are used to understand the challenges for urban planning in delivering the CE, thus also relating to CAD on post-industrial sites. Thereafter, a brief introduction is provided into the five main analytical categories: governance, financial, spatial, social capital, and lastly knowledge & technology. Within those categories drivers and barriers are identified through discussing literature on both the CE in cities and post-industrial regeneration literature. This will illustrate the common challenges that are specific to those concepts, but also potential synergies. Those insights can then be operationalised in the methodology to research the potential of CAD in post-industrial regeneration.

2.2 Post-Industrial Regeneration

2.2.1 Defining Post-Industrial Areas

Post-industrial sites can be found throughout most western cities, especially on the European continent and the United States. As most of the western societies saw a shift from an industrial and production-based economy to one that was more service based, a state which is often referred to as post-industrial cities or societies (Lehmann, 2019). This shift of de-industrialization often started from the second half of the twentieth century as a consequence of globalization. Most of the once industrial areas were then subject to abandonment, gradually turning into brownfields, and therefore became of low economic, social and environmental importance (Loures, 2015; Ferm & Jones, 2016). The growth of cities was then often in greenfields or at the urban fringe, especially since space for development was often not a limiting factor. However, this gradually changed towards the change of the century, but especially during the nineties and onwards. Main driving factors were firstly, compact and mixed-use designs which gained interest, especially as cities continued to grow. Second, the economic potential of redeveloping these areas

increased as the city continued to grow around them. Thirdly, the increasing challenge for cities to house more residents, businesses, and services. while also contributing to more sustainable land-use (Lehmann, 2019; Loures, 2015; Healey, 1995).

While post-industrial sites can vary in their size, location, industrial heritage, amount of brownfields, and redevelopment potentials and strategies, Loures (2015) found a lot of commonalities even in various contexts. First, these sites can often be found in inner-city advantageous locations but are often poorly integrated into the surrounding areas by means of economic, social and environmental services (Loures, 2015; Small & Syssner, 2016). Second, they often include brownfields or industrial heritage, but do not have to solely consist of those to be deemed a post-industrial site (Loures & Vaz, 2018). Ekman (2004) and Loures & Vaz (2018) found that scholars and professionals often confuse post-industrial sites with brownfields. Where the former refers to places that are subject to a historic process of de-industrialization which often results in commonalities that are discussed in this section, the latter is often a consequence of those developments and can therefore be a feature, but it is not specific to post-industrial sites. Third, the process of de-industrialization often led to scattered landownership, which can lead to strong contrasts within the areas (Loures, 2015). Lastly, aging infrastructures and poor accessibility are often found in contrast with its surroundings (Lehmann, 2019; Loures, 2015).

2.2.2 Urban Regeneration

Urban regeneration, often also referred to as redevelopment, is ‘’*an elastic term that has been widely used for urban renewal projects that transform a large part of a city or area of properties (e.g. privately or publicly owned neglected land) within a designated renewal area by developing and changing the use of the land’’* (Lehmann, 2019, p. 3). Also, Roberts (2000) describes urban regeneration as an ongoing process of a city to adjust to macro, meso and micro forces that influence the relationship between physical structure and social response. Therefore, Roberts (2000) suggest that urban regeneration is not very different from more conventional urban management, other than that it specifically focusses on areas that are lacking in social, environmental, and economic aspects, whereby the current trajectory is unlikely to account for those issues (Roberts, 2000; Lehmann, 2019). While change is an intrinsic part of urban regeneration, it is different from urban renewal projects in that the economic, environmental, and human features as well as physical features of an area are viewed as assets to drive regeneration, rather than

barriers for redevelopment. Consequently, governance is unavoidably a part of regeneration, and long-term strategies and commitment are needed as these processes tend to develop over longer time periods (Roberts, 2000). In figure 1, an overview is provided of how post-industrial sites are viewed through the lens of urban regeneration, creating insights into defining the problem an area is experiencing.

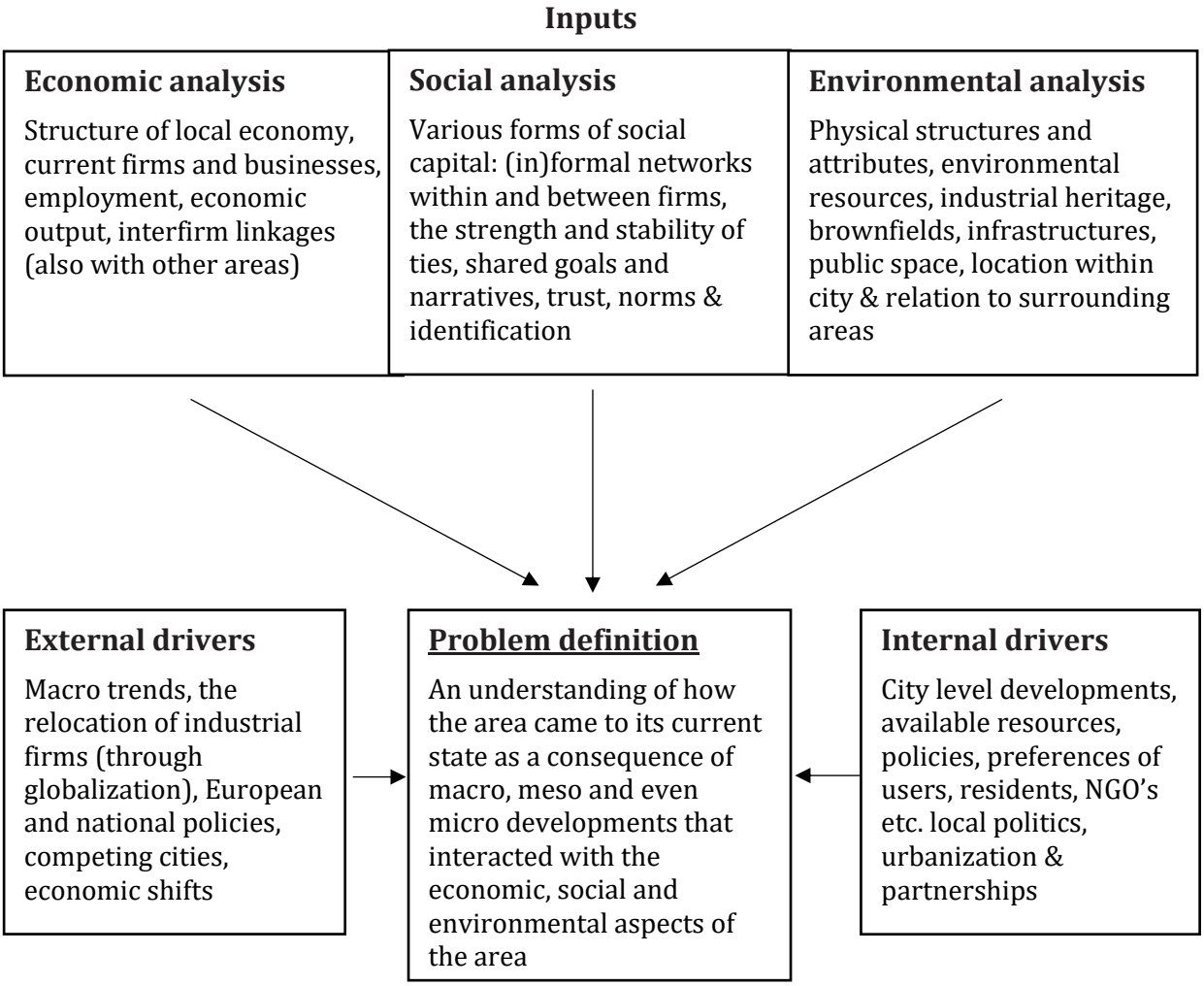


Figure 1: Potential drivers in the underdevelopment of post-industrial areas based on Roberts (2004), Loures (2015) & Theodoraki et al. (2018).

Although the aim of urban regeneration is to find solutions for challenges an area is subject to, the phase prior to action is perhaps even more important, namely the definition of the problem (Rhodes & Murray, 2007). This step tends to get little attention in common practice, but it was shown to be a critical factor as it is the underlying determent for potential solutions (Roberts, 2000; Lehmann, 2018; Rhodes & Murray, 2007). For instance, some studies found that government agents point out highly derelict industrial heritage as a key problem that is hampering development, whereas local residents and

users might see this as a major asset of such an area (Lehmann, 2018). And since urban regeneration is a collaborative process with the existing users and residents of an area, reaching consensus on the various problems and their priorities is a crucial step (Rhodes & Murray, 2007). While later sections will elaborate on potential solutions CAD may provide for post-industrial regeneration, it is important to take into account the problems of an area, if those are agreed upon by its actors, and if CAD therefore is a viable solution to those. Because the potential of a solution is largely dependent on the existence and shared consensus of the problem it should account for.

2.3 The Circular Economy

2.3.1 The Circular Economy and its Definition

Before elaborating on the consequences of the CE in cities, CAD, and linking those to urban regeneration of post-industrial sites, this section will start off by providing a definition regarding the CE and some related discussions and challenges from the current state of literature.

Over the last fifteen years, the CE concept gained worldwide attention, as the alternative to the currently dominant 'take-make-dispose' linear economy (Ghisellini et al., 2016). Instead of disposing waste, the CE its aim is to increase the life cycle of products and their parts by processes like recycling, recovering, reusing, remanufacturing, repurposing, remining, and repairing, thereby ideally doing away with waste as a whole (Korhonen, Nuur, Feldmann & Birkie, 2018; Geissdoerfer, Savaget, Bocken & Hultink, 2017; Reike et al., 2018). However, Reike et al. (2018) also emphasize that the CE requires consumption behaviours to change, thereby adding refusing to buy (linear) products, and reducing the overall resource needs to this list. These ways of operationalising the CE are often referred to as the R-imperatives[2].

Many of these R-imperatives have been deployed and researched before it was referred to as the CE, thus it is seen as an umbrella concept that links together these practices as they can all be used to reduce the need for virgin materials, and turning waste into a resource (Ghisellini et al., 2017). Also, these circular practices have been deployed already

[2] Reike et al. (2018) created the following hierarchy of R-imperatives from most circular to the least: refuse, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle, recover & remine.

in other sustainability concepts[3], most notably industrial ecology (Korhonen et al., 2018; Geissdoerfer et al., 2017).

Throughout its history, various definitions were developed for the CE, but a univocal one is still non-existing (Korhonen et al., 2018; EMF, 2012). For this thesis, the definition that was produced by a meta study of 114 publications by Kirchherr et al. (2017) is used, as it attempts to capture the CE concept in its entirety:

> "The CE is an economic system that replaces the 'end-of-life' concept with reducing, alternatively reusing, recycling, and recovering materials in production/distribution and consumption processes. It operates at the micro level, meso level and macro level, with the aim to accomplish sustainable development, thus simultaneously creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations.'' (Kirchherr et al., 2017)."

In contrast to other definitions, this one includes the three dimensions of sustainable development: the economic, environmental, and social dimension, while most other definitions only incorporate the former two dimensions, therefore being based around the economic viability of reusing non-virgin resources (Kirchherr et al., 2017). Many scholars argue in recent publications that including the social dimension is of great importance as governance, institutional conditions and lock-ins, political and societal support, consumer interest, hesitant company cultures, regulations and laws, leadership, and trust among companies were all identified as either drivers or barriers for CE development (Kirchherr et al., 2018; Moreau et al., 2017; Geissdoerfer et al., 2017; Murray, Skene & Haynes, 2017). Thereby, accounting for all three dimensions is of importance for this study, as these are not only relevant for CE developments, but also play a role in urban regeneration (see figure 1).

2.3.2 The Circular Economy in Cities

Within cities resource consumption and the production of waste accumulates, but they are also centres of users, retailers, producers, innovation, knowledge, technology, and

[3] Concepts such as: sustainable development, cleaner production, eco-efficiency, industrial symbiosis, and cradle to cradle (Korhonen et al., 2018; Geissdoerfer et al., 2017; Ghisellini et al., 2016; Andersen, 2007).

economic activity (Camaren & Swilling, 2012; Williams, 2019; Remøy, Wandl, Ceric & van Timmeren, 2019). Due to the relative proximity of all those aspects, cities also hold a great potential to close resource loops (Williams, 2019; Bolger & Doyon, 2019; McCormick, Anderberg, Coenen & Neij, 2013). Therefore, several studies found the rate of circular innovation to be higher within cities than other areas (Bolger & Doyon, 2019; Russell et al., 2019).

To better understand the above-mentioned phenomenon, and to further understand the geographical aspects of the CE, thus also relating to planning for a CE, this section introduces the concepts of value retention and geographical proximity. First, Reike et al. (2018) introduce the concept of *value retention* as a means to judge how much a given practice contributes to a CE. It can be understood as follows: any product or resource has an intrinsic value that can be retained when using it in its current state, all the additional energy, money and resources that are needed to invest in the resource or product lessens the value retention, making it a suboptimal practice of CE (Reike et al., 2018). Thus, reusing a product results in a high level of value retention, and recovering resources from it is a less optimal practice. However, when applied to for instance the adaptive reuse of buildings (which is a common practice in urban regeneration), it becomes evident that also the operational effects need to be taken into account when judging the circular performance of the building. For instance, reisolating a building would only make sense if the additional energy and CO_2 emissions that are required for this intervention would eventually be outweighed by the performance gains (more efficiently heated) (Yung & Chan, 2012). While discussing the technical and environmental effects of certain CE options is beyond the scope of this study, this example goes to show that decision making regarding, for instance adaptive reuse can have a complicated technical, economic and environmental dimension. Thus, a poor understanding of those dimensions can lead to suboptimal CE performance, or even unsustainability (Foster, 2020; Kirchherr et al., 2017).

Secondly, another way to increase the circularity is by closing loops at a lower geographical scale, thereby creating proximity supply chains, and short supply chains (Williams, 2019; Gallaud & Laperche, 2016; Savini, 2019; Petit-Boix & Leipold, 2018). The former relates to the proximity of producers, consumers, suppliers, and retailers, and the latter to reducing the intermediate steps between producers and consumers (Gallaud & Laperche, 2016). Both supply chains are of importance to the CE, as shortening

transportation distances and decreasing the intermediate parties both lower the additional energy and time that is required, thereby resulting in a higher level of value retention and lower greenhouse gas emissions (Williams, 2019; Petit-Boix & Leipold, 2018). By allowing more emphasis on localisation (thus enhancing proximity) in the production of goods and services, the city scale becomes of great importance for transitioning to a CE, many authors agree (EMF, 2019; van Buren et al., 2016; Russell et al., 2019; Williams, 2019; Petit-Boix & Leipold, 2018). In addition, closing loops more locally decreases opportunities for offsetting negative externalities of the production of goods and services, in turn stimulating more sustainable practices that generate fewer negative externalities (Su, Heshmati, Geng & Yu, 2013; Gallaud & Laperche, 2016). However, cities do not have the capacities to close all resource cycles or generate all the necessary services, thus a subsidiarity principle applies here, meaning that resource loops should be closed at the lowest possible geographical scale while adjusting for the effects on value retention (Williams 2019; Gallaus & Laperche, 2016). A great example are Eco-industrial Parks (EIPs) where the geographical proximity allows industries to integrate their production processes, often by using negative externalities or waste (e.g. residual heat) of one production process as an input for a different process (e.g. heating greenhouses), thus lowering the resource dependency of both industries (Velenturf & Jensen, 2016). In later sections, the concept of proximity will be discussed into greater detail by utilising literature from EIPs, (sustainable) urban regeneration, and other CE practices in relation to financial, social capital, spatial, governance and knowledge factors.

2.3.3 Circular Area Development as a Planning Strategy

The previous section already paved the way for explaining why the CE has consequences for planners through its intrinsic geographical element to it, then why cities are of importance, and that an understanding of value retention and the operational effects need to be included into decision making regarding circularity. In this section, CAD is introduced and discussed as a tool for planners to enhance CE development in post-industrial areas. While the CE has been discussed in many publications in relation to the (sub)city level, by urban living labs, experiments, public procurement, tendering and infrastructures (Petit-Boix & Leipold, 2018; Williams, 2019; Savini, 2019; Levoso et al., 2019), van den Berghe & Vos (2019) is the only scientific publication that specifically

mentions CAD but does not provide a definition[4]. Therefore, this research combines insights from grey literature published by independent research institutes and consultancy companies, namely Platform31, Metabolic, and The Ellen MacArhtur Foundation to formulate a definition.

First, all of the publications about CAD refer to the three dimensions of sustainability: economic prosperity, social justice, and environmental protection, as fundamental principles CE developments should adhere to (EMF, 2015; Huijding et al., 2018; Metabolic, 2019). Whereas sustainable area development can often be too ambiguous and has shown to provide little guidance in how to be applied in area development, the CE has an advantage in that it provides operationalized guidelines, such as the R-imperatives (EMF, 2015). At its core, CAD is a strategy to enhance the development of the CE in a given area, and it should therefore enhance drivers and lower barriers for CE development (EMF, 2015; Huijding et al., 2018; Metabolic, 2019). In addition, CAD should not just be a composition of various CE business and initiatives in the same area, but attention needs to be paid to possible interconnections, synergies, and win-wins within the designated area that can lower the resource dependency and production of waste for the area as a whole (EMF, 2015, Huijding et al., 2018). Therefore, circular principles are acknowledged, enhanced and practiced at both the micro and meso scale (van den Berghe & Vos, 2019). And lastly, the area should enhance the provision of social, economic and environmental effects for its city and the region, thus having an emphasis on geographical proximity (Willams, 2019). For instance, by providing jobs for local residents, providing ecosystem services, and allowing equal access to various socio-economic groups (EMF. 2015). Concluding, when planning for CAD there are various challenges here for urban planning, and the tools to enhance CE development (e.g. co-production, zoning, policies, living labs) should be chosen and evaluated with the embeddedness of the R-imperatives and geographical proximity of services at various scales in mind.

[4] Databases used: Web of Science, Scopus & Google Scholar.

2.4 Aligning Circular Area Development with Post-Industrial Regeneration

2.4.1 Introducing the Five Categories

The previous sections gave an overview of the central concepts for this research and provided definitions and some common challenges and characteristics of those. In this section both concepts are discussed more in combination and comparison through five main categories: governance, financial factors, spatial factors, social capital, and finally knowledge & technology. For each category, drivers and barriers for both post-industrial regeneration and CAD are discussed and compared, thereby giving a theoretical foundation that can be operationalized to eventually assess the potential of CAD as a regeneration strategy. These five categories were identified through a thorough literature study on both CAD (and more generally the CE in cities) and urban regeneration of post-industrial sites in the global north. The identification of the categories could come from either concept based on it reoccurring in literature. However, most categories occurred in the literature of both concepts. Then, for the regeneration literature, only studies were included that focussed on specifically business-led redevelopments, rather than the majority of studies which included housing as a redevelopment strategy. This decision was based on the case of the Werkspoorkwartier solely being business-led redeveloped, thus housing-led redevelopment literature would not apply. Lastly, due to the CE being researched only more recently, the literature on CAD and planning for the CE often had research gaps. Therefore, literature on both sustainable regeneration of post-industrial sites and EIPs, which are concepts that show great similarities with this research aim, are utilised where CE literature has gaps.

2.4.2 Governance

The previous sections exemplified how governance plays an important role in both urban regeneration and CAD. The former must deal with an already existing and often diversified landscape wherein regeneration is sought through collaborating with its current actors to steer the area into a more desired direction (Roberts, 2000). The latter requires a type of steering that fosters the inclusion of R-imperatives within and between businesses (Williams, 2019; Huijding et al., 2018). Therefore, governance is an unavoidable aspect and will be discussed in this section through institutions, actors, and the governance process. For this study governance is understood as *'the process through which local authorities, in concert with private interests, seek to enhance collective goals. It is a process shaped by those systems of political, economic, and social values from which the urban regime derives its legitimacy* (Pierre, 1999, pp. 374-375). Also, there are various

modes of governance that relate to the possible interactions between the state, market and civil society. This study primarily refers to public-private governance, which aims at the interactions between the state, in this case the municipality, and the market, referring to the various businesses at the post-industrial site (Driessen et al., 2012). Since the Werkspoorkwartier is a business park and is currently redeveloped solely for business purposes, most of the governance happens between the state and market, and civil society is more indirectly involved.

2.4.2.1 Actors

During the de-industrialization phase, industrial properties were often sold back to governments parcelled into smaller lots and sold for other purposes (Lehmann, 2019). As governments were now facing the complicated task of finding a new purpose for these areas, property-led redevelopment was often chosen. Thereby leaving as much of the development to the market as possible, which in practice often resulted in the selling of smaller lots, non-brownfields, and better situated sites that would developing more rapidly than others (Loures, 2015; Healey, 1995). Consequently, the areas experienced unequal development, while many new actors (e.g. businesses and developers), which also meant that the municipality was losing its ground position in the area (Roberts, 2000; Lehmann, 2019). Thereby, Loures (2015) found post-industrial sites to often have scattered landownership and contrasting businesses within the area (e.g. cultural functions next to industries). Thus, when regenerating these areas, a great variety of actors and often diverging interests have to be dealt with, especially when the ground position of the municipality has weakened over time (Roberts, 2000; Healey, 1995).

In CE literature, the inclusion of local actors is highlighted as a critical factor, especially since CE practices need to be enhanced within and between firms (De Haas & Kranendonk ,2019; Sdino et al., 2020; Turcu & Gillie, 2020). This is also supported by EIP literature, which found that cases that exclusively rely on top-down governance increased the chances for projects to fail (Pellenbarg, 2002). Therefore, identifying and then communicating, defining the problem, and collaborating with actors sustained over time is a key component for governments to foster CE development (Girard & Gravagnuolo, 2017; Turcu & Gillie, 2020; Sdino et al. 2020; EMF, 2015). The first phase, identifying actors means understanding the existing companies in the area, knowing what resources these have to exert power, and how these are potentially benefitting by the CE. Especially identifying and including more powerful local actors can have a leverage effect on other

companies to participate (Pellenbarg, 2002). Moreover, the inclusion of actors other than local companies can contribute, especially if these bring resources that are not present in the area itself. For instance, knowledge institutes like universities and consultancy companies can be important actors as these can provide knowledge, technologies, research, and are often sources for CE startups (Amenta et al., 2019; Varjú et al., 2019; De Medici et al., 2018). And lastly, Cramer (2015 & 2020) found that intermediate agents can accelerate CE development from case studies in the Netherlands. A characteristic of these agents is that they do not act out of self-interest, thereby often gaining trust among actors and enabling them to build cooperation and alliances among them.

Taken together, the literature of both concepts highlights that the circular regeneration of post-industrial requires a strategy which includes the local actors as much as possible, while CE literature also exemplifies that the inclusion of external actors can be a driving factor. Although this requires a deliberative form of governance, many scholars agree that municipalities are still very important in this proces (Termeer & metze, 2019; McDowall et al., 2017; Velenturf, Purnell, Tregent, Ferguson & Holmes, 2018). Throughout literature, three ways for municipalities to take an enabling role as an actor were found. First, strategic plans for a CE do not just serve as a common goal for a city, these also illustrate the commitment the municipality is willing to take on. Therefore, providing legitimacy to certain CE developments within the city, and guiding governance, and sometimes it can be used to reprimand the municipality when deviating from their formulated goals (Velenturf et al., 2018). Second, municipalities themselves have legislative, financial, economic, and (practical) knowledge resources (Bolger & Doyon, 2019). Especially combining resources was found to lower barriers more than only utilising a single resource (Bolger & Doyon, Lindner et al., 2017) Therefore, acknowledging, utilising and allowing access to these resources through co-producing with CE initiatives can go a long way in enhancing CE development (Prendeville et al., 2018; Amenta et al., 2019; Varjú et al., 2019). Third, municipalities make decisions on public procurement, which approximately accounts for 14% of the GDP for European Countries (EMF, 2019). When setting up contracts and tenders, municipalities can prefer CE initiatives, thereby stimulating the CE within its city, but also giving a good example to local businesses (Bolger & Doyon, 2019).

2.4.2.2 Institutions

One important dimension of governance are institutions, which can be defined as ''*cognitive, normative, and regulative structures and activities that provide stability and meaning to social behaviour. Institutions are transported by various carriers (cultures, structures and routines) and they operate at multiple levels of jurisdiction''* (Scott, 1995, p. 33). In the case of post-industrial regeneration, the main institutional challenge is to understand the fine-grain of local conditions that have developed over time, then building the institutional capacity to bring long-term change to those conditions (Healey, 1995). Davies (2002) adds that ''*institutions must be based on principles consistent with the outcomes they are intended to generate*". However, post-industrial sites often lack institutional capacity or have institutions that support the status quo (Roberts, 2000, Lehmann 2019). Therefore, creating a common goal, regulations and policies to support it, and allocating roles to incumbent actors can be important strategies to create new institutions that can break with the current path dependency and create coalitions in a multi-actor setting (Taşan-Kok, 2010; Loures, 2015; Healey, 1995).

In the case of the CE, many institutional barriers have been identified by scholars, most of those are related to the linear economy status quo. First, Fischer & Pascucci (2017) found that the existing financial institutions of the textile industry in the Netherlands work against circular business models that provide products as a service. Those financial institutions base their criteria for investment on the ownership of assets, which applies more to conventional business models, rather than the cashflows that are more applicable to products as services. Consequently, it was harder for textile start-ups to get similar investments to linear equivalent business models. Second, Stahel (2016) argues that pro-growth arrangements hinder the shift from taxation on labour to virgin resources, which hampers CE development as it is often more labour intensive compared to its linear alternatives. Building on that argument, Moreau et al. (2017) argue that the profitability of CE activities will not surpass the linear activities, if the costs and benefits through the taxation of virgin resources, energy, and labour are not redistributed. Third, the competition narrative among companies was found to counteract the development of institutional networks for the dissemination of knowledge and synergies of production processes among companies which the CE requires (van Buren et al., 2016). Fourth, the market structure relating to the quality, availability, and pricing of usable resources is a critical factor for successful implementation of CE initiatives (Russell et al., 2019; De Jesus & Mendoca, 2018). For instance, materials are often too quickly categorised as waste,

leading to a variety of directives and regulations to be applied that can hamper retrieving parts or resources from it (De Jesus & Mendoca, 2018). The abundance of waste in cities therefore has the potential to create prolific market structures for CE initiatives, however the access and regulations that apply to waste infrastructures create barriers for initiatives to access it for resources (Russell et al., 2019).

2.4.2.3 The Governance Process

Now that the previous sections helped to understand the constellation of actors and how these are affected by various institutional factors, this final section on governance will elaborate on procedural factors of this specific multi-actor approach. First, the regeneration of post-industrial sites requires a tailor-made institutional and governance setting as the differences among these areas and their multi-actor nature lead to site specific complexities (Taşan-Kok, 2010). Secondly, Taşan-Kok (2010) found that a lack of transparency during the process of governing can have very negative effects on the ability to bring actors together and cooperate, this is especially relevant when there are disputes among actors. And thirdly, multi-actor participation needs to be encouraged at every stage of governing from the problem definition (which was already addressed in section 2.2.2) until formulating goals and allocating resources and responsibilities, the key challenge here is to sustain the interest of actors during this process (Roberts, 2000; Ekman, 2004).

In CE literature, recent publications point to the direction of so-called *triple-helix governance* as a mode that could foster CE development (Anttonen et al., 2018; De Medici et al., 2018; De Haas & Kranendonk, 2019; Cramer, 2020). Within this mode of governance, the three helices: government, businesses, and universities, each have resources and capacities that can be complementary to each other and therefore foster greater CE development (Cramer, 2020; Anttonen et al., 2018). The aim of this model is to create a consensus space among the helix-actors where there are agreed-upon definitions, problems, opportunities, and goals for CE development, thus encouraging commitment for the actors to utilise their resources (Anttonen et al., 2018). This is very similar to the process described for governing post-industrial regeneration, however the role of universities is emphasised more greatly in this approach. Anttonen et al. (2018) compared documents and publications from the three helix-actors and found that there is currently only consensus space regarding economic opportunities for waste, recycling and waste management, thus consensus regarding other economic, social and

environmental practices are often missing. Cramer (2020) suggests that the intermediate agents could play a role here, as they can foster knowledge transfer regarding the CE among the actors, thus potentially enlarging the consensus space due to a better understanding of CE practices. Lastly, De Medici et al. (2018) found the triple-helix approach to be effective in fostering circular regeneration of heritage. Therein, universities provided technical knowledge regarding the degree of circularity for several approaches that were then considered by businesses and the municipality. Thereafter, public-private partnerships were made to realise these projects which strengthened commitment of the actors within the consensus space (De Medici et al., 2018).

2.4.3 Financial Factors

In the redevelopment of post-industrial sites there are various financial factors that play a role as either enablers or barriers for developments. First, these sites often have advantageous locations in cities which can be directly linked to raising prices of properties over time (Loures, 2015). This is often a key driver for redevelopment, especially when the potential profits can be outweighed by the additional costs for remediation or transformation on these sites (McCarthy, 2002; Lehmann, 2019). According to McCarthy (2002) the privatisation of landownership on these sites over time can result in implications for policies. The incumbent actors need to be incentivised for redevelopment, for instance by lowering regulatory barriers. However, these developments need a new trajectory for development, often with the aim to reconnect these places with their surroundings which on the contrary, might require more steering from the government. This leads to what McCarthy (2002) coins the dual land-use policy challenge. Additionally, a new trajectory for an area also creates financial uncertainties for private parties, especially when there is industrial heritage or contaminated soil which can drive up the costs of redevelopment (BenDor, Metcalf & Paich, 2011). Therefore, scholars suggest that public funding in the forms of grants, loans, or tax credits which are specifically aimed at desired redevelopment schemes can go a long way in enhancing redevelopment (BenDor et al., 2011; McCarthy, 2002). Also, this brings implications for which sites are given priority, should that be the ones with the highest financial barriers (e.g. heavily contaminated), or the highest economic, social and environmental viabilities? Answers to those questions are often site-specific as it is influenced by the local context and redevelopment purpose. However, when these implications are understood and implemented poorly, funding might increase local contrasts rather than decreasing those (BenDor et al., 2011). And lastly, McCarthy (2002) also found that a single high-profile

redevelopment on a site with more financial challenges can foster a ''domino effect'' in the area as it provides credible evidence to other actors that struggle with financial uncertainties.

The process of finding new uses for post-industrial sites and real estate already has a CE element to it since the existing resources form the base for regeneration (Nowakowska & Grodzicka-Kowalczyk, 2019). Besides adaptive reuse of building stocks, CAD requires the uses within the area to have CE elements in their business cases, so the area is not just designed by CE principles, but also functions according to those (van den Berghe & Vos, 2019). Most of the important frontrunning CE initiatives, especially in urban regeneration, are SMEs, which face various barriers and opportunities related to financing (Rizos et al., 2016). First, a lack of financial capital is often identified as a major barrier that hampers CE development. Due to experimental business cases and high upfront costs related to required resources for researching the business potential, the first stage of setting up businesses brings along financial barriers (Rizos et al., 2016; Russell et al., 2019). Secondly, although cities have an abundance of waste, the lack of infrastructure to access those resources, and required additional processing costs, in contrast to low taxes and costs of virgin and ready-to-use resources, greatly hampers the possibilities for the CE businesses to compete with linear alternatives (ibid). CAD has a potential in lowering financial barriers due to positive external effects of clusters. First, clusters allow the dissemination of knowledge and know-how among CE initiatives, thus lowering upfront costs for new initiatives, which is supported by studies based on incubators and living labs (Rizos et al., 2016). Secondly, clusters could provide better access to waste infrastructures for resources due to scale effects that are generated by the cluster (Girard & Gravagnuolo, 2017). Examples often include resource hubs, collective procurement, or overspill of resources between companies (EMF, 2019). Although direct financial support in the forms of grants, loans and subsidies are often discussed as tools to enable CE development, the primary financial focus of CAD should arguably be on creating financial stimuli related to place specific benefits and win-wins between initiatives, rather than primarily supporting individual businesses. Studies on EIPs showed that the more successful cases often prioritised place-specific benefits and intercompany win-wins rather than treating those as potential benefits. Thereby, utilising financial stimuli directly for those aspects (Roberts, 2004).

2.4.4 Spatial Factors

Post-industrial sites often have common spatial characteristics due to partial neglection of these areas for several decades by developers and governments, resulting in a downward spiral of decay, the creation of brownfields, decline of building stock quality and decline of spatial quality (Loures, 2015; Ploegmakers & Beckers, 2012; Roberts, 2000). In previous sections, the splintering of properties and ownership was already discussed as a barrier for creating capacity for redevelopment schemes. In this section, several other spatial factors are discussed. First, these areas often experience higher rates and perception of crime (Roberts, 2000; Loures, 2015). Several authors suggest that these rates of crime can be explained by the high levels of vacancy in these areas, since strong correlations were found between vacancy rates and crime rates (ibid). Second, these areas often have aging infrastructures that are inherited by their industrial history, but do not function by today's standards. In the case of mobility, the areas are often car-oriented, and thus have underdeveloped infrastructures for other means of transportation (Small & Syssner, 2016). Other infrastructures are often specifically developed for industry purposes, and thereby lack the capacity to support other means of uses. For instance, Roberts (2000) found several cases where the electricity infrastructure would only support high voltages that are common for heavy machinery but does require expensive inverters for domestic types of uses. Third, ecosystem services are often underdeveloped in these areas, thus the creation of green spaces often plays a major role in redevelopment strategies (Loures, 2015). However, due to its indirect addition of value, developing green spaces in an area with fragmentated landownership can be a great challenge (Ploegmakers & Beckers, 2012; Roberts, 2000). Taken together, the reintegration of post-industrial areas into the surrounding cities is not merely a challenge of rezoning the area for different uses but does require a more comprehensive approach that tackles other spatial barriers that could obstruct regeneration.

In CE literature, there is a growing emphasis on the importance of spatial factors that either enable or obstruct CE development. Many authors suggest that a localization of economic activities is necessary to counteract the negative externalities of goods and services based on arguments related to proximity and value retention (Williams, 2019; Levoso et al., 2019; Obersteg et al., 2019). As a consequence, the management of space is of great importance as space is required for attracting and housing various links of the production process, but also for the necessary capacities related to infrastructure,

knowledge, technology, and other types of capital need to be present (Williams, 2019). In addition, these factors should create an environment that encourages symbiotic relations among companies, thus strategic planning and management of space is of great importance to ensure the development of the right circumstances (Bolger & Doyon, 2019). Thereby, planning tools such as CAD do not require general policies for CE development, but should rather encourage the development of capital and initiatives that also have a mutually enforcing effect. This is supported by EIP studies that showcase that detailed strategies combined with a pro-active role of governments were more likely to reduce waste production due to the specific development of certain infrastructures and capitals. General policies on the other hand could also foster EIP development, but often led to splintered developments throughout the areas with suboptimal reductions of waste (Roberts, 2004).

2.4.5 Social Capital

In this section, urban regeneration and the CE are discussed through the social capital lenses of networks, trust, and leadership. First, local networks are often identified as a precondition for coordination and collaboration with incumbent actors. However, because of fragmentation and lack of overarching strategies, post-industrial areas often lack the network capacities to build coalitions for regeneration strategies (Roberts, 2000). Ekman (2004) argues that by building networks and by including important stakeholders at the offset of regeneration programs, the likeliness of creating partnerships and joint ventures increases, which can be important aspects of regeneration strategies. Although requiring a larger upfront investment in time, Ekman (2004) finds that it eventually pays off since networks are not only useful for deliberation and coalition building, but also increase the likeliness of addressing area specific concerns that could lead to debilitating problems further on. In the case of EIPs, networks also play a vital role since resource sharing, linking production processes, and exchanging technology and knowledge among actors is very unlikely when ties among them are weak (Roberts, 2004). Geographical proximity also plays a role here, as several CE studies found that it increases the chances of building trust and networks among companies (Velentuf & Jensen, 2016).

Secondly, trust plays an important role for both regeneration and CE initiatives. The former relies on mutual trust among actors and stakeholders because regeneration often requires taking risks, which actors are far less likely to take when those do not trust the intentions of other actors (Tötzer & Gigler, 2005). In CE development on the other hand,

trust is necessary as production processes in circular initiatives are often integrated, for example by processing residual energy or waste, mutual trust was found to be of great importance (Velenturf & Jensen, 2016). This is also present in EIP literature, where trust is considered as a prerequisite as symbiotic links between companies makes them more vulnerable (Tudor et al., 2007). Although trust usually develops over time, it can also be accelerated by development plans, arrangements among companies, development strategies, policies, and financial risk limiting strategies (Roberts, 2004).

Thirdly, leadership can play a role as well. In regeneration literature, senior or other important actors could play an important role in setting an example or by convincing other actors to participate in a regeneration strategy (Roberts, 2000). The most effective leaders are usually those that share the same background as incumbent actors, rather than the ones those are attracted to a place because of its regeneration strategy. In CE literature a lack of leadership is usually identified as a barrier as it can cause a lack of coordination among initiatives which is highly requires to foster mutual benefits (Obersteg et al., 2019). Cramer (2020) argues that especially in a development that requires triple helix actors, external leaders could play an important role as these are less likely to act out of self-interest in comparison to incumbent actors. Although it is harder for these actors to build trust with the actors of the area, in the end their neutral role as an intermediate in a multi-actor setting might also have benefits that incumbent actors lack.

2.4.6 Knowledge & Technology

Especially in CE literature, the availability and access to knowledge and technology play an important role. Examples include innovative equipment, data systems and digital platforms (Russell et al., 2019). In addition, CE activities often require more skill intensive labor than their linear counterparts (Bolger & Doyon, 2019). Therefore, many CE scholars argue that innovative milieus such as incubators, start-up facilitators and living labs could play an important role for CE development as technology and knowledge is often more readily available and disseminated in those settings (Amenta et al., 2019; Varjú et al., 2019). These factors are also closely related to various forms of social capital, financial factors and governance. For instance, Cramer (2020) exemplifies that specific networks for sharing knowledge and skills could have an enabling effect, especially when universities and governments allow access to their resources. Russell et al. (2019) showcase that the availability and access to knowledge and technology are especially

crucial in early stages of CE development, thus policies and financing could be aimed at those aspects when cities seek to accelerate their CE development.

3. Methodology

3.1 Introduction

In this chapter the methodological decisions and steps towards operationalising this research are discussed in relation to the research aim. First and foremost, the research aim of this study can be divided into two knowledge gaps, 1. Gathering a deeper understanding of how CAD can be used as a regeneration strategy, and 2. Which drivers and barriers are experienced by circular practitioners and how these are dealt with in CAD. In the following order, methodological decisions are discussed starting with the conceptual model which formulates the findings of the theoretical framework into variables and units of analysis. Thereafter, various methodological decisions are discussed in the following order: qualitative research, deduction and induction, case study analysis, data gathering, analysis methods, and validity/replicability. By doing so, the procedures contribute to a stronger replicability and internal validity of the research (Bryman, 2012, p. 47).

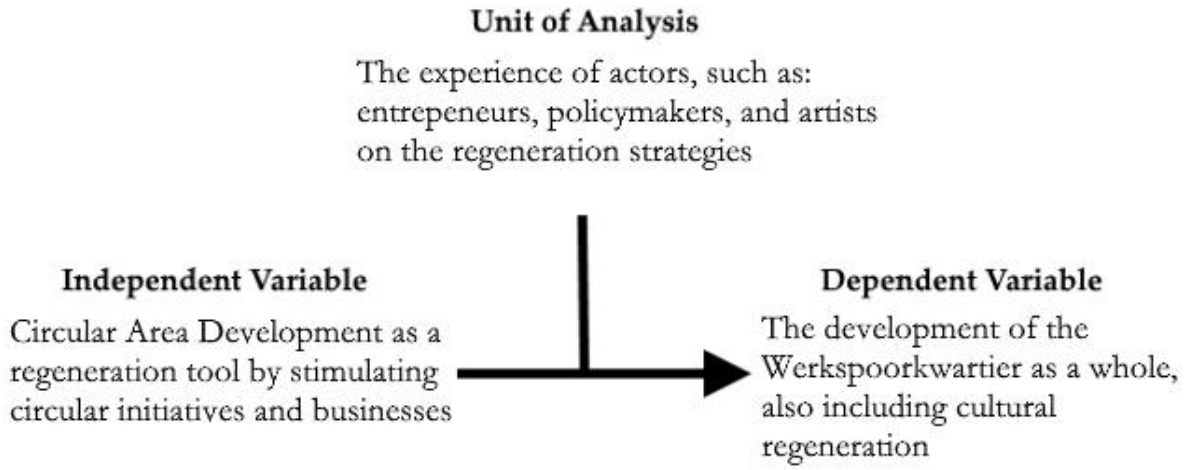
3.2 Conceptual Model

In figure 2, the variables and unit of analysis are presented. Since the aim of this research is to provide insight into the regeneration possibilities of CAD, it becomes the independent variable of this study, as it is expected to have a causal effect on the general development of the area (Bryman, 2012, p. 712). Consequently, the general development of the area is assigned to the dependent variable as it is expected to be influenced by CAD. Including the general development as a contextual variable can be an important part of policy analysis, as social phenomena rarely happen in a vacuum (Huberman & Miles, 2002). Thereby, the conceptual model does not exclude other factors that can be of influence on the regeneration of the area, thus allowing for those to be identified and accounted for in the results. According to Huberman & Miles (2002) in this case the causal relation between the variables can be described as an evaluative type of approach, as the purpose of this study is to evaluate on the potential of CAD in the context of the WSK.

To study the causal relation between both variables, the experiences of important actors such as (circular) entrepreneurs, artists, business owners and policymakers form the

basis of data gathering. By gathering their narratives, views, stories and experiences on the regeneration of the area, and more specifically on the influence of CAD in this process conclusions can be drawn on the potential of CAD as a regeneration strategy. Therefore, these interviews form the unit of analysis for this study, as illustrated by figure 2.

Figure 2: Conceptual Model based upon the literature review.



3.3 Qualitative Research

One of the findings from the literature reviews was that the CE is only researched to a small extent in relation to its geographical application in cities, and CAD specifically is only mentioned in a single scientific publication. This limits the quantitative options for studying CAD, as causal relations between spatial variables and the CE have mostly been suggested on the base of other related concepts. Thus, there is too little empirical evidence to limit the scope of this study to quantitative variables (Bryman, 2012).

The main purpose of qualitative research is to understand a social phenomenon through the interpretations of its participants (Bryman, 2012). It allows for in-dept research whereby detailed information can be produced about a certain phenomenon by taking into account possible contextual factors (Bryman, 2012, pp. 35-36; Yin, 2009). Relating to CAD, it allows for detailed descriptions on how it affects regeneration and interacts with other strategies. Secondly, other than in quantitative research, qualitative research allows for exploring and discovering new findings, which can extend the understanding and knowledge of the topic. For instance, interviews allow a researcher to react to information that is given by interviewees and might ask follow-up questions based on the importance of this information (Bryman, 2012). This allows the researcher to include data and

information that is not reflected in the theoretical framework. Thirdly, qualitative methods allow to a greater extend to account for the complexity and interrelatedness of a social phenomenon (Huberman & Miles, 2002). Since this research utilizes five categories which have specific influences on both urban regeneration and CE development, while also being strongly interrelated, a qualitative approach can better account for these nuances and interplay between factors (Thomas, 2006).

3.4 Deduction and Induction

Qualitative research is often concerned with an inductive approach, whereas quantitative research is more often deductive (Bryman, 2012, pp. 24-27). In inductive research, findings are analysed to eventually move towards the formulation of a theory, while deductive research is focused on testing assumptions from theory through empirical analysis. For this thesis, a combination of the two is used since on the one hand, there are established theories on urban regeneration, thereby these can be deductively operationalised. In addition, the five categories from the theoretical framework are also deductively operationalised, although their empirical evidence for either regeneration or CAD varies between categories. On the other hand, the field of research that links the CE to spatial factors is still developing and therefore lacks empirical evidence for a deductive approach. Therefore, the majority of this thesis is based on a general inductive approach, wherein the five categories are used for deductive guidance, but the findings are based on themes and patterns that are identified in the data (Thomas, 2006). This also allows the researcher to do a 'goal-free' analysis, meaning that the study seeks to describe and evaluate the actual phenomenon its effects, rather than restraining itself to justify it to predetermined effects. Thereby, deviations from the theoretical framework within the results are common for inductive research, but also form a pitfall as it gives leeway for digressing from the research objective (ibid). Therefore, justification and transparency of the identified patterns and categories related to the research aim are an important step to remain consistent in a general inductive approach.

3.4 Case Study

For this thesis, a single case study is chosen as the research design (Yin, 2009). This design suits the aim of the thesis as it allows the researcher to make a detailed description of how CAD influences area regeneration, thereby with higher certainty the researcher can reach internal validity, meaning that the relation between the dependent and independent variable is accurate and described in its entirety (Bryman, 2012, pp. 66-74). In addition,

single case studies allow for even higher internal validity as more time and energy can be dedicated to account for contextual factors, but also the identification of unanticipated effects (Yin, 2009, pp. 84-92). Since the research objective is partly explorative —linking area-specific effects to CE development— a single case study would fit this thesis best as a strong internal validity is more likely to give insight into a hypothesized causal relation (Bryman. 2012; Yin, 2009, pp. 84-92). Thus, this research design can be described as a single holistic case study (Yin, 2009, p. 85). Single because it only one case is chosen to research thoroughly, and holistic as the combined experiences from the different actors account for a single unit of analysis (See Figure 2).

When choosing a case, several criteria are of importance. First, the development needs to be CAD rather than any other form of area development. This means that the definition given in section 2.3.3 must apply to the case. Second, it needs to be researchable, meaning that the development should not be too recent, thereby allowing for sufficient data to be gathered. This is especially relevant for a novel planning strategy like CAD. Thirdly, the case should be accessible for research, also meaning that the actors are willing to take part in the research (Yin, 2009). By comparing CAD cases[5] in the Netherlands it became evident that the Werkspoorkwartier is the case that suits the requirements the best. Most of the other cases do not specifically utilise CAD as a regeneration strategy, or their CE developments are still minimal or in an early phase of development. In addition, the EFRD project *'Werkspoorkwartier: Circulair Creatief Maakgebied'* that was launched in 2017 provides opportunities for this thesis to research CAD in the area, thereby providing access to data, their network, and funding to support the process of this thesis. Besides the case fitting the scientific requirements, there is also a societal relevance in researching the Werkspoorkwartier. The city of Utrecht strives to become fully circular in 2050. To get there, CAD is appointed as one of focal points for delivering the CE, and therefore the current aim is to gather as much information about this novel planning strategy to enable upscaling (Gemeente Utrecht, 2020). Therefore, studying the leading example of CAD in the city contributes to the municipal agenda as well.

[5] Binckhorst, Buiksloterham, Merwe4Havens, Werkspoorkwartier, and Brainport were considered.

3.5 Methods of Data Gathering and Analysis

For this research, semi-structured interviews are used as the primary method of data gathering. As there is little written about CAD in documents and literature, most of the data exists within the experience of the actors, making interviews the most suited way to gather these insights. Semi-structured interviews also allow interviewees to talk about their experiences in details that are not reflected in the data gathered through written resources like project reports and policy documents. In addition, the answers reflect the perspectives and narratives of the related actors, which provides meaningful insights into how CAD is perceived from different actor groups (Bryman, 2012, pp. 468-498). Also, policy documents, white papers, zoning plans, and project reports are analysed to reach for triangulation, meaning that various data sources often more accurately represent the case, but also allow for comparative analysis between the interviews and various documents (Bryman, 2012, p. 392). Therefore, also giving possibilities to find congruence and differences among various data sources, for instance between the initial plans and implementation. To develop interview guides, the drivers and barriers for CE initiatives are used to formulate questions, as these most likely are the subjects wherein the stimulating or obstructing effects for CE initiatives reside. In addition, more general questions about the area regeneration, changing perspectives, and other limiting or enabling factors are used to gather a deep understanding of the contextual factors. Also, by reflecting on the interviews during the phase wherein the interviews are held, additional questions can be formulated based on themes that have not been addressed enough or on interesting insights that were given in previous interviews.

For this study a total of 23 interviews were held that range between 30 and 60 minutes in length. The most important interviewees for this study are entrepreneurs and people that are in other ways related to the circular initiatives in the area. Also, government officials and policymakers from both the municipality and province of Utrecht were interviewed about their views on the area. Additionally, non-circular and sustainable initiatives in the area were interviewed about their experiences, these views are especially helpful as some of them have been so-called first movers or have been associated with the area for a longer time. Thereby, they can provide important contextual information on the regeneration proces in the area as a whole. Due to the frequent request by interviewees to anonymise their provided data, this has been done for all interviews. The interviews and other primary data will however be provided in another document for supervision purposes.

Lastly, on request of a handful of interviewees some phrases are left out of their transcripts, often because of the sensitivity of the information.

When analysing the gathered data, axial coding is used. This means that the codes that are given to a certain line of text is either based upon codes from literature, or new codes are formulated based upon the interviews (Bryman, 2012, p. 569). This way the analysing stage allows new information from the interviews to be dealt with, which was previously addressed as one of the arguments for choosing the qualitative approach. By including the code trees in the appendix, the replicability and reliability of the results of this thesis are increased (Bryman, 2012).

The general strategy of analysing the data follows two techniques. First, a chronical description of the case is developed mainly to provide the contextual background wherein CAD is applied. Especially in complex social structures where developments are greatly interrelated, sketching a timeline of important events and developments can be an important aspect of tracing causes and relations among those (Thomas, 2006). Thematic analysis forms the second and most important strategy for this thesis, its purpose is to identify, analyse, and report patterns (themes) within the data (Bryman, 2012, p. 578). It aims to build an explanation about the case and answer the '*how*' and '*why*' questions about the research objective. Therefore, it applies to this thesis as it strives to answer questions about 1. How CAD is deployed, 2. How it effects common drivers and barriers for CE initiatives, 3. Why it is (or not) effective, and finally 4. How it can be utilised for urban regeneration of post-industrial sites. To get there, themes and subthemes are identified through a thorough reading and rereading of the interview transcripts whereby especially through looking out for repetition, metaphors, similarities, differences, and theory-related material those were coded (Bryman, 2012, p. 580). Lastly, to structure and analyse the data, the program Nvivo is used for coding the transcribed interviews.

3.6 Validity & Replicability

Finally, validity and replicability are two themes that need to be accounted for in the research design in order to produce reliable and replicable outcomes (Boeije, 2010). Regarding validity, this study is mostly concerned with providing the highest possible *internal validity.* This means that the chosen research methods produce reliable results concerning the chosen case. Due to the qualitative methodological approach, this study can integrate many contextual factors that might influence the researched phenomenon,

thus contributing to the internal validity. The *external validity* however is expected to be suboptimal as it reflects the extent to which the results can be generalized. Mostly due to the single case study design, findings of this study cannot be generalised for other CAD projects (Boeije, 2010).

Regarding replicability, it can be defined as the extent to which replication of the research would lead to the same results (Bryman, 2012, Boeije, 2010). This can be accounted for in two ways. First, the documentation of each step from data gathering to analysis, for instance by providing the interview guides, code trees, and transcripts, a chain of evidence is produced which enhances replicability (Yin, 2009). Second, replicability in qualitative research is prone to the bias of the researcher, and because thematic analysis lacks rigorous methodological procedures for analysing data (Bryman 2012, p. 581). While arguably it is nearly impossible to completely do away with the bias, there are still various things that can be done to control for it. Chenail (2011) argues that most of the bias in qualitative research occurs during the interviews as the questions and how they are worded, influence the answers that are given. Chenail (2011) says this can be accounted for when the framing of the topics and questions are peer-reviewed before conducting any interviews. A representative example for this study is the question 'how do you experience the circular initiatives are changing the area?', this not only forces the interviewee to exclude their answer to the circular initiatives, but it also states that the initiatives unarguably change the area. By discussing the interview guide with fellow students and supervisors, it was eventually changed to 'What is your experience of the area? And how do recent developments influence it?' While this is a very broad question, it enables the interviewees to come up with their narrative which might include mentions of circular initiatives instead of limiting their answers to just those.

4 Case Description

4.1 Introduction

The general outline of this chapter is threefold and will be mostly based around the chronical analysis of documents and interviews. Eventually, a timeline is developed of important events and developments which aims to understand the changing conditions of the social, economic, and physical fabric of the area. First, the national and local context is discussed around CE developments and the regeneration of (post-industrial) business parks. It intends to describe the origin, considerations, and strategies that have been

applied and some links are made to the case of the Werkspoorkwartier. The aim of discussing and explaining those processes enables the subsequent chapter on results to discuss exclusively themes that are relevant to the research objective without expanding on background descriptions of these processes. Therefore, the relevance of some discussed items might not become entirely clear from this chapter alone. The second half of this chapter is based around discussing the Werkspoorkwartier, by providing a historical background of the area, and specifically focussing on some of the major developments, projects, and strategies, that shaped the area into its current condition. The chapter concludes by providing a timeline of the most relevant developments.

4.2 The Circular Economy in the Netherlands

In recent years, various national policy documents were published regarding the sustainability and CE of the Netherlands. In this section, the more general national climate agreement and its consequences for the CE is discussed. Then, two national policy documents related to the CE are discussed, one being the general strategy to become circular by 2050, the second document is related to the agenda for circular development between 2019-2023. Since these are large documents that contain many examples and practical explanations, this analysis is mostly concerned with discussing the prioritised policies for CE development, and the policies that affect the organisation of space.

In 2019, the national climate agreement was published, which states that the country strives to reduce its greenhouse emissions by 49% in 2030, and by 95% in 2050 (when compared to 1990) (Rijksoverheid, 2019). To reach the goals, the agreement states that the usage of virgin materials for all industries needs to be mitigated, synergies need to be made in production processes, and waste needs to be reused. This requires a system transition wherein the majority of businesses adopt sustainable and circular business models instead of the current linear status quo. To enhance CE development, the document highlights various action areas. First, places need to be created where innovation and experimentation go together, for instance by developing living labs. To get there, financial arrangements and subsidies become available[6], and public-private partnerships are encouraged to reduce the financial risks for companies. Also, the document states that governments need to reposition themselves to become partners

[6] The national government invests 100 million each year for sustainable or circular innovation

rather than regulators of sustainable development. Especially triple helix governance is mentioned as the recommended arrangement to enhance sustainable development within cities whilst creating attractive and competitive business climates. Also, the development of local clusters where synergies among companies, and scale effects of sustainable alternatives are achieved, are action areas for local development. As most of the urban planning in the Netherlands is decentralised, local governments play a key role in delivering these national strategies. Therefore, the document repeatedly mentions the importance of local governments to adopt these strategies and find solutions wherein sustainability is enhanced in their unique local context (Rijksoverheid, 2019).

While the national climate agreement was in the making, a separate document was published in 2016 concerning the goal for the country to have a circular economy by 2050 (Rijksoverheid, 2016). By 2050 the goal is to cut the use of primary virgin resources like metals, minerals, and fossil fuels by 50%, replacing them by resources retrieved form waste. To do so, resource efficiency needs to be increased, more products need to be developed that are serviceable, repairable, or can be easily taken apart, and sustainable substitutes need to be discovered. Throughout the document, the CE is often portrayed as an economic opportunity, as it allows for new business opportunities and the creation of new jobs. Therefore, barriers to CE development and concrete measures to account for those a covered to a far lesser extent. The document does acknowledge that economic growth should be contained within the earth's carrying capacity, but lacks the justification of given action areas to ensure to stay within those limits while providing economic prosperity.

To move towards a CE agenda containing concrete interventions and action, a separate document was published in 2019 which highlights priorities for the period 2019-2023 (IenW, 2019). Those being: biomass and food production, plastics, the manufacturing industry, the construction sector, and consumer goods. Regarding this thesis, especially the last three are of relevance and will be discussed separately.

First, the agenda regarding the manufacturing industry is especially focussed on information, knowledge, and technology. The document elaborates on various programs which seek to provide more readily available information on product design (e.g. CIRCO), and knowledge platforms to enhance resource efficiency and sharing knowledge and technology on recycling technologies. The document does not elaborate on specific

financial stimuli or constructions (such as shifting taxation from labour to virgin materials), which have been advised prior by the Social Economic Council (SER, 2016).

Second, the interventions for the construction sector are based around creating market incentives, measurement tools, policies and regulations, and knowledge and technology. Especially in this sector, the government sees opportunities via procurement and tenders to play a crucial role itself. Thereby, creating demand for circular renovation and construction of buildings, potentially leading to a domino-effect. Another action area is the development of so-called '*material passports*' to map out the various materials that are used in existing buildings. In addition, experiments are taking place to develop a common language for life cycle assessments which seeks to create insights into the material and resource usage of buildings throughout its lifespan. Regarding policies and regulations, the primary goal is to incorporate circular performance indicators into the current sustainability measurement tool (the '*milieuprestatie eis'*, also known as MPG), which has become a mandatory criterion for building permits. For knowledge and technology, the '*cickelstad*' initiative was launched as a platform for construction firms, governments, architects, and other stakeholder from the construction sector to share their experiences and knowledge (IenW, 2019).

Third, regarding consumption goods, the agenda is much more based around certain sectors rather than presenting overarching actions for the entire industry. Especially the textile industry, the recycling of matrasses, and biobased alternatives are given priority by programs and funding. Also, the development of *communities of practice* within circular hubs where combinations of functions and initiatives can lead to CE development are encouraged. While the document provides various examples of such locations, it lacks in concrete actions and policies to foster these local symbiotic relations, and does not engage in examples of CAD nor EIPs (IenW, 2019).

4.3 Regenerating business parks in the Netherlands

From 1945 until 1995, policies regarding business parks were mostly focussed on separating those from residential areas to mitigate negative externalities, and to centralise industries in areas that were accessible by highways and provided plenty of space for economic development. These areas, often greenfields outside of cities, saw a rapid increase until 1995 as there was still land readily available, and the development and selling of properties provided revenues for municipalities. As investing in already

existing industrial areas was costly and did not provide revenues anywhere close to those of greenfields, pre-1945 industrial areas would often be neglected. Also, the growth of cities around those areas would not enable the same physical separation from industries and residential areas that was encouraged by national policies (Nota's Ruimtelijke Ordening) (Platform31, 2015).

Around 1995, more and more cities started to experience negative effects of the previous policy. Municipalities were now running out of space, due to the growth of residential areas, and the continuous development of new industrial areas on greenfields. Simultaneously, the economy was shifting towards being based around services and innovation, which required to be more geographically centralised in innovative districts with proximity to universities and research institutes. Thus, science parks started to develop at the urban fringes, and the development of business parks far from the urban centres was brought to a halt. While the primary focus was on developing these areas and accommodating the new economic activities, the post-industrial areas continued to remain of a very low priority. Due to these areas being mostly neglected for decades, they were now causing all sorts of issues such as high crime rates, squatting, vacancy, and the deterioration of real estate and urban heritage (Platform31, 2015).

It was not until 2008 when social pressure, and the urgent advice of the Social Economic Council led to the development of the *Covenant for Business Parks 2010-2020* and the *Taskforce for Restructuring Business Parks* (Beekmans & Ploegmakers, 2014). The latter was given a budget of 400 million in 2009 for restructuring, regenerating, and attracting new economic activity in existing business parks (Platform31, 2008). The covenant was eventually based upon the advice from the taskforce to allocate specific responsibilities to provinces and municipalities (BZ, 2010). The necessity for this approach was based on regional and interregional competition, which was an important driver for the continuous development of new business parks in greenfields, and business frequently moving to those newer areas (Beekmans & Ploegmakers, 2014). By providing provinces with the task to align and direct the plans for restructuring and revitalization existing business parks on a regional and interregional scale, the primary goal was the encouragement and development of specialized regions thereby mitigating regional competition (Bestuur Regio Utrecht, 2012). The municipalities were given the task to initiate regeneration, reason for it being that municipalities have the closest ties to the businesses in the areas and are usually far more familiar with the dynamics in the parks than provinces. Thereby,

most of the national budget goes towards municipalities as these are eventually carrying out most of the regeneration (BZ, 2010). The budget was mostly spent on physical renewal in the areas, such as infrastructure, public space, urban greening, and on premises that are owned by municipalities (Beekmans & Ploegmakers, 2014).

Quantitative comparative case-studies evaluated the effects of this policy on private investments, and the value of properties, but could not find any significant causal relation among those (ibid). Ploegmakers et al. (2018) argues that the policy was too one-dimensional, as it often solely targeted physical renewal, but lacking any form of strategic developments that targeted social, environmental, and economic barriers. Platform31 (2015) adds that the policy was too much top-down oriented, and was largely based around outdated economic policies that did not meet the current changing demand of cities. For example, the increasing demand for incubators, start-up and scale-up facilitators, flex working, and freelancing was often barely accounted for by the policies. Platsform31 (2015) argues that the fundamental problem was the outcome-oriented approach of this policy, which did not allow for flexibility and was not able to keep up with the dynamic and continuously changing demand within cities. Therefore, a process-oriented approach was proposed by Platform31 (2015) that would enable bottom-up development rather than restricting it by predetermined requirements.

4.3 The Circular Economy in Utrecht

The CE ambitions of the city of Utrecht shows congruence with the national goal, as the city strives to be 50% circular by 2030 to eventually become fully circular by 2050. The pathway towards a CE is divided into three distinct stages. The first stage lasts until 2023 and is mainly characterised by exploration and experimentation to unravel the opportunities and barriers for CE development in the city. Then, the stage between 2023 and 2030 is mainly focussed on accelerating CE development and exploring previously untouched economic sectors. And the last 20 years until 2050 will be spent to become fully circular (Gemeente Utrecht, 2020). The strategy does not include substantial policies or action areas for the last two stages yet as those will be developed along the way by utilising the input gathered from the first stage. For the first stage, five main action areas are given priority:

1. Enhancing the business climate for CE initiatives, particularly by CAD.
2. Increasing public investments in CE initiatives by procurement

3. Enhancing CAD especially through CE development in the construction sector,
4. More extensive waste collection and separation to further enable the 'waste as a resource' program.
5. Enhancing the availability of knowledge and education on the CE.

When analysing this policy document, it becomes evident that it is mostly comprised of focal points regarding the construction sector, the development and dissemination of CE knowledge (including business cases, measuring CE potential, and data), cooperation, and procurement. Especially the emphasis on the construction sector is visible throughout the document, and planning objectives such as CAD and the CE business climate are mostly discussed in the light of this sector. This emphasis is largely based on a previous explorative study that was published which noted that the growing city of Utrecht and the circular developments throughout the city could create a beneficial environment for this particular industry. In addition, instruments and actions such as landownership, zoning plans, and negotiations with private companies, could all be utilised to encourage CE development in the construction industry (Bureau Buiten, 2019). To experiment with this sector, the municipality denoted 20 areas throughout the city to further explore these possibilities, of which the Werkspoorkwartier especially holds a prominent position.

Furthermore, the document does mention various action areas which are also related to CAD. First, the document states that the municipality should actively guide new initiatives to locations where synergies between production processes may develop. Thereby the pursuit is to create proximity of product and supply chains, but also the development of (specialised) hubs that encourage the CE business climate. Second, in this process the municipality envisions its role mostly as a facilitator and partner for new initiatives. To execute this goal, the municipality takes part, finances, and facilitates organisations such as the Cirkelregio Utrecht, and the Regional Development Company. The focal points of Cirkelregio is mostly based around cooperation and the availability of knowledge. The Regional Development Company, which went into operation in June 2020, also has financial capabilities to directly invest in initiatives with subsidies. Third, the municipality strives to directly invest in circular businesses via procurement and tenders. The aim is to increase its total circular procurement from 13% in 2017 towards 33% in 2022. Fourth, the municipality seeks to take a proactive role in financing and cooperating with knowledge and research institutes to enable teaching and research possibilities. The EFRO project, which is specifically aimed at the Werkspoorkwartier, is one of the

initiatives the municipality is partly financing to work towards this goal, more on that in the next section. Thereby, not all goals have direct geographical components to them, but when focussing on how these are operationalised, it becomes apparent that a few areas[7] throughout the city are often the focal point of these policies and action areas (Gemeente Utrecht, 2020).

4.4 The Werkspoorkwartier

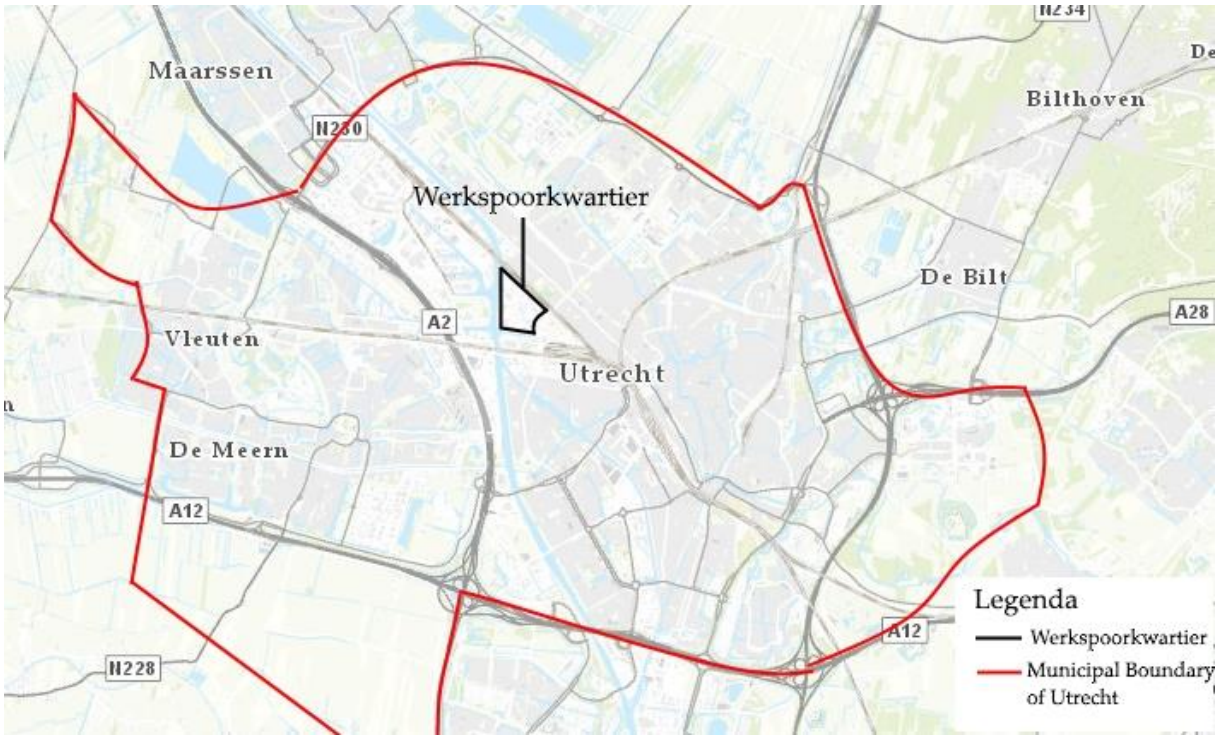
4.4.1 Outline and Introduction

The aim of this subsection is to discuss the case in detail, partly by doing a chronical analysis (as discussed in 3.5) that aims to provide a comprehensive assessment of the context in which CAD is used as a regeneration strategy. To do so, this section is structured as follows: first, a brief historic overview of the area is given. This overview eventually provides a problem-definition diagram for regeneration, as introduced by Roberts (2004) and discussed in section 2.2.2 (see figure 1). This analysis helps to sperate economic, environmental, and social factors together with internal and external drivers, to eventually provide an overview of how these various factors contributed to a state that requires regeneration. In the following chapter on results, CAD practices are also discussed in the light of this framework. The second part of this section is focussed on introducing and discussing CAD practices in the Werkspoorkwartier, also by providing a timeline of important events and developments that took place in the area.

The Werkspoorkwartier is a triangular shaped area of 45 hectares which is situated at the west from the city centre, as can be seen in figure 3. At the northern side, the area is divided form the residential neighbourhood of Zuilen by the railway connection of Utrecht and Amsterdam.

[7] Frequently mentioned: The Werkspoorkwartier, Lagerweijde, Strijkviertel, Merwedekanaalzone & Utrecht Science Park

Figure 3: Location of the Werkspoorkwartier (Source: Utrecht.nl)



At the western side, the area is geographically closed off by the Amsterdam-Rhine Canal, which is of economic importance for transportation (of goods), and also played a crucial role in the development of the Werkspoorkwartier. Therefore, small harbours, as can be seen on figure 4, are also situated at the western side of the area which were used to supply and export goods and products for the factories. All across the southern side, the area is divided by another harbour, called the '*industriehaven*'. On the other side of this harbour there is a strip of warehouses behind which the Schepenbuurt, another residential neighbourhood is located. And finally, at the eastern side, the corner of the triangular shape of the area is cut off by the Cartesiusweg, an arterial road that connects the north and south of the city. Facing the Cartesiusweg, a row of terraced houses is located, which besides five houses that are located at the waterfront, are the only residential part of the area. Since all the houses are located at the borders of the area, it is considered to be predominantly a business park (Gemeente Utrecht, 2012). At the other side of the Cartesiusweg, the CAB building is located. Although this building is technically just outside of the Werkspoorkwartier, it is a piece of industrial heritage that has undergone cultural regeneration that shows great similarities to the cultural regeneration of the Werkspoorkwartier. Therefore, the interaction and influence of the developments in the CAB building should be taken into account when assessing the Werkspoorkwartier

(9 & 23)[8]. The area wherein the CAB building is situated, called the '*the Cartesiusdriehoek*', is currently in the planning stage of a large urban renewal and regeneration strategy. The current plan is to develop 2800 new houses in the area, and the CAB building is likely to become mixed use of housing, cultural, and retail functions (9). The exact plans for the CAB building are still not set in stone, but the housing development in the area at this point largely is.

4.4.2 History of the Area

The developments of the area date back more than 100 years, and in the meantime many events and developments took place that shaped the area to its current state as a business park. Figure 4 shows a recent areal shot of the area that shows a mixture of warehouses that are inherited from the industrial era, but also many smaller warehouses, workshops and offices, which were developed more recently. This subsection will provide an overview of developments and events that shaped the area before regeneration through CAD started in 2016.

Figure 4: Aerial shot of the Werkspoorkwartier (Source: efro-wsk.nl)

[8] From here onwards, numbers are used to refer to the interviews, the list is given in appendix 2.

In 1913 when the Werkspoor, which was one of the largest industrial companies at the time, settled in the area for the production of rail vehicles and steel constructions. As can be seen in figure 5, the area was then at a relatively remote place outside of the city of Utrecht. As the Werkspoor company was facing economic heydays at this time, the company was looking for another location to expand its industrial processes, as it was running out of space at the initial location in Amsterdam. Because of various tactical and economic reasons, the area that is now known as the Werskpoorkwartier was chosen. Some of the important reasons were: the geographical location, as it was situated next to the Merwedekanaal and the railway connection of Utrecht and Amsterdam. This allowed for plenty of transportation options to supply and export goods. In addition, Zuilen which was still an independent village at that point, provided possibilities for housing the workers that the newly developed factories required. Also, the rural surroundings still provided plenty of possibilities for expanding the factories as well as the residential areas next to it (van der Maarl, 2019).

Figure 5: The Werkspoorkwartier in 1923 surrounded by mostly rural areas. (Source: Beeldbank Utrechts Archief)

The following decades were economically great years for the company, which continued to increase its footprint in the area by developing new factory halls and warehouses. Also, the transformation of the Merwedekanaal into the Amsterdam-Rhine Canal, which was completed in 1952, would only increase the geographical benefits, as the renewed canal allowed for much larger vessels to reach the area (16). As the factories also had great energy requirements, the regional energy producer called PEGUS, settled in 1922 at the southern end of the area next to the canal to supply the energy needs of Werkspoor. Later, this power plant would develop into what is now known as the '*Merwedecentrale*', and is currently owned by energy company Eneco, as can be seen in figure 6. The power plant was later transformed to supply the city with district heating (16). Nowadays, the former power plant remains as the largest industrial building in the area and will soon go into the planning stage for redevelopment (4).

Figure 6: The Merwedecentrale in 2011, photographed from the Amsterdam-Rhine Canal. (Source: usine-utrecht.nl)

Figure 6: The Werkspoorkwartier (orange)
In the continuously growing city (Gemeente Utrecht, 2012)

Over the years, the Werkspoor, as well as the village of Zuilen, and the city of Utrecht kept expanding, as illustrated in figure 6. In 1954 the city of Utrecht would annex the still independent village of Zuilen. During the post-war period, especially the northern and southern areas from the Werkspoorkwartier would see mostly residential developments. Also, around 1945 development began of what is now the largest business park and industrial area of the city '*Lage Weide',* which is situated just across the canal from the Werkspoorkwartier. While the Werkspoorkwartier its expansion possibilities were limited by urban development around the area (see figure 7), Lage Weide was still at the fringe of the city where ample space was available for industrial expansion across the renewed canal (16).

Almost 60 years after the Werkspoor settled in the area, the last order of railway vehicles was delivered in 1972 (van der Maarl, 2019). Even though the Werkspoor attempted to adapt to a changing market by diversifying its products and research—which at one point even included nuclear energy—it could not compete with international competitors and gradually closed during the 1970s. How the area developed after the closure of the Werkspoor is still a bit of a grey area, as the exact order of developments is not very well documented. However, according to the interviewees, various developments and trends were influencing the area during those times. In general, the area remained of relatively low economic importance for the city (9 & 16).

Figure 7: 1949, The Werkspoorkwartier at the bottom and the residential neighbourhood of Zuilen at the top, divided by a railway and the Juliana park. (Source: Beeldbank Utrechts Archief)

At the national and local level, the separation of working and living was a dominant conception up to 1995, and was further enabled by the widespread adoption of automobiles from the 1950s onwards. In addition, new environmental legislations that went into effect during the 1970s prohibited heavy industrial activities in proximity to residential areas (van der Maarl, 2019). Therefore, the Werkspoorkwartier had to undergo a transition in functions, but struggled to find demand as the infrastructures and industrial heritage were catered for heavy industry, and the contamination related costs were largely unclear (16). During those years, some of the factories and warehouses were demolished, resulting in in patches of open spaces distributed throughout the area, as can be seen in figure 8. Besides the energy plant still being in operation, and the offices for the municipal energy services being constructed (the white building in the middle of figure 8), large parts of the area were vacant or unused. During those years, the municipality itself was a source of development, as municipal services were moved to the area, and later in the 1990s it would open a recycling centre in the middle of the area (9).

Figure 8: The Werkspoorkwartier in 1989 (Source: Beeldbank Utrechts Arcief)

During the 1980s and 1990s, some light industries, garages, transportation companies, offices, and distribution centres would come to the area, mostly by developing the areas in between the industrial heritage, or sometimes by reusing some of the structural elements of the buildings (16). During these years, the municipality was very welcoming to any companies that had interest in setting up business in the area, as most of the companies were drawn to the newer state of the art business parks that were being developed outside of cities (4 & 19). This led to relatively uncoordinated developments, as a general master plan or vision for the area was missing. According to some interviewees, various levels of government neglected these post-industrial areas, as their redevelopment costs and potential could not outweigh the economic developments of green fields (4 & 12). Thus, there were little political and societal incentives to invest in these areas at the time.

Figure 9: The Werkspoorkwartier in 1991 (Source: Beeldbank Utrechts Archief)

Figure 9 shows how these various new businesses developed throughout the area, but the industrial heritage remained largely untouched and vacant. During those years, the Werkspoorkwartier was also known for high rates of crime. Especially, dealing of drugs, burglary, vandalism, squatting, and illegal prostitution were common acts of crime in the area (9). Therefore, besides being of moderate economic relevance for the city, it was considered to become a burden in social and environmental factors (4, 9 & 16). *'Most of the citizens had no reason to visit the Werkspoorkwartier, it was dirty, ugly, and could feel very unsafe at night'* (9). Due to its industrial origins, there was also little to no attention for developing ecosystem services, such as green spaces, or to create attractive public spaces in general (4). In addition, the sale of fragmented pieces of land to smaller businesses also decreased the ground position the municipality had in the area, which reduced the possibilities for directly influencing the area by the municipality (1).

Besides offices and light industries settling in the area, creative entrepreneurs were attracted to the area as well. Some of these were squatters, others were attracted by the low costs of renting studios in the area (16). Multiple interviewees pointed out that the influx of creatives was driven by three factors. First, the strongest driving factor was the ample availability of relative cheap workspaces in the area, which were starting to become scarcer in other areas of the city (20). Second, where most economic sectors and industries have relative high requirements from their buildings and environment, the degraded buildings, infrastructures, relative bad environment and underdeveloped business climate were hampering the attraction of service based economic activities that started to develop in western countries (4 & 16). The creative class however, had little requirements from either real estate or their surroundings, and were mostly able to set up shop without depending too much on existing resources (16 & 20). Or as someone put it '*The creative class rather works with blank canvases than prefabricated solutions. This holds true for their work, but also for their needs in terms of space. Therefore, they prefer realizing their own studios and ateliers that suits their creative process, even if this requires their own resources to get there'* (16). Thus, the large halls, warehouses, in between spaces, and other inherited buildings from the industrial era gave potential to the creative class to realise their own spaces. Third and last, the environment itself was regarded to be an inspiring place for this creative class. The rough edges, its history, internal contrasts, and eroded industrial heritage provided a unique selling point (16 & 20). Thereby, the creative class saw an untapped potential in the area, sometimes referred to as '*the creative playground of the city*' (20).

Although most of the cultural developments happened independently throughout the area, a group of artists saw the potential of this new influx of the creative class and decided to set up a collective called the '*Cartesius Museum'.* The initiative envisioned the entire area to be an open-air museum, where anyone could take a walk along the different ateliers, workshops, studios, and creative collectives (16). However, the initiative was especially successful in drawing attention into the future of the development of the area (4, 9, 13 & 18). Every month, the collective would organise an open meeting for anyone that was interested in the development of the area, to discuss and exchange ideas about potential pathways of developing and regenerating the area. The meetings, called the '*Cartesius Tafel'*, were distinctive in their bottom-up organisation, being open and accessible to anyone, and did not have a strict agenda to follow. The events drew crowds between 20-60 attendees, among which some of the entrepreneurs that would later

contribute to CAD in the area (1 & 10). The meetings had a significant contribution in kickstarting regeneration in the area, '*the meetings urged the (creative) entrepreneurs in the area for the first time to think about their collective potential in influencing the course for the area, it excited the attendees as we allowed them to dream big'* (16). Although the non-creative entrepreneurs of the area had little interest in taking part in these meetings, the Cartesius Museum actively reached out to those parties, with some successes. Among its activities were company outings, events, and exhibitions that drew local entrepreneurs and citizens to the area. *'This was probably the beginning of the rediscovery of the area'* (9).

4.4.3 The First Regeneration Strategy

The contribution of the creative class settling in the area became the more evident when the development strategy for the Werkspoorkwartier was published in 2012. The development vision for the area became '*a business park with small scale and low environmental impact manufacturing industries, combined with culture-led regeneration, and some space for leisure and sports*' (4). The area manager of the municipality was a frequent attendee at the Cartesius Tafel and was intrigued by the potential of culture-led regeneration. '*Around the turn of the century, examples were popping up from other Western cities, such as Berlin, London and Amsterdam where culture-led regeneration proved itself as a development strategy for post-industrial areas*' (4). In addition, the positioning of the Werkspoorkwartier became more central in the 21st century due to the development of the neighbourhood of Leidsche Rijn at the western edge of the city, as can be seen in figure 6. Also, the area became more accessible by a railway station that opened just outside the area in 2007. Taken together, these were considerations for revisiting the development strategy of the area (Gemeente Utrecht, 2012). Based on the information gathered from interviews and policy documents, the following problem definition diagram was produced:

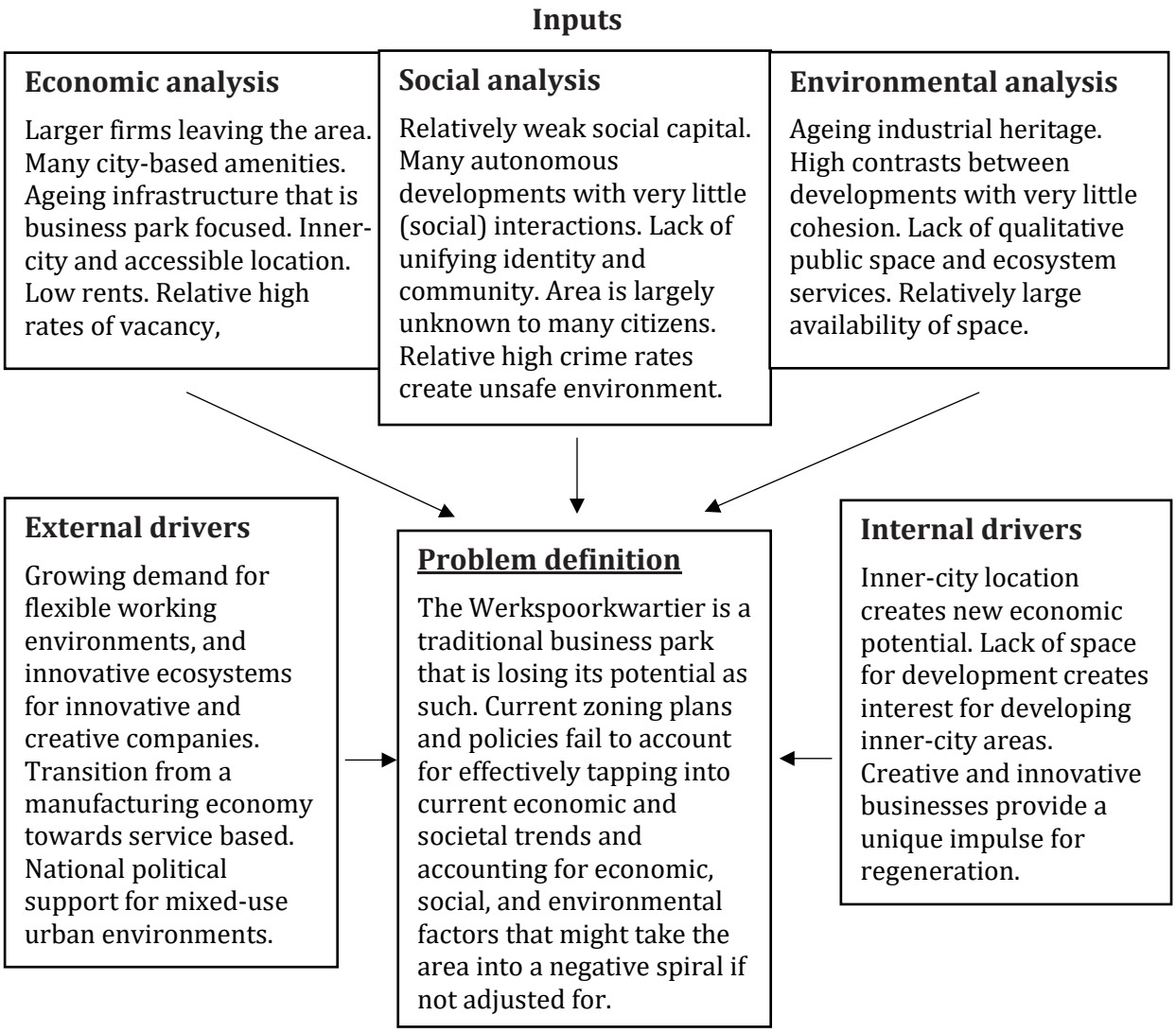


Figure 10: The pre-regeneration problem analysis of the Werkspoorkwartier. Based on Gemeente Utrecht (2012) and interview 1, 2, 4, 9, 10, 13, 16 & 18.

Due to parcelling taking place over the course of multiple decades, and the municipality housing amenities for the city on its lots, the ground position weakened over the course of the years (19). '*Since only few of the lots were still in hands of the municipality, cooperating with vested parties is required, as only so many regulatory instruments remain available to influence the future for the area*' (4). Therefore, taking a hard turn by exclusively envisioning the area as a cultural and innovative hub was not considered to be an option as it would bypass the majority of more traditional businesses that still got a foothold in the area. *'These transitions do not happen overnight, therefore we decided to not take drastic turns, but acknowledge and proactively guide the new developments'* (Interview 19). Thereby, the municipality decided to handle all new applications for the

area on a case-by-case basis, so that some flexibility was guaranteed while working towards a mixed-use goal (4). Although many of the traditional companies had mixed feelings about this new trajectory, their worries did fade when in practice this strategy did not limit their practices in any way or tried to actively push those out of the area (1). Although most of the creatives are happy about the strategy and how it worked out over the past eight years, two main complaints were expressed during the interviews (1, 10, 13, 16, 18 & 20). First, the strategy lacked concrete measures or actions that would contribute to a business climate for these developments. *'It would have certainly helped if it was more detailed and less general, this makes it hard to critique the strategy, but also to put it to use'* (17). Some others argued that the strategy was too much a reflection of the current state, thereby falling short of being transformative in nature (10, 18 & 22). Second, the flexibility that was incorporated into the strategy was critiqued for not being transparent. This case-by-case approach for licenses gave the municipality an influential position, but sometimes failed to substantiate certain decisions. '*We were very enthusiastic about some submissions that we felt would contribute to the area but were denied for unclear reasons'* (4). Despite the critique, the strategy seems to be effective when focusing on quantitative indicators. Overall, the number of jobs increased from 2.775 to 3800 between 2012 and 2020. Between those same years, the portion of creative and cultural jobs increased from 6% to 34%, and the industrial jobs shrank from 43% to 15% (Gemeente Utrecht, 2020). Based on these indicators, many of the interviewees suggested that the strategy and how it was practiced in those eight years had a significant influence on these changes (1, 4, 6, 7, 9, 10, 12 & 19). Although this study did yield more results in relation to the first regeneration strategy, those will be discussed in relation to CAD in the next chapter on results.

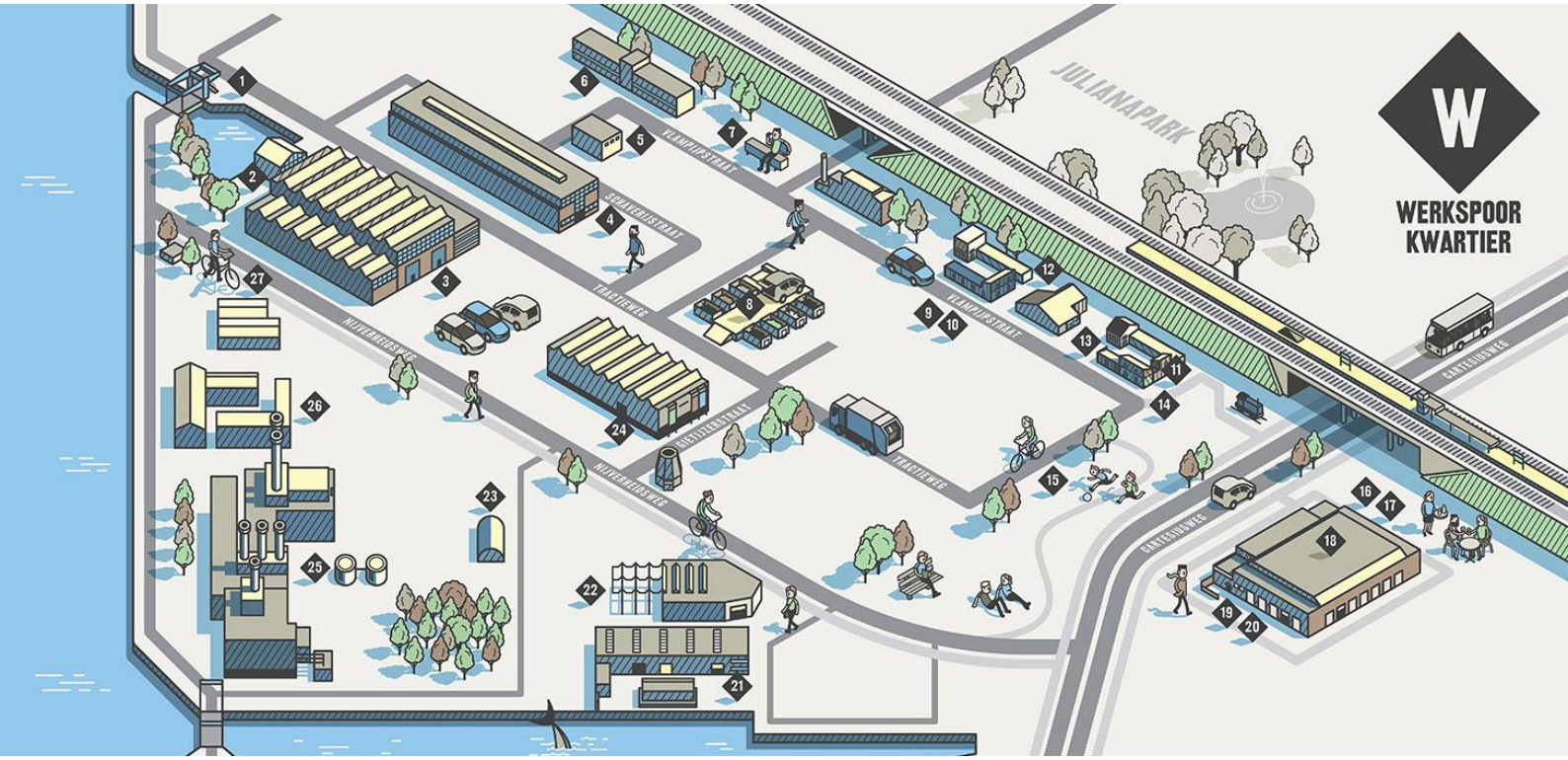
4.5 The Circular Regeneration Strategy

4.5.1 The Start of the Project

In 2016 vested businesses initiated the addition of circularity to the existing vision of the municipality. The project receives funding by the European Regional Development Fund (ERDF) and the municipality, which is also responsible for the financial monitoring of the project (Gemeente Utrecht, 2020). One of the core principles of the project is the enhancement of cooperation between knowledge institutes and circular initiatives. The Utrecht University (UU), University of Applied Sciences (HU), and the University of the Arts (HKU) all take part in the project. The Utrecht Sustainability Institute (USI)—which is a department of the UU which specifically focusses on linking developments with

research institutes—takes the role of project management. The project lasts five years, and will end in September 2021, thus when this research was executed, most of the project already had taken place. The ERDF requires the project to enhance job opportunities in the area, and does not have any direct criteria for circularity. '*Some of the developments that took place already had an interface with the CE, newer initiatives even more, so linking the ERDF to the CE makes a lot of sense judging the turn of events*' (2). Others added that knowledge institutes were interested in creating research opportunities into the CE as it was gaining momentum, making the Werkspoorkwartier a relevant place to research CE development, possibilities and to create teaching possibilities on the subject (10, 12 & 21). To fit into the scope of the area and not counteract the already existing regeneration strategy, the scope became a '*Circulair and Creative Manufacturing Area*.' Figure 11 shows a map of projects in the Werkspoorkwartier of which most are directly linked to the ERDF project, which are introduced in the following sections.

Figure 11: Map of circular and creative businesses in the Werkspoorkwartier (ERDF, 2020, graphics: Jochem Coenen)



4.5.1 Introduction to Circular Initiatives

In this section, some of the most notable circular developments in the area are introduced since the result section will be based mostly on these projects. These projects are also numbered in figure 11, so their dispersion throughout the area can be seen. First, the Werkspoorkathedraal is discussed (marked with a 3 in figure 11), then the Hof van Cartesius and Buurmam (marked by 13), the Havenloods & Vlampijpateliers (Respectively 22 & 6), the Werkspoorfabriek (4), De Schaverij (5), Campus Werkspoor (26), and lastly the Machinerie (24).

4.5.2 The Werkspoorkathedraal

The Werkspoorkathedraal is seen as the pioneering project of the redevelopment of the Werkspoorkwartier, marked with a 3 in figure 11 and shown in figure 12. This enormous warehouse once played a vital role in the development of trains during the industrial era but has been subject to vacancy and decay until it was redeveloped in 2014 (2). The building is owned by Erfgoed Werkspoor Utrecht (EWU), one of the most important partners for the circularity program. The redevelopment of the largest warehouse in the area was by many interviewees marked as the turning point for regeneration in the area, as one put it '*for an investor to show interest in restoring this historical humongous building gave a signal to others that the area is ready for a transition.*' (9).

Figure 12: The Werkspoorkathedraal frontside, inside & backside views (Sources: today.nl. cirkelstad.nl & russchertekstenbeeld.nl)

The Werkspoorkathedraal is left as much in its original state to preserve the heritage that it resembles. Currently it is used for large events, in addition to a row of offices that were added on its left side, the black lower building on the first picture in figure 12. On the right side already existing offices and washing room are now housing a nightclub and offices. Since it was redeveloped in 2014, it predates the CE strategy, but it was realized with adaptive reuse and sustainability in mind yet did not get the CE moniker at the time (2). The floor of the building was levelled out, and the internal structures were left mostly as is, and additional materials were used to restore the building to bring it into today's standards (16). Thus, the overall resource intensity for redevelopment was brought down to a minimum (7). At the backside, the building meets a small harbour that is connected to the Amsterdam-Rhine canal. Since the harbour is contaminated from the industrial activities, redeveloping the area has some additional challenges that need to be overcome

(2). Currently the area is used for a pop-up bar, as well as the *Werkspoorcafé* that is a pub that is owned by brewery *The Leckere* which is located close by in the Werkspoorkwartier.

4.5.3 Hof van Cartesius & Buurman

The Hof van Cartesius (Figure 13) is currently one of the flagship CE projects in the area and even for the city of Utrecht (6, 9, 10 & 19). It was realised in 2016, and is currently expanding parallel to the train tracks to eventually tripple its capacity (10). The Hof van Cartesius exists for 90% out of excess building materials and seeks many ways to reduce its ecological footprint as much as possible. The Hof van Cartesius is a facilitator for self-employed entrepeneurs and small companies in the creative, educative, and circular sectors. Besides workspaces there are art studios, a communal garden which the spaces are organised around, and it is frequently used as an event area (10). The Hof attracted ciruclar entrepeneurs and artists alike to settle in the Hof van Cartesius because of its circular reputation, but also because of a unique co-operative business case (8, 10 & 11). All of the memebers (the entrepeneurs and artists) can influence the decisions that are made but are also responsible for its maintainance (6). Thereby, the initiators take a role in coordinating this process, rather than a more traditional approach wherein all responsibilities are theirs.

Figure 13: Hof van Cartesius in 2018 (Source: Biind.nl)

Among the companies that are housed by the Hof van Cartesius is Buurman, a hardware store for used and excess materials. Currently Buurman also has branches in Rotterdam and Antwerp, and will soon upgrade to a larger building in the Hof van Cartesius once the expansion of the area is completed (10). Besides being a hardware store, Buurman offers workshops for building circular furniture, as well as team building activities. For the Hof and the area, Buurman has an important role as many artisans and CE initiatives shop here for used materials (8, 11, 14, 18, 20 & 22).

4.5.4 The Havenloods & Vlampijpateliers

The Havenloods and Vlampijpateliers (Figure 14) are properties that are both exploited by DePlaatsmaker. DePlaatsmaker is an organization that houses 750 creatives and cultural initiatives in 41 buildings around Utrecht, of which these two buildings are important contributors. The Vlampijpateliers is regarded by many as the first example of cultural development in the area as it houses artists and creative entrepreneurs since the end of the 20th century when squatters settled in the building (16). The Havenloods on the other hand was more recently acquired by DePlaatsmaker, it hosts 65 workshops inside and utilizes its outdoor space for artists and creative entrepreneurs to realise their own workshops for at least the coming 10 years (16). Some of the studios that are realized in the outdoor space are also built with used materials. Both projects are examples of adaptive reuse, as DePlaatsmaker strives to exploit these locations while reducing interventions to the physical structure of buildings.

Figure 14: The Havenloods (above), and the Vlampijpateliers (below). (Sources: deplaatsmaker.nl & duic.nl)

4.5.5 The Werkspoorfabriek

Adjacent to the Werkspookathedraal, and also owned by EWU, is the Werkspoorfabriek, a building that was redeveloped in 2018 and is currently housing a variety of (circular) businesses. The historical warehouse also dates back to the era of heavy industry, and for redeveloping a couple of circular methods were used. For one, it is also an example of adaptive reuse as most of its outer shell was left intact. However, on the inside its

development is very different from the neighboring Werkspoorkathedraal. About half of the warehouse is used by the brewery the Leckere, which is the first brewery in the Netherlands that switched from gas to green energy, which is partly produced by the solar cells on the roof (2). The other half houses smaller businesses, freelancers, and meeting rooms. This section was crafted by utilizing a box-in-box system out of wood. This system is also modular which makes it future proof for any expansions and can be easily removed to be applied in a different location (5).

Figure 15: The Werkspoorfabriek (above), and the modular interior (below) (Sources: openmonumentendagutrecht.nl & dearchitect.nl).

4.5.6 Other Circular Initiatives

The before mentioned projects are all directly linked to the ERDF project. However, there are several initiatives that have interfaces with the CE are not a part of the project. First, the *Schaverij*, which is a workplace and sawing mill for creatives and artisans that opened in 2013 (18). One of the core principles of the Schaverij is the reduction of its ecological footprint, by utilising used materials and upscaling materials. Second, *Campus Werkspoor*, which is a facilitator business space and is currently working on a wooden building called *HoutWerk,* wherein various companies will be housed. By sharing as many spaces as possible and designing the building to have a low ecological footprint in the design as well as functioning of the building. The use of wood and partly modular spaces enables adaptive use of the building and upcycling of building materials (1 & 2). Lastly, The *Machinerie*, which is currently in its planning phase to be developed in a building that was previously used as an event location. It is planned to become a collective building for filmmakers, and other forms of visual art, catered for events, exhibitions, and movies. The building is owned and partially funded by EWU, also the municipality pledged to invest 3.5 million euros into the project (2). Although it is still in the planning stage and partially delayed by the Covid-19 pandemic, initiators expressed that CE principles will play an important role in the redevelopment of the building (17).

5 Results

5.1 Introduction

This chapter presents the results from the empirical data by a thematic analysis. The themes were both deductively and inductively identified. Therefore, the five analytical categories as discussed in the literature review are presented, in addition, two integral themes were identified from the data that will be addressed first. Those are the division between circular area design, and circular area functioning, and secondly the diverging conceptions about the CE. Thereafter, financial aspects are discussed, followed by spatial aspects, social capital, and knowledge & information. The themes discussed in all these sections will finally be used to reflect on the overall governance process in the final section.

5.2 Circular Design & Circular Functioning

This study found that CE principles were mostly applied in the design of the area, and to a lesser extend practiced in business cases. For instance. The Havenloods, Haventuin. Werkspoorkathedraal & Werkspoofabriek, are all examples where the (adaptive) reuse of these buildings and sites is the primary driver of their CE performance, but only a few of their housed businesses and creatives apply CE principles in their practices (1,2, 5, 10, 20 & 22). While CE criteria are never used as a precondition for businesses to rent spaces in these buildings, cultural and creative criteria are used by some facilitators (4, 12 & 20). This is one of the contributing factors that led to an increase in jobs related to these fields from 6% in 2012 to 34% in 2020 (4). The Hof van Cartesius on the other hand applies CE principles extensive in the design and organization of space but are equally represented in the business cases of companies (10). '*Where other business facilitating buildings approach a broader target audience, the cooperative organization of the Hof speaks to a more narrows target audience that is often enthusiastic about the CE*' (6).

Additionally, various internal and external drivers were found that contributed to this bias towards CE in design as well. First, the national and municipal CE strategies currently have a stronger emphasis on the CE in the construction sector (3, 12, 19 & 21). Therefore, many national resources are spent on the development of material flows, knowledge sharing platforms such as CB'23, and research into material passports, a pace of development that is currently higher than in other economic sectors (3, 15 & 21). This is also echoed at the municipal level, where more explorative studies and more concrete

goals have been formulated in regard to the construction sector (21). '*The Werkspoorkwartier is currently an important testing ground to prove construction concepts and eventually apply elsewhere*' (21). Also, the ecological footprint of the constructing sector plays a role here, as climate regulations are currently hampering the development of new projects, thus incentivizing the market to find sustainable alternatives (3 & 5). Second, vacancy has been a pressing problem for the area, and forms of adaptive reuse could both maintain the monumental values of some buildings, as well as finding new non-industrial uses (4). '*Vacancy can lead to a negative spiral for the area as a whole, thus redeveloping these buildings had a high priority, the circular benefits were nice bonusses*' (19). Third, some interviewees noted that circular design should come before circular function as '*it is harder to apply CE principles in the design of buildings and space retrospectively, while business cases could adopt over time*' (15). Thus, national CE goals as well as local challenges contributed to this bias towards CE design. However, while the CE functioning of the area is developing as well, some interviewees noted that it should gain more priority on the agenda to assure a broader economic application (3, 10 & 21).

5.3 Understanding of the CE Concept

Much like the scientific community, there is still a lack of consensus about what the CE entails, how it is defined and understood, and how it can be operationalized in the Werkspoorkwartier. The different views on the CE can be roughly divided into three camps. First, the CE as a new trend or buzzword in sustainability. '*A few years ago, we had sustainable urban development, now it is CAD. Focusing too much on trends is not favoured in long-term processes like urban planning*' (4). This view is especially prevalent in the economic and planning departments of the municipality (4 & 19). Although these actors by no means doubt the legitimacy of CAD in the Werkspoorkwartier, their moderate scepticism does have important consequences for the area, as will be discussed in later sections. Second, at the other end of the spectrum we find views that relate to the CE as a transformative concept. Their view is often more comprehensive, includes social, economic and societal factors, and they present arguments related to a linear regime that hampers circular development (3, 5, 8, 10, 11, 12, 15 & 18). Additionally, they do not view the CE as another sustainability trend, but rather as a means to operationalize and move beyond the ambiguity of sustainable development. These views are most common for entrepreneurs that include CE principles in their business cases, researchers, and the circular department of the municipality. And third, there is a group that views the CE merely as a resource and waste management strategy, thus often referring to some of the

R-imperatives (e.g., recycling and reusing). Although these acknowledge economic and environmental aspects. Social, legal and regime aspects are often not discussed as extensive as the previous group (1, 7, 9, 13, 17, 20 & 22). Among this group are some of the non-circular, but often sustainably minded businesses in the area. Although in practice it is more nuanced and there is some overlap between these groups, this division between (1) CE as a trend, (2) CE as transformative, and (3) CE as an economic alternative, can be distinguished within the data.

5.4 Financial and Economic Factors

Many scholars pointed out in their research that financial factors can be the most important barrier for further CE development. For instance, Russell et al (2019) showcased that most circular initiatives are very subsidy dependent, and Stahel (2016) argues that a shift is required in taxes that incentivises circular practices over linear practices. This study found several financial factors that influenced CAD in the Werkspoorkwartier, and will be discussed in three separate sections.

5.4.1 Affordability & Availability of Space

First off, the availability of affordable space was pointed out as one of the strongest selling points of the Werkspoorkwartier, which holds true for both circular and creative businesses (1, 5, 6, 8, 9, 11 & 18). Affordable spaces are becoming rarer in the city of Utrecht, which is partly caused by the selling of municipal real estates, and by the growth of the city (20). Also, the relatively small industrial sector of the city resulted in fewer post-industrial areas, making the Werkspoorkwartier a unique area within the city (16). The area is often referred to as '*the last business park within the city to have affordable and readily available spaces*' (18). The necessity of space for CE businesses was expressed by the challenge to make supply and demand meet (10, 11, 14 & 20). '*The market for used materials fluctuates a lot, this means that you have to store some materials for long periods*' (10). Especially at the Hof van Cartesius and the Haventuin, which relied greatly on used materials for their designs, the availability of space to store materials played role. '*Some of the materials are here for months already although these are only needed in about a month to build the workshop. But once these are needed, there might not be any circular materials available.'* (20).

The affordability of spaces is expressed as the most important financial factor for CAD. '*Bottom-up innovation falls or stands by leeway to take financial risks*' (21). Much like

Russell et al (2019) concluded, the first stage of business case development is met with the greatest financial uncertainties, as many resources need to be spent—often more than for linear alternatives—without substantial revenue (3, 5, 8, 10 & 11). For companies that were in a later phase of development such as a circular architecture firm, the amount of rent played a smaller role (5). Since most of the entrepreneurs in the area are within their first stages of development, or are more financially vulnerable, maintaining low rents is considered to be of great importance to protect the bottom-up innovations (12). However, the last decade the rents have increased drastically—in one case even tripled—and became more uneven between projects (1, 2, 4, 9, 10 & 16). Three dominant factors were mentioned that influenced this development.

First, both the circular and cultural regeneration of the area were found to attract the attention of speculators and investors. *'They turned this vacant and degraded area into an interesting place, which in urban development translates to financial opportunities'* (19). Second, the development of a new residential neighbourhood across the road (as discussed in 4.4.1) was found to further drive the interest of investments and speculating (1). Third, the municipality gradually sold its properties, among which are the Werkspoorfabriek and the Hof van Cartesius that were sold to landowners and investors that acknowledge the importance of affordable rents (2 & 10). However, the weakening ground position in the area meant that the municipality is now lacking instruments to control rents (4). Consequently, initiatives that are housed in premises that are owned by investors, or have a temporary contract, such as the Havenloods, Haventuin, Schaverij & Nijverheid are the ones that are most vulnerable to increasing rents (18, 20 & 22). Above all, some interviewees claimed that the underlying neoliberalist approach to urban development is the main driver behind these contributing factors, that will eventually lead to a gentrifying effect for circular and creative initiatives (16 & 20). '*If we stay on the current trajectory and do not intervene with the market mechanisms at play, I doubt that there will be a future for the financially vulnerable projects*' (16). The other interviewee added '*there is nothing wrong with creating economic opportunities through CAD and cultural regeneration, it becomes a problem however if you run out of affordable places within the city and lose the grassroots (and bottom-up) developments altogether'* (20).

5.4.2 Financial Arrangements

Other than subsidies for CE initiatives, this study found financial frameworks that are specifically aimed at enhancing CE development to be lacking. The EFRO project is

subsidised with 1,25 million euro over the course of five years (2), additionally non-place bound subsidies for cultural and placemaking initiatives are financing some initiatives (4, 10 & 19). However, the EFRO subsidy was not found to be a determining factor for CAD as some interviewees noted that they would have done most of the same things (2, 10 & 20). The lack of financial frameworks however was pointed out by some as a barrier for CE development. The Hof van Cartesius for instance with its co-operative business case and mixed-use of its premises struggled to obtain conventional loans from banks. '*We fall directly between being a social and commercial enterprise. Social because we do not make profits, and commercial because we house companies here'* (10). Since different financial directives apply to both categories of companies, the Hof struggled greatly to find an arrangement that could support their business case. Consequently, the initiators had to put their own savings on the line to realise the project. '*These financial hurdles are often coupled to regulatory frameworks that were developed for linear companies, we see many examples where it hampers innovative and circular business cases*' (6). These financial hurdles are especially prevalent in the first stage of business case development. For instance, for the expansion of the Hof van Cartesius it was a lot easier to apply for conventional forms of financing as it could now prove its concept (6 & 10). Lastly, some interviewees noted that the Werkspoorkwartier should become a testing ground for financial frameworks for CE development, as it is currently mostly driven by goodwill over financial feasibility (2, 6, 10 & 18). '*We might have to provide subsidies for processing each other's waste that has a circular potential, as companies are now paying waste charges to have it processed elsewhere and are thus not incentivised to look for local possibilities*' (18).

5.4.3 Financial Proximity Effects

There are several examples of financial benefits that are the product of proximity between CE initiatives in the Werkspoorkwartier. First, cooperation between CE initiatives within the area was found to happen more each year. For instance, the wooden modular interior of the Werkspoorfabriek was realised using the support of entrepreneurs at the Hof van Cartesius (5 & 14). And the various members of the Hof van Cartesius cooperate to take on projects that exceed the capabilities of single entrepreneurs (10). *'Cooperating with other entrepreneurs that understand your circular ambitions is valuable, conventional contractors would often not understand the importance for us to utilise circular materials regardless of the extra challenges'* (5). Others express their interest to look for cooperation with neighbouring (non-circular) companies in the future, especially since some of these

companies have resources and know-how about specific sectors and subjects (7, 8, 14 & 18). Second, there are many examples of resource sharing such as equipment, storage, and facilities between mostly cultural and circular initiatives that are enforced by proximity (11, 14 & 24). *'It is very costly to rent a piece of equipment that I maybe need once or twice, instead I can often lend it from some people I know here'* (11). Also, Buurman (a hardware store for used materials) benefits from the proximity of the municipal recycling centre in the area where it retrieves materials from. Additionally, various entrepreneurs expressed the importance of a hardware store like Buurman in the area, as it eases the process for obtaining and storing circular materials (5, 8, 11, 18 & 20). Taken together, place-specific financial benefits are developing in the area, but many agree that this is a process that takes time to develop further (1, 2, 4, 12 & 21). It is still far from being comparable to EIPs, as there are too few material flows between the various companies to speak of such a development. Lastly, some interviewees note that cooperation with other business areas (Lage Weide & Strijkviertel) within the region could enforce city wide benefits to CE initiatives (1, 2, 19 & 21). Therein, the Werkspoorkwartier and Strijkviertel are often referred to as the '*brains',* as there is practical knowledge about the CE, in addition to the '*muscles'* of Lage Weide where firms with greater industrial capacities are housed (Interview 19 & 21). However, during this study, empirical evidence of such regional cooperation was not yet present.

5.5 Spatial Aspects

The growth of the city around the Werkspoorkwartier, as well as the development of a new residential neighbourhood across the road are seen as contributing factors to develop a multifunctional area that could meet the demands of locals (1, 2, 4, 10 & 21). '*The area is now almost the geographical centre of the city, therefore it has a huge potential to create it into more than a business park*' (17). Especially leisure (cultural activities and hospitality industry), ecosystem services & sports are mentioned as action areas to facilitate local demand (4). *'People only used to come here for the recycling centre or if they had a job here, now they are coming for all sorts of reasons which makes the area of greater importance to the city'* (21). Although these developments create new economic potentials for the area, the spatial management of the area becomes of greater importance as space becomes scarcer. In the previous section the importance of affordable and availability of spaces for innovative and circular businesses were discussed, and how housing initiatives in the same area could develop positive mutual effects. In this subsection, two other spatial aspects are discussed, namely how space could be managed and planned to

support CAD, and how mixed-use development is often a result of a circular approach to using space at the Werkspoorkwartier.

5.5.1 Offering Space to the CE

Studies such as Williams (2019) express that one way of incorporating CE principles in planning is by localising economic activities. In the case of the Werkspoorkwartier the (economic) potential of developing new functions as well as the goal to reintegrate the area beyond its economic relevance seem to be the primary top-down driver for the development of new functions, rather than CE motives (4 & 19). According to the area manager the '*CE development fits nicely into the overarching area vision, but we do not regulate CE development top-down […] when a company that is enthusiastic about the CE approaches us, we will try to guide them towards the Werkspoorkwartier'* (4). This quote sums up the approach the municipality is currently taking in managing CE development in the area, there are no specific policies or regulations used to enforce the CE, but it rather grants permits to those that fit within the strategy (21). Thus, CE development is mostly carried out bottom-up and is assisted by the municipality when needed (e.g. license applications). Generally, initiatives contend that this approach contributes to CE development since they agree that the CE would likely not be adopted as widely if it were predominantly imposed in a top-down manner (2, 10 & 20). However, some argue that a more proactive role from the municipality could contribute to enhance CAD (21 & 18). For instance, the municipality houses some of its city services as well as a recycling centre in (which is exclusively for residents, not businesses) in the area. Besides Buurman retrieving some of the materials from the recycling centre, there are no other examples of local resources cycling between companies and municipal services. Additionally, the more traditional companies in the area have little incentive to explore CE possibilities since '*they are already fed up with managing their own businesses and do not have the time and resources to exchange waste'* (1). Especially arguments that are related to a supportive infrastructure are mentioned as an action area, which could potentially be initiated by the municipality. *'We need some sort of central point where resources are stored and can be exchanged between locals, a marketplace or depot which is non-profit'* (2, 18 (quote) & 20). Thereupon, planning for infrastructure could be beneficial to create opportunities that could have a leveraging effect on linear companies.

5.5.2 Seeking to use Space more Circular

In the use and organisation of space it became apparent that circular reasoning is used by the initiatives behind the sharing, diversifying, and intensifying the use of space on their premises (2, 8, 10, 11, 18, 20 & 22). According to some entrepreneurs that view the CE as a transformative concept (see 5.3), by adaptively using space for various uses it can generate additional values beyond merely housing entrepreneurs and being used exclusively during business hours (22). '*Reusing what is already there is one of the best ways to contribute to a CE*' (20). At one initiative, the indoor and outdoor spaces are used around the clock to house ateliers, exhibitions, events, terraces, or to store materials. Therein, these are in stark contrast with the more traditional companies in the area that provide most of their facilities on their own premises enclosed by fences and '*9 out of 10 times do not need all these resources simultaneously, which is a waste of space*' (6). Thus, seeking to use space more efficiently by mixing uses is mostly limited to the circular initiatives, except some examples of parking spaces being shared. Some are optimistic that approach to using space more efficiently could be an opening to engage with the traditional companies as '*themes like parking and space becoming scarcer are also experienced by them, that might incentivise them to take part*' (1). However, when this study was executed, besides a single exploration being executed in relation to mobility, there were no other overarching initiatives for the area that seek to apply the CE in the spatial context,

5.6 Social Capital

In this section the role of social capital in the development of CAD is discussed through three themes: networks, trust, and leadership. Taken together, social capital did have an important role in developing the local CE and is arguably one of the strongest selling points of the Werkspoorkwartier. There is a mutual consensus that '*social interaction is a precondition for cooperating and creating an innovative ecosystem*' (12). Its importance is shared by all different actors, ranging from the municipality to researchers, and most of the (non-)circular initiatives.

5.6.1 Networks

As discussed in the theoretical framework (section 2.4.6), publications like Roberts (2000) showcase that networks are often lacking in post-industrial areas due to a lack of overarching strategies and high level of autonomy in these areas that do not encourage actors to interact with one another. These challenges are also evident in the empirical data

from the Werkspoorkwartier and is further influenced by the organization of space where '*every company is on its own secluded island*' (6), as discussed in the previous section. However, in the case of the Werkspoorkwartier, the lack of networks has been on the agenda well before the start of the cultural and circular regeneration strategies (16). Consequently, the groundwork was laid which the regeneration strategies could build upon. Perhaps the most important contributing factor was the monthly organized '*Cartesius Tafel*' (Discussed in section 4.4.2) sessions where actors would meet each other and exchange ideas (1 & 10). According to many, the cultural regeneration strategy that was launched in 2012 was largely a product of these meetings, and some of the actors that would later become the initiators and investors behind the Werkspoorkathedraal, Werkspoofabriek, Hof van Cartesius, and the Havenloods would meet each other during these meetings. Although sustainability was discussed during these meetings, there was especially a strong emphasis on the combined potential of cultural and creative initiatives which were developing in the area (10). Second, since 2012 the '*Vriendinnen van Cartesius*' became active in the area as community managers which organize meetings each quarter of the year—specifically focused on urban development—and they actively reach out to connect actors with one another (1, 10 & 18). Due to these efforts, it was eased to develop a specific circular network in the area around the EFRO project since '*most of us knew each other already and knew each other's intentions*' (1).

The circular networks that exist in the area can be roughly divided into three groups, first, at the lower level the individual businesses and freelancers that are housed within the partaking initiatives of the EFRO project. Their link with circularity is either by their own business cases that incorporate CE principles, or more indirectly by renting spaces at these locations or cooperating with circular initiatives (5, 8, 10, 11, 14 & 24). Secondly, there is the group of representatives (often managers) from the first group that cooperate with researchers and the USI in the project team of the EFRO (1, 2, 10, 20 & 24). And third, there is a group of initiatives which are not participating in the EFRO project but do incorporate the CE in their business cases (3, 18, 22 & 23). The empirical data from this study pointed out three areas where networks within and between these groups had affected CAD. First, the sharing of resources, equipment and knowledge about the CE is not only driven by the proximity of initiatives in the area, but especially by the existing formal and informal ties between initiatives (1, 2, 8, 9, 14 & 20). For instance, a circular architecture firm cooperated with a local partner in the development to develop a modular interior for the Werkspoorfabriek and is now exchanging experiences and

knowledge about circular architecture with the Hof van Cartesius where the partner is housed (5 & 14). Especially for initiatives that are in their first stage of development this local network is valuable, and it is partly the reason why more established SMEs, that belong to the previously mentioned third group, do not invest in these networks as extensively (2, 3, 5, 8, 10, 11, 12, 18 & 20). '*We do actively reach out to those groups since they are low hanging fruit for the EFRO project, but it is sometimes not clear to them how they could benefit from taking part*' (1). Secondly, networks are the strongest within the various projects where companies are housed since resources (such as working spaces) are by far shared to a larger extent within the projects rather than between them, thus leading to strengthened ties (2, 7, 10, 20 & 23). Additionally, the cooperative business case of the Hof van Cartesius where responsibilities are shared among partakers is experienced by interviewees to be a great contributing factor for cooperating (6, 8, 10 & 11). This is also reflected in the data as most of the examples of networks leading to mutual benefits can be allocated to the Hof van Cartesius (6, 8, 10 & 11). Also, the scattering of initiatives throughout the area, as well as the traditional planning of business parks leading to '*autonomous islands behind fences*' were mentioned as contributing factors that hamper the development of an area wide community (1, 2, 4, 7, 13, 18 & 22).

Responding to the previous mentioned challenges in community development is one of the areas the EFRO project team is addressing (1, 2 & 10). By meeting regularly with representatives from the different projects, exchanging information about their progress and challenges, and seeking for mutual benefits, connections could be made between the partners and the communities they represent. However, at this point it is hard to isolate which social ties could be allocated to the EFRO project since the representatives already knew one another and the Vriendinnen van Cartesius, as well as the area manager seek to connect people too (1, 2, 10, 18, 20). Notwithstanding, the group that participates in the project agrees that it had a positive influence on strengthening networks, especially in regard to coordinating interactions (1, 2, 10 & 20). For instance, the network is used extensively to bring researchers that study the area into contact with the initiatives and other researches, thereby trying to streamline communication and find cross-fertilization among them (1, 4 & 21). This leads up to a final network factor which is the added value of a specialised network regarding the CE. The EFRO project laid the groundwork for the initiatives to discuss the CE performance beyond their own businesses, but to start thinking about the performance of the area as a whole (1, 2 & 10). This is important since CAD should not be merely a collection of CE initiatives, but eventually the resource

consumption of the area as a whole should be mitigated, thus incentivising local resource looping (EMF, 2015, Huijding et al., 2018). At this point, there are still few examples of such resources being shared, but many agree that the EFRO project is a valuable first step as '*it takes years to find such forms of cooperation and make it work*' (1, 2, 11 & 21). Thus, as the project is getting close to the end of its five-year program, interviewees express the necessity to maintain the network it created, and continue to seek for collaboration (1, 2 & 10).

Lastly, several interviewees noted that the development of regional networks is necessary to encourage CE development (2, 4, 19 & 21). As addressed in 5.4.3 the '*brains*' of the Werkspoorkwartier and Strijkviertel in combination with the '*muscles*' of Lage Weide is often referred to as a potential fruitful combination. During this study, such networks have yet to be developed (19). At the provincial scale, an alliance dubbed '*Cirkelregio Utrecht*' was initiated between various levels of government, circular initiatives and knowledge institutes. Although the interaction between this alliance and the Werkspoorkwartier is beyond the scope of this study, the data points out that local networks seem to be of greater importance as fewer initiatives are currently active regionally (2, 5, 8, 10, 11, 18, 20 & 22). However, as one interviewee puts it '*it would be wasteful if other areas that seek to become more circular cannot take effective lessons form the Werkspoorkwartier, and potential resource loops could be missed*' (19). Others added that developing local networks should be prioritised, since there is still a lot to gain by connecting with other CE initiatives and non-circular businesses to become more circular (1, 4 & 18).

5.6.2 Trust & Stakeholders

According to EIP and CE literature, mutual trust between companies can be a precondition for resource loops to develop since it will lead to more dependency on one another (Velenturf & Jensen, 2016; Tudor et al., 2007). Due to a lack of such resource loops currently in the Werkspoorkwartier, this specific form of trust was not found to be of relevance (2, 3, 5, 8, 9, 10, 14 & 20). However, trust was found to play a role in two other instances. First, trust is often recognised as an indicator that networks in the area are fruitful, as '*knowing each other is one thing, to cooperate, share resources and your knowledge requires trust*' (6). Also, the negative economic effects related to the Covid-19 pandemic seemed to strengthen ties among companies, '*Some initiatives had suddenly lost all their income, for others it brought economic opportunities […] it led to new forms of (CE)*

cooperation among initiatives to help each other out […] which is not just goodwill' (10). Thus, trust is not merely related to believing actors will keep their promises, but also trust in the community could be a way of increasing (economic) resilience (1, 11, 19, 21). Especially for the more vulnerable start-ups self-employed initiatives, and innovative concepts this seems of greater importance since more established companies are often more economically resilient (3 & 5).

Second, the data presents a link between important stakeholders and trust. Although there are various examples that can illustrate the effects of trust in stakeholders with CE development, this section will present three different examples. First, the investor behind both the Werkspoorkathedraal and Werkspoorfabriek, is widely regarded as a great contributor to CE development (1, 2, 3, 4, 9, 10, 16, 18, 22 & 24). As discussed in 4.5.2, the redevelopment of the Werkspoorkathedraal (and later the Werkspoorfabriek) marked a turning point for regeneration since '*it shows great trust in the CE potential to take on such a project*' (18). Thus, like McCarthy (2002) discusses how large redevelopment projects could have a domino-effect in urban regeneration, it also holds true for CAD here, since the interviewees univocally agree that it gave a great economic impulse which is not exclusive to the CE (1, 2, 3, 4, 9, 10, 16, 18, 22 & 24). Additionally, the investor has close ties with other projects, while in some cases this involves financial support, he was also praised for '*being readily available to share much of his knowledge about procedures, politics, business cases etc. which new initiatives often do not have'* (20). Second, the project manager of the EFRO project is mentioned to have a catalysing effect in building trust among companies and researchers (2 & 10). This supports the claim of Cramer (2020) that intermediate agents that do not have an economic interest within the areas could help to coordinate CE development. *'He manages how subsidies are spent between the initiatives and keeps a close eye on how the interest of researchers could meet those of initiatives*' (2). Third, the area manager of the municipality is—especially by cultural initiatives—praised for his involvement with all the actors in the area. '*He understands the way that we try to add value to this area in our plans and is open to thinking outside of the box'* (20). However, his hesitation about the longevity of the CE putts some initiatives off as they feel that thereby the municipality is less committed to CAD while it has resources to enable its development, as discussed in the sections on spatial and financial factors (10 & 18).

5.7 Knowledge, Information & Research

The topic of knowledge was already touched upon in the previous sections about social capital, spatial, and financial aspects, and how especially the sharing of knowledge is positively influenced by a circular network (including project team), proximity, stakeholders, and trust. In this section, the forms of knowledge that are developed through experience and research are discussed in relation to their contribution to CAD.

5.7.1 Knowledge Development on CE Design

In 5.2 a distinguishment was made between CE in design and CE in functioning which both are of importance to CAD (van den Berghe & Vos, 2019). Similarly, to the bias towards circular design at the Werkspoorkwartier, especially most of the research seems to be based on CE in design rather than functioning (1, 2, 10 & 24). There are several findings that are of relevance to CAD here. First, the Werkspoorkwartier its industrial heritage creates a prolific condition for developing research and knowledge about circularity for both researchers and initiatives (3, 5 & 15). Additionally, the national and municipal focus on CE in the construction sector was experienced to be the second major contributing factor (21). Third, the diversity of CE applications in buildings ranging from modular interiors, buildings being mostly constructed from residual materials, to various forms of adaptive reuse create opportunities for comparative studies (2, 10 & 17). Fourth, since there are still plenty of (redevelopment) projects planned for the area (the Machinerie & Eneco plant), this form of knowledge plays an important role for the near future as well (2, 17, 19 & 21). For instance, as one of the initiators of the Machinerie puts it '*with all of the experience and knowledge that is now already there, it is hard to not want to look for CE potential*' (17). Likewise, for the Eneco energy plant (discussed in 4.4.2) '*we will definitely look for CE possibilities with the people from the Werkspoorkwartier*' (4), Therefore, interviewees agree that research and knowledge being specifically developed regarding CE in design is favoured since it is currently the most important challenge for the area and creates conditions which could lead to knowledge spillovers (1, 2, 4, 5, 10 & 19).

In contrast to the previous results, there are several aspects regarding design knowledge which require to be noted. First, the research publications which are associated with the EFRO project are mostly focussed on creating material passports, mapping material flows in construction materials, and developing tools to measure circularity in renovating buildings (1, 2 & 10). *'In practice the achievability of some options is more of a concern than its specific CE potential, this is less on the agenda of researchers'* (2). This works towards

the second argument, which is a misalignment between research and practice. '*Researchers often have very theoretical questions about the CE while the initiatives sometimes have very practical questions*' (2). This holds especially true for the CE initiatives which are represented in the EFRO project by others, and are more focussed on CE functioning (8, 9, 20 & 24). Some even argue that they are more reluctant to participating in research since for previous studies the time required did not outweigh their perceived benefits (10). This problem has been addressed by the EFRO project team lately, and attempts are made to translate this to current studies.

5.7.2 Knowledge on CE Functioning

Regarding CE functioning this study yielded three results. First, knowledge regarding CE functioning seems to circulate more strongly at the lower level between businesses, than being aggregated to higher levels (such as Cirkelregio Utrecht, or the EFRO project team) (10, 11 & 18). Currently, it mostly consists of practical knowledge, such as where others get their resources from and skill-related questions. Unsurprisingly, it is especially the initiatives that are in first stages of development that profit from this local knowledge (8, 10, 11 & 20). Additionally, some note that local information about material flows in the area should become an action area (11 & 18). '*We don't even know what forms of waste or residual materials others are producing […] this could be a way to involve non-sustainable businesses as well*' (18). In other interviews, similar examples were mentioned related to information about material flows by other interviewees, '*everyone has to pay waste taxes by law, but it is still too difficult to find someone who might be able to do something with it because we lack such an infrastructure*' (2). Third, this study found multiple examples of cross fertilization between circular and creative businesses (2, 3, 8, 11, 16, 17, 18 & 20). When the CAD was launched, some had concerns that it would compete with the previously launched cultural regeneration program (1, 4, 19, 2, 18 & 21). However, in practice several interviewees explained that there were '*co-evolution*' benefits, rather than spatial and economic competition (12). As one interviewee did puts it '*CE requires out-of-the-box solutions to be an alternative to the linear economy, creatives are especially good at that*' (11). A researcher added '*You often find creatives and innovators in the same ecosystems, that it creates prolific conditions for CAD is therefore unsurprising*' (12). In practice, many of the CE initiatives and entrepreneurs have a background in cultural areas or are artisans or artists that apply CE principles in their work (2, 11, 14, 18, 17, 20 & 22). Additionally, some note that it is often creatives who are sustainably minded, and thus there are not two distinct groups as they share many interfaces (1 & 19). In contrast to

the previous mentioned concerns about competition, all the interviewees now univocally agree that the combination of creatives and CE initiatives are creating a prolific ecosystem for CE innovation (1, 2, 4, 6, 7, 8, 10, 11, 14, 16, 17, 18, 19, 20, 21, 22 & 24).

5.7.3 Aligning CE Understandings

One clear barrier to CAD that was discussed by some interviewees is the lack of a generally accepted CE definition among actors. As discussed in 5.3, there are roughly three camps that have different conceptions about the CE, and while all share the idea that waste becomes a resource in a CE, there are different ideas and often a lack of knowledge about potential action areas to enable CE development (2, 4, 6, 9, 10, 12, 14, 15, 16, 17 & 22). In Table 1, a summary is made on how the groups explained the social, environmental, and economic aspects of the CE differently. During this study, especially an understanding of how social and spatial factors influence the CE are lacking, while economic and environmental aspects of the CE are often more widely recognised. For instance, the influence of regulations, management of space, and geographical scales was only recognised by initiatives and researchers. As the circular policymaker from the municipality puts it '*One of our important tasks is to create more awareness about the CE in our own organisation as many departments do not know how they could play a role*' (21). The group that sees the CE more as a trend in sustainability argues that '*it is unclear when something that is sustainable becomes circular, that makes it hard to translate it into effective policies that support it*' (4). Exactly these gaps of understanding have been on the agenda to address in this early phase of CE transition, which the Cirkelregio Utrecht alliance and the USI (by organising CE labs for policymakers) are addressing. However, the lack of a univocal definition by scientists, as well as the time it takes to disseminate such knowledge are additional barriers (2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 15, 16, 18 & 21). In response, many of the CE initiatives actively engage by inviting policymakers, speaking at conferences, and participate in research to '*show that CE development cannot happen on its own, and there is so much that can be achieved through effective policies, taxes, and planning*' (10).

Table 1: A summary of how different groups perceive the social, environmental, and economic aspects about the CE differently.

	Social & Spatial	**Environmental**	**Economic**
CE as sustainability trend	Awareness and space should be given for CE development, but this should mostly happen within current frameworks. CAD can be used for mixed-use and compact redevelopment.	CE is a great tool to put environmental goals into practice, but it is unclear to what extend it contributes to those.	CE is an economic opportunity that is driven by the scarcity of resources. Thus, a transition will likely happen by economic mechanisms.
CE as transformative	Breaking with current linear regime that resulted in frameworks, policies and institutions that are barriers to CE development (and CAD). For the CE to be successful, all these aspects need to be addressed.	CE is a way of operationalising sustainability, therefore it is much easier to measure and plan for better environmental results.	Taxes, application procedures (for subsidies and funding), market structures, and access to waste resources are all designed to favour the linear economy. Fundamental change to economic structures is required for the CE. Some add that localising economic activity is necessary as a driver.
CE as an economic alternative	More sustainability awareness will result in better CE development, top-down approaches could be used as a catalyst for CE development.	CE has a great potential for reducing the environmental burden by reusing existing resources.	Demand for sustainable alternatives will drive CE development.

5.8 Governance

In this final section builds upon many of the previous discussed results and will evaluate how governance of both the cultural as CE regeneration influenced the development of CAD. In general, the *triple-helix governance* approach is used to analyse and structure these results,

5.8.1 The Roles of the Actors

Following the triple-helix governance model, this section discusses the three different actor groups, the existing nuances and contrasts within those groups, and some of their influences on CAD.

the Werkspoorkwartier consists of a diverse group of business actors, which can be divided into three groups, the CE-initiatives, the cultural initiatives, and (as been referred to it previously) the 'traditional' companies. The latter refers to companies that are often housed in the area for 10+ years and consists of companies related to: logistics, offices, light industry (e.g. metalworking), or various services (e.g. car garages, plumbers, painters). This study supports the finding of Loures (2015) and Lehmann (2019) that post-industrial areas often deal with a great multitude of actors because of a property-led redevelopment strategy, '*The municipality used to own a lot of land in the Werkspoorkwartier but continued to sell it the last decades. […] By introducing regulations that enable offices and buildings to be used for multiple companies and uses simultaneously, many new companies, and investors alike, found their way to the Werkspoorkwartier*' (16).

As discussed in previous sections, the groups of circular and cultural initiatives have a lot of overlap, both geographically (sharing resources), and by their joint efforts to regenerate the area. Although there are nuances between these groups, there is a clear distinguishment between the traditional companies and the newer cultural and circular companies (1, 2, 4, 10, 16, 19 & 20). This division is discussed in many interviews and is often referred to as a challenge. Perhaps the most problematic aspect about this division is that it breaks with an important aspect about regeneration which distinguishes it from urban renewal, being that the existing assets (including vested actors) are the basis for regeneration (Roberts, 2000; Lehmann, 2019). However, many initiatives have been active in the area for nearly a decade, and some cultural initiatives date back even longer, it is therefore debatable to what extent these are actually '*newcomers*' since '*companies move in and out of these areas all the time, a lot do not pass the 10-year mark*' (16). However, in practice this dichotomy is experienced as a barrier to CAD (2, 4, 10, 16, 17, 18, 19 & 20). First, some traditional companies '*see that there is probably not much future for them in the Werkspoorkwartier*' (19). This holds especially true for the larger logistic companies that require lots of space and car-oriented infrastructure (The restructuring of Cartesiusweg will reduce car accessibility, see 4.4.1). Consequently, these companies are more reluctant to taking part in CE development which might take years for the costs

(investing time and resources) to outweigh the benefits (21). Also, the municipality is proactively trying to find places to facilitate companies in the city, especially for the ones that are considering moving elsewhere. Thus, some companies might '*patiently wait for the municipality to come with an option*' (9). Second, investors found their way to the Werkspoorkwartier which had strongly variating effects. On the one hand, EWU (investing firm) is a great contributor to CAD, and actively engages with other projects (2 & 10). On the other hand, there are investors which are experienced by others as '*prioritizing profits over contributing to the area*' (9) and thus contribute less to either regeneration strategy, often by solely applying financial requirements for their renters (9, 16, 20 & 22). Lastly, many interviewees note that *'companies are often too busy to participate'* (1). Especially for the development of networks this argument seems to be prevailing, '*we make so many attempts at reaching out to them, but this is often the answer*' (10). Thus, interviewees agree that '*only if we can make participating very attractive to them we might be able to persuade them'* (17). However, one interviewee criticised this by saying '*we might be able to generate more CE potential if we spend those resources on companies that are already partaking'* (20).

The municipality on the other hand is often referred to as having '*multiple faces'*, meaning that different departments have different conceptions about the CE, as was discussed in 5.7.3. Two '*faces*' were present in the results, namely the planning and financial departments which approach the CE more as a sustainability trend (see Table 1), and the sustainability department which approaches the CE more as a transformative approach to sustainability (4, 19, 21). In 5.8.3 about the governance process the consequences of these different faces is discussed in relation to CAD.

The last helix is dedicated to knowledge institutes, which in the case of the Werkspoorkwartier predominantly consists of the UU, HU, and HKU. Their interest in the Werkspoorkwartier is driven by societal and scientific relevance of developing knowledge regarding the CE and creating teaching possibilities for students (12). Through the EFRO project, interviewees agree that this helix is well organised and coordinated to '*not flood the area with different research propositions*' (2). Additionally, by organising seminars and collecting research output in a common database, it soughs to close the gap between research and practice also beyond its application in the Werkspoorkwartier (1, 2 & 10). However, as discussed in 5.7.1, aligning research output to match practice remains a challenge, and spin-offs from research have yet to occur.

5.8.2 Institutions

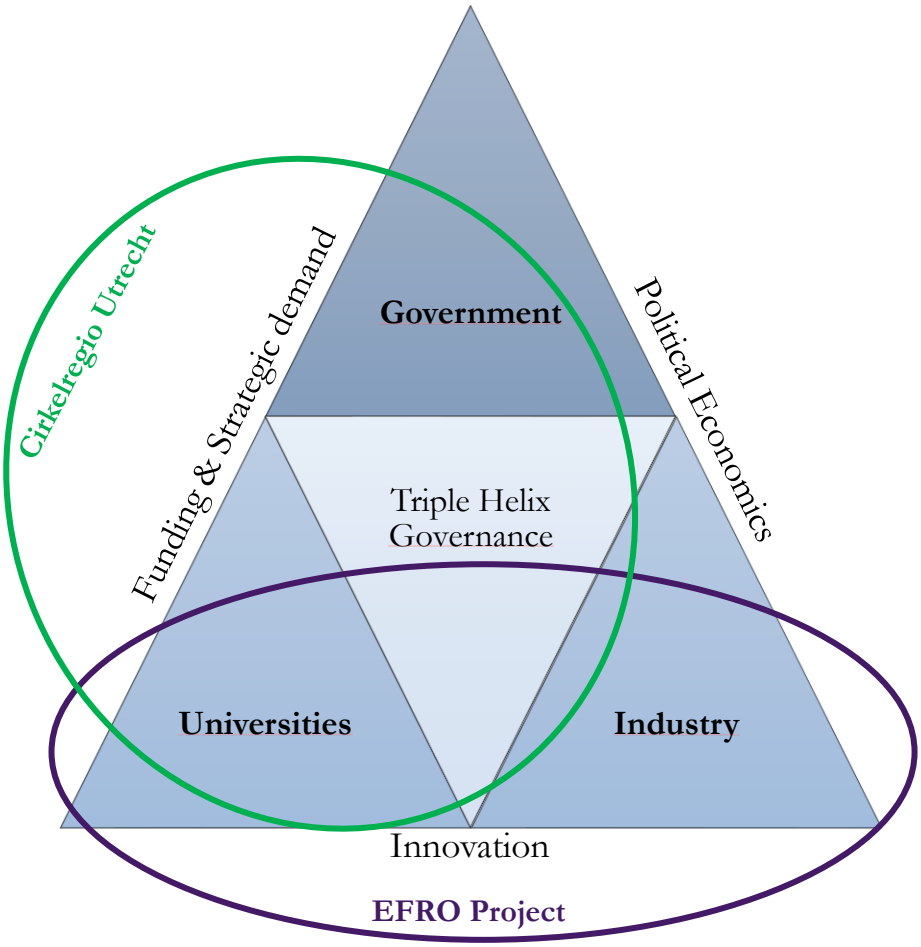
As pointed out in the literature framework, the institutional dimension of governance is an important factor for both post-industrial regeneration and CE development (Healey, 1995; Moreau et al., 2017). Often institutional lock-ins are experienced for both phenomena that support the current status quo and hampers a transition to a new state (ibid). This case study yielded two results. First, initiatives experienced scepticism regarding CE solutions by fellow companies, contractors, financers, and policymakers. For instance, a circular architecture firm explains '*the construction sector can be quite conservative, they sometimes say: 'wood is only good for sheds''* (5). Also, quality concerns seem to be of relevance, '*people think that used materials cannot be as qualitative as new ones, but these people often did not have first-person experience with my products'* (11). Or even '*waste and quality do not seem to go together for people'* (21). From the data it is hard to judge if these views about the CE and waste did play a role in the division of the three 'CE understanding camps' (see 5.7.3), but awareness is regarded to be of importance to change people their perceptions about the CE (2, 5, 8, 10, 11, 18 & 20). Second, the Hof van Cartesius experienced institutional barriers related to the use and organization of space. The cooperative business case, together with using its premises extensively for mixed-use (e.g., garden, event space, workshop area, or terrace) made applying for funding and loans a problem. '*We fell exactly between a social initiative, and a commercial business […] which are conditions for the application procedures*' (10). Again, awareness plays a role here, since applying for financial instruments was easier for the expansion of the Hof as '*they could now see with their own eyes what we tried to explain before'* (10). Additionally, for the Havenloods, Haventuin & Nijverheid, their temporary contracts seem to have had influence on these same use-related institutional barriers (20 & 22). '*Stakeholders are often more willing to allow innovative or non-regular business cases since we're here only for 10 more years and do not make permanent changes'* (20).

5.8.3 Process

For this final section on governance, a reflection is given for the governance proces by utilising the triple-helix governance model. The literature review explained that this approach to governance could contribute to innovative ecosystems and thus enhance CE development (Cramer, 2020) In Figure 15, both the EFRO project (meso) and the Cirkelregio alliance (macro) are laid over this model. The most important finding that this portrays is that in practice, both projects include mostly two of the three helices, and that

there are few examples of political economic measures between the industry and governments (3, 5, 10, 16 & 20). As showcased in previous sections, this first stage of CE transition is mostly focussed on the development, dissemination and availability of knowledge and innovation to create CE opportunities. This approach is reflected by the approach of both CE projects. Consequently, political economic measures have been addressed to a far lesser extent, examples such as reforming taxes, creating supportive infrastructures, and addressing institutional barriers have not been on the agenda. The only exception are the subsidies that are provided through these funds, although these are regarded as beneficial to CE development, a critique is that *'if subsidies are necessary to make a CE solution viable in a linear economy [...] a transition will not happen if we do not address the economic system'* (18). On the other hand, others argue that this current stage of transitioning, focussing on innovation and facilitating initiatives is preferred. The outcome could be utilised to take political economic measures that could be effectively accelerate CE development (12 & 21).

Figure 15: Triple-Helix Governance at the Werkspoorkwartier.



Regarding the helices, the aim of the Cirkelregio alliance is particularly focussed on combining the three helices, however in practice, some CE initiatives take part in it, and for others it is unclear what it could deliver to them (5, 8, 14 & 18). Regarding the EFRO project, many agree that in the future the municipality should take a seat at the table to discuss potential pathways for enabling more local CE development (2, 10, 20, 21 & 22). Often, the Buiksloterham (CAD in Amsterdam), is mentioned as an example of how to move forward. '*They have a manifest that was signed by all the important actors and is used to align their interests and to cooperate for CAD, we could learn a lot from such an approach*' (2). Concluding, specifically planning the Werkspoorkwartier as a living lab (like Buiksloterham) for CE and cultural development could be an approach to '*use all the resources, actors, and knowledge we already have and combine it with experimental approaches to regulations, subsidies or taxes so we can find out together what works and what doesn't*' (21).

6. Conclusion

To date, the influence of planning on CE development—more particularly CAD—is starting to gain attention as it not only is applied in practice, but some explorative studies showed that the planning of cities could have critical success factors to deliver the CE (Williams, 2019; van den Berghe & Vos, 2019). This qualitative single case study on the Werkspoorkwartier in Utrecht seeks to contribute to this growing body of literature by exploring the importance of five common critical factors (drivers and barriers) on CAD. Additionally, the case presented an opportunity to study how CAD is used to regenerate a post-industrial area, which are common places for CAD to develop in the Netherlands.

6.1 Drivers & Barriers to CAD

Taken together, the results found that the five analytical categories: (i) financial; (ii) spatial; (iii) social capital; (iv) knowledge & innovation; and (v) governance, were the categories where the most important barriers and opportunities for CAD could be ascribed to. However, it must be recognised that each factor discussed does not act in isolation, and strong relations between these categories were found as well. This holds especially true for different conceptions and understandings of the CE which were found to influence each category. Especially a lack of CE knowledge or moderate scepticism were found to contribute to institutional and regulatory lock-ins. Second, the bias towards CE in design at the Werkspoorkwartier enabled this thesis to uncover internal and external factors that contributed to this bias but makes it questionable to what extent the

Werkspoorkwartier is truly CAD and not a collection of CE initiatives, since the functioning and related material flows at the meso level were addressed to a far lesser extent. However, taking all this in consideration, the case was able to shed a light on some of the most important findings within and between the analytical categories. First, the market-led redevelopment approach that dominated the management of municipal real estate over the last decades was found as a driver for space becoming scarcer and more expensive in the Werkspoorkwartier. This especially affects financially vulnerable initiatives and creates a barrier for CE innovation as it often requires more financial risks. Also, there is a common fear that cultural and CE regeneration creates a 'self-gentrifying effect', and thus will only function as a proxy to create new economic opportunities. Additionally, it is especially those innovative business cases where cultural and CE entrepreneurs reside that are the primary drivers of knowledge spill-overs, creating mutual beneficial networks, seeking cooperation, and sharing resources which were shown to be contributing to CAD. It could also be used to partially explain the role of the municipality in triple-helix governance. While the municipality seeks cooperation at a macro-level with the three helices in the Cirkelregio alliance, at the meso level the municipality is lacking instruments to directly influence the development of CAD due to a weak ground position. Alternatively, to manage the area, it has to use more soft measures such as negotiations, which were found to be effective to some degree but many doubt if it is enough to counteract the market mechanisms at play. Further, hesitations about the longevity of the CE, together with the intention of the municipality to create a regeneration strategy that does not exclude any vested actors, were found as barriers for the municipality to introduce political economic measures. Thus, the municipality rather focusses on opportunities to 'facilitate' CE and cultural regeneration rather than using its instruments to 'regulate' its development. The early phase of CE transition in the Netherlands is often used to explain the lack of enabling policies and regulations, since it is still unclear which policies would be effective in which context, and there are currently varying CE conceptions that influence this debate. However, to enable the development of more CE functioning in the Werkspoorkwartier, and potentially lead to more CAD and counteract gentrification, regulative measures should not be overlooked in the future.

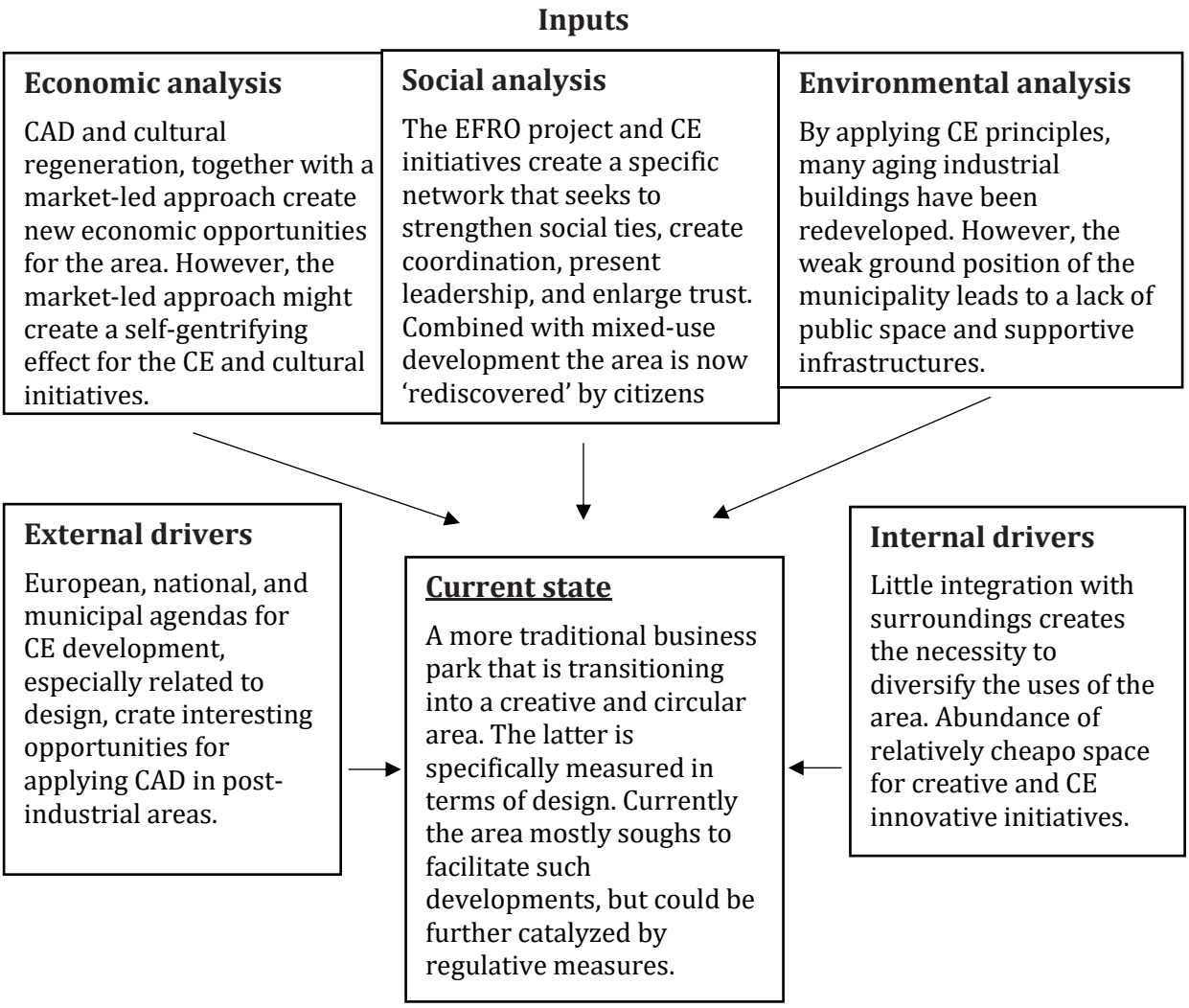
Reflecting on the current state of research, the results of this thesis undescribe the importance of the social dimension of the CE that is starting to gain attention in recent publications (Kirchherr et al., 2017; Moreau et al., 2017; Geissdoerfer et al., 2017; Williams, 2019). Especially various forms of social capital, CE knowledge &

understandings, CE agendas & programs, and planning approaches to facilitate CAD were found to be of great influence in this particular case. However, due to the single qualitative case-study design of this thesis, it must be noted that the extent to which these results can be used inductively is limited. Nonetheless, it does present interesting prospects for future research. Especially a comparative case-study design into drivers and barriers could be an interesting way to move forward and unravel potential external and internal aspects of various cases that affect CAD. Additionally, this study found that varying conception about the CE could be a fundamental driver for various approaches to facilitating the CE within cities. Thus, this presents opportunities for a discourse analysis, potentially applied to the triple-helix actors.

6.2 CAD for Regenerating Post-Industrial Areas

Lastly, this final section discusses the potential of CAD as an approach to regenerate post-industrial areas. In the literature review the problem definition model for post-industrial regeneration was discussed. In 4.4.3 and figure 10 this approach was applied to the Werkspoorkwartier. In figure 16 an overview of the effects of CAD on the regeneration of the area are given, following the same method of visualisation by Roberts (2004). Additionally, two aspects are discussed in more detail, as well as one important notion of critique. First, as Loures (2015) discusses, the industrial heritage in these areas can often be a barrier to regeneration. However, in the case of the Werkspoorkwartier the existing industrial heritage was an important driver for CE development in design. This resulted in various approaches of adaptive reuse to develop in the area, much of which are important contributors to its circular performance. Second, another challenge for post-industrial areas is the reintegration into surrounding areas (Roberts, 2000), mixed-use development is often favoured as these areas tend to be monofunctional. Interestingly, the application of CE principles on the use of space by various initiatives often resulted in mixed-use development. Therefore, CAD might pose opportunities as a proxy for mixed-use development as well. Lastly, it is debatable to what extend the Werkspoorkwartier is currently developing in a ‘regenerative’ fashion rather than being urban renewal, since most of CE initiatives were not initiated by vested actors. Although the regeneration programs seek to include vested parties, their traditional approach to doing business in these business parks, as well as their doubts about their future in the area made it difficult to include them.

Figure 16: the contribution of CAD to the regeneration challenges of the Werkspoorkwartier



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6. Appendixes

Appendix 1: Coding Tree

Nodes	**Codes**
CE drivers	-
CE barriers	-
CE in design	-
CE in functioning	-
Financial	Investment costs
	Profitability
	External financial support
	Win-wins (cooperation)
	Win-wins (proximity)
	Supply & demand
	Space (affordability)
	Space (availability)
	Political economics
	Financial arrangements
Spatial	External effects
	Diversity of functions
	Physical environment
	Public space
	Nature
	Infrastructure (mobility)
	Infrastructure (materials)
	Facilitating CE
	Regulating CE
Social capital	Networks (micro)
	Networks (meso)
	Networks (macro)
	Networks (pre-EFRO)
	Networks (post-EFRO)
	Trust
	Stakeholders & leaders

	Awareness
Knowledge & information	Skills
	Construction
	Business cases
	CE as transformative
	CE as sustainability trend
	CE as economic opportunity
	Spillovers
	Availability
	Research
	Cross-fertilization
Governance	Actors (Industries)
	Actors (governments)
	Actors (universities)
	Funding & strategic demand
	Political economics
	Innovation

Appendix 2: List of interviews

1. Vriendinnen van Cartesius
2. Erfgoed Werkspoor Utrecht
3. Urban Climate Architects
4. Municipality of Utrecht, planning department
5. Sustainer Homes
6. Vereniging Delta Metropool
7. Sublime FM
8. Earthkweek
9. dB's
10. Hof van Cartesius / Buurman Utrecht
11. Het Groene Kabinet
12. Policymaker, Province of Utrecht / researcher
13. Mailmen Studio's
14. Uitvindersgilde
15. Project Manager Circle Economy
16. Cartesius Museum
17. 't Hoogt
18. De Schaverij
19. Municipality of Utrecht, economic department
20. De Plaatsmaker
21. Municipality of Utrecht, sustainability department
22. Nijverheid
23. Filmcafé