House of Circularity

Activating synergy:

A proposal for a hybrid building that stimulates circular interaction

POMPENBURG

Fikri Yalvaç

author
Fikri Yalvaç

studio
Cross Domain: City of the Future

tutors
Dr. ir. R. Cavallo (Roberto)
Dr. M. Parravicini (Mauro)
Dr. ir. M.G.A.D. Harteveld (Maurice)

Delft University of Technology
Faculty of Architecture and the Built Environment

July 9, 2019

House of Circularity

Activating synergy:

A proposal for a hybrid building that stimulates circular interaction

POMPENBURG

Table of contents

Summary

This thesis is conducted under the studio Cross Domain Lab: City of the Future in collaboration with BNA Onderzoek (Stad van de Toekomst). The studio focuses on the opportunities and challenges our cities (currently) face in order to prepare for the near future of 2040. This research deals with the currently critical notion of 'circularity' (originated from the Circular Economy). Circularity correlates highly with sustainability and therefore with the welfare of our planet. The Paris Agreement and the Commodity Agreement induced the Circular Economy to catch momentum. Many municipalities, especially in the Netherlands, placed circular developments higher on their agenda. Rotterdam was one of the first to state a bold ambition to become a fully circular city by 2050. However, recent studies have shown that, even after the international agreements, our current commitments have not proved sufficient.
Within architecture circularity is mainly measured through performance related aspects, such as recyclability, reusability, and demountability. However, in this thesis circularity is placed in a different context. The year 2050 is relatively short to transform an existing city and economy to a circular one, but considerably long enough to influence and educate the next generation to embrace and adopt circularity as their standard.
On the one hand there are many people who are still unfamiliar with circularity, or do not know in what ways they can contribute to the economy. On the other hand, there are people (and also students) who have brilliant circular ideas but cannot afford the resources to execute them.
Instead of approaching circularity in a conventional way, this thesis made a distinction between hard and soft characteristics of circularity and classified them as short-term and long-term achievements respectively. The soft characteristics are circular interventions that have education, interaction, and spearing awareness as their main focus. Promoting the works of circular initiatives, facilitating interaction between users and actors, and providing space for people who want to engage with circularity is a critical and necessary venture for the future of our planet.

The location and accessibility are decisive factors for facilitating circular interaction. Therefore, it was essential to avoid or resolve barriers and obstacles. Through research and careful observation, Park Pompenburg, which is located in the center of Rotterdam and could be turned into an important node for the city's infrastructure, appeared as the most suitable location to promote circularity and activate interaction. Park Pompenburg overlaps three different neighborhoods that are difficult to reach due to the underground railway that rises above the ground and forms a barrier in the park. By extending and connecting the railway tunnel with the Hofbogen and the Luchtsingel, a plateau has been created that becomes a public square where traffic from various directions meet.

The project is called 'House of Circularity' and resulted in a hybrid building that accommodates educational programs, dedicated workspaces for circular initiatives, commercial facilities, flexible office spaces, (short-stay) hotel, and apartments. The project consists of two plinths and towers on either side of the railway, and a public plateau that connects both structures and the two districts. The complex is a modest tribute to the place's history and the former Hofpoort (city gate). The two towers mark the transition in the skyline between the Central District and Rotterdam North.

The project investigates how architecture can contribute to boost circular awareness in order to influence behavior and activate interaction. This project is a critical statement towards traditional and conventional approaches to circularity. It is an attempt to make circularity transparent and accessible for the public in order to spread a message; The future of our city concerns us all, therefore a healthy planet is a waste-free planet!

activate /ˈaktɪveɪt/
Make (something) active or operative.

attitude /ˈatɪtjuːd/
A *settled* way of thinking or feeling about something.

awareness /əˈwer.nəs/
Knowledge that something exists, or understanding of a situation or subject at the present time based on information or *experience*.

behavior /bɪˈheɪvjə/
The way in which an animal or person behaves in response to a particular situation or *stimulus*.

circularity /səːkjəˈlarəti/
A closed control loop where no waste is produced and all raw materials are reused.

education /ɛdjʊˈkeɪʃ(ə)n/
A body of knowledge acquired while being educated.
An enlightening *experience*.

environment /ɛnˈvʌɪrənm(ə)nt/
The setting or conditions in which a particular activity is carried on.

exchange /ɪksˈtʃeɪndʒ/
Give something and receive something of the same kind in return.

experience /ɪkˈspɪərɪəns/
An event or occurrence which leaves an impression on someone.

facilitate /fəˈsɪlɪteɪt/
Make (an action or process) easy or easier.

hybrid /ˈhʌɪbrɪd/
Of mixed character; composed of different elements.

Glossary

incentive /ɪnˈsɛntɪv/
A thing that motivates or encourages someone to do something.

influence /ˈɪnflʊəns/
The capacity to have an effect on the character, development, or *behavior* of someone or something, or the effect itself.

interaction /ɪntərˈakʃ(ə)n/
Communication or direct involvement with someone or something.

nudge /nʌdʒ/
To encourage or persuade someone to do something in a way that is gentle rather than forceful or direct.

perception /pəˈsɛpʃ(ə)n/
Awareness of something through the senses.
The way in which something is regarded, understood, or interpreted.

prototype /ˈprəʊtətʌɪp/
The first, original, or typical form of something; an archetype.

sharing economy
An economic system in which assets or services are shared between private individuals, either free or for a fee (typically by means of the Internet).

stimulus /ˈstɪmjʊləs/
A thing that arouses activity or energy in someone or something; a spur or *incentive*.

synergy /ˈsɪnədʒi/
The *interaction* or cooperation of two or more organizations, substances, or other agents to produce a combined effect greater than the sum of their separate effects.

1

BNA Onderzoek | Stad van de Toekomst

BNA ONDERZOEK
Praktijklab voor slimme ruimtelijke ideeën

PACT

TU Delft

vereniging delta metropool

Ministerie van Infrastructuur en Waterstaat

Ministerie van Binnenlandse Zaken en Koninkrijksrelaties

City of Amsterdam

Den Haag

EINDHOVEN

Gemeente Rotterdam

Gemeente Utrecht

source: BNA Onderzoek.

Stad van de Toekomst | City of the Future

i. **Introduction**

"Stad van de Toekomst" (City of the Future) is a research project initiated by the Ministry of Infrastructure and Water Management in close coordination with BNA (The Royal Institute of Dutch Architects), Delft University of Technology/DIMI (Delft Deltas, Infrastructures & Mobility Initiatives), Delta Metropolis Association, Ministry of Internal Affairs and the five concerning municipalities of Amsterdam, Eindhoven, The Hague, Rotterdam and Utrecht.
"The city of the future: Making a city in times of major transitions", as the research project is stated by BNA Onderzoek, is concerned with the central question "How can we design and develop a transformation area in an integral way into an attractive and future-proof urban environment?"

This question is associated with a wide range of urban issues. Cities need to be prepared for fundamental transitions varying from housing demand, social inclusiveness, new economy, densification, climate adaptation, but also the transitions in energy, mobility, circularity and digitization. Through future scenarios, the goal of this study is to obtain insights into central and locals questions in order to inform integral area development from systems and networks (Cavallo & Kuijper, 2018).

ii. **BNA Onderzoek: Stad van de Toekomst**

The five biggest cities of the Netherlands have to contend with a growing number of inhabitants. They all have to deal with compaction and expansion. For each of these five cities Stad van de Toekomst had appointed a 1 × 1 km transformation area to be analyzed, researched and designed by two interdisciplinary teams of architects, urbanists, city planners, visionaries, engineers and sociologists. For the five cities there were in total ten multidisciplinary teams of practitioners fully involved with the project. This size of the 1 km 'window' was considered necessary because many different functions and spatial issues come together and are visible at once. These windows have in common the challenge of dealing with the existing city and, at the same time, with an urban densification assignment. They served as test locations for new insights that can also be implemented in other places where further urbanization takes place (Cavallo & Kuijper, 2018).

Workshop at the Università Iuav di Venezia (top and middle) and the Biennale (bottom) source: BNA.

iii. **Cross Domain: Graduation studio**

The graduation studio is connected to the research and design project Stad van de Toekomst. In this experimental design project, largely based on the same assignment given by BNA Onderzoek, students from different disciplines, such as architecture, urbanism, management, transportation and geomatics are interested on one hand to the urban intervention in the built environment and its effect on architecture, and on the other hand to the architectural treatment of the city and its effect on urbanism.

Starting point of the design study is the large system transitions that are necessary for the fundamental social tasks that we are facing. These system transitions concern energy supply, mobility systems, circularity of raw materials and digitization. De Stad van de Toekomst depends on the extent to which these transitions can be given a place as part of a new daily living environment. The transformation of the city from the current situation to a new situation of such complex and interlocking systems is far-reaching and yet unknown.

In addition, the system transitions have a major impact on societal tasks such as progressive urbanization, regional and urban accessibility and climate adaptation, which for instance must ensure that we can better control extreme rainfall or long-term drought. Therefore, this design study is not looking for classic area development solutions, but for new ways of thinking about the city, which should be based on how the different transitions can work to the advantage of the area (Cavallo & Kuijper, 2018).

iv. **Workshop: Venice (Biennale)**

The pre-Venice research phase was devoted to understand the spatial context of one of the five predefined sites by BNA Onderzoek. In a subgroup of two students, the objective was to focus on the one square kilometer window and collate as much data as possible for three weeks. In addition, local and plenary meetings of the design teams could be attended to get more involved in the actual study.
In Venice, a two-day workshop with five other universities was organized at the University of Architecture in Venice (IUAV) to collaborate and form scenarios for the ve cities. The next day the results were shared at the Venice Biennale in a short presentation for all the teams, stakeholders and students involved.

2

x Domain Lab | City of the Future

The climate crisis.

Introduction

i. **Focussing the lens**

The mitigations against climate change is a growing issue in today's society, including but not limited to increasing temperatures, extreme precipitation, prolonged drought and devastating wind speeds. There is a unanimous scientific consensus that these events are the results of human activity (McMichael et al., 2006).
The increasing awareness that we have to face major transitions has led to a global urgency to initiate various studies on future cities with regards to sustainability, circularity, energy transition, network innovations and mobility (BNA Onderzoek, 2018).

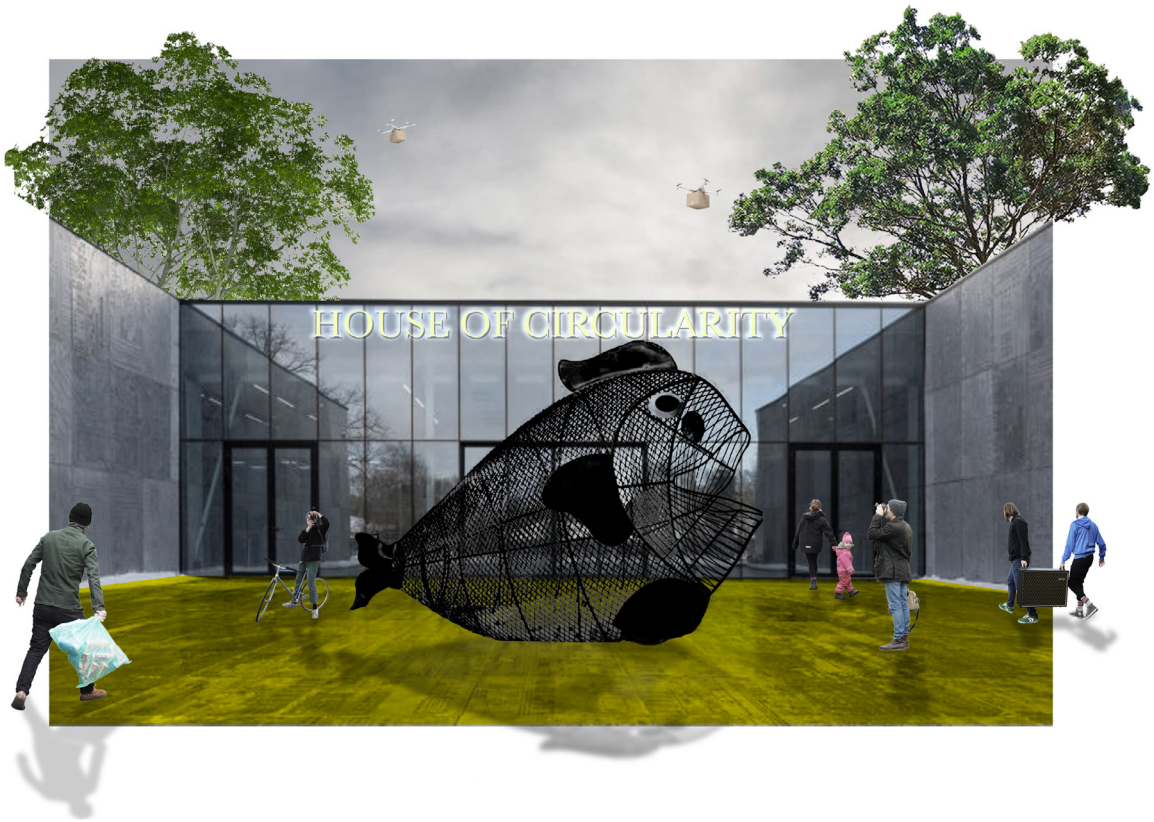
In 2015, this led to the Paris Agreement on Climate Change adaptation and mitigation, which coerced many municipalities to speed up their preparations to integrate circularity on a regional scale (UNFCCC, 2015). For example, the municipality of Rotterdam started the "Next City" program to understand how to deal with the physical transition of the city with an emphasis on: space and systems. The program focuses on the transition issue by accepting it as a process to address the critical question "how to deal with uncertainties as a city?", through five substantive aspects: Space as a Service, Mobility as a Service, Next Energy, Climate adaptation, and Circularity (BNA, 2018). This also encouraged the municipality of Rotterdam to make an ambitious statement to become a fully circular city by 2050.

The challenge to find transitional solutions for circularity is also a central topic of discussion in the national project; Stad van de Toekomst – City of the Future, as part of the solution to the underlying question "How can we design and develop a transformation area into an attractive and future-proof environment?" (BNA Onderzoek, 2018). However, the challenge of integrating circularity as the standard within the built environment is that it reaches far beyond mere sustainable implementations.

It is clear that buildings are now obliged to meet more requirements than before, due to the ever-changing working and living conditions. Sustainability, circularity and energy consumption, therefore, demand for a different design approach. But this also interfaces with the use of the building from a user perspective. It requires an active involvement and participation which calls for a change in lifestyle such as, separating waste more consciously, sharing more and possessing less, and making more use of public facility services, as a critical behavior to decrease our carbon footprint.
This anticipated behavioral change and the lens with which we look at buildings today, offers possibilities for a constant change of programs and enables opportunities for new kinds of mixes (typologies), which in turn leads to new ways of 'use' and different kinds of 'users'.

These (new economic) dynamics have started to emerge in various neighborhoods. In contrast to the functional separation advocated by CIAM in the early 1930s, the discourse has gradually shifted towards activity-oriented establishments based on mixed-use development policies to enhance urban quality (Hutton, 2004). These progressions, as a result, fundamentally changed the way different programs are combined. Hybrid buildings, therefore, have developed themselves as (semi-)public structures with an evolving character and inherent potential to adopt and anticipate on ever-changing advancements (Floris et al., 2011). Due to their characteristic qualities, hybrid buildings contribute effectively to densify the existing urban fabric and to activate, enhance and extend the public domain. This reveals unexplored opportunities to combine circularity with the characteristics of public space to instigate and conduce circular behavior.

Although sustainability and circularity are currently accepted as the main focus of our field, it should not be limited to the realization of buildings. It should instead be fundamentally integrated into the operative core of our designs. Rather than only focusing on how circularity can be integrated into architecture, we should investigate how architecture can facilitate circular action.
This graduation project, therefore, takes the position to explore a way to design a hybrid building that promotes and stimulates circular behavior by facilitating interaction with its (immediate) environment in order to exchange resources to reduce waste production. If the architect can become the mediator who instigates circular behavior through physical interventions, it becomes more realistic for cities to achieve a fully circular status.



A circular hub to promote and stimulate circularity.

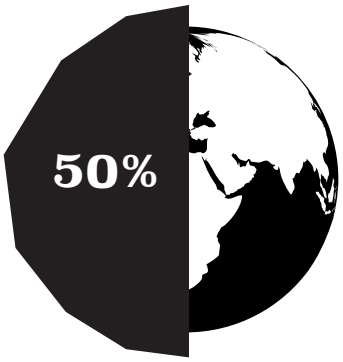
ii. **Towards a circular city**

Today, cities have become increasingly complex structures. Urbanization, densification, mobility, sustainability and circularity have become an integral part within our occupation and a significant, and slightly disturbing, confrontation in our daily life. Coping with the ever-increasing population and preventing further consequences of climate change not only requires buildings that are designed differently, but that also function differently.

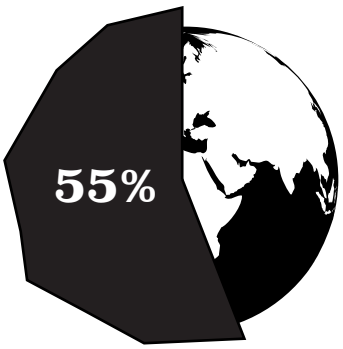
Currently, it is common for circularity to be approached and measured through the design of buildings. Assessing the amount of reusable/recycled materials that have been used, or the degree of disassembly and remountability of the materials. In other words, does the building use materials with a second life, or does it respect its materials in order to provide a second life. The flaw of circularity is that it is usually measured as an individual performance or achievement. However, the ambition to become a fully circular city is unrealistic if circularity is limited by individual accomplishments. There is a need for interventions that activate and stimulate circular behavior in different areas, by facilitating interaction with other initiatives and processes in the vicinity.

Public space could be an incentive in boosting circular behavior through enhanced reachability and connectivity. Linking the context with the neighborhood could instigate circular behavior in a proactive way. Rather than integrating a circular building into a specific area, the building can be designed to activate and to stimulate circularity in that area. Therefore, this graduation project attempts to explore a way to create an interactive link between circularity and public space in order to stimulate the process of exchanging resources to reduce waste.

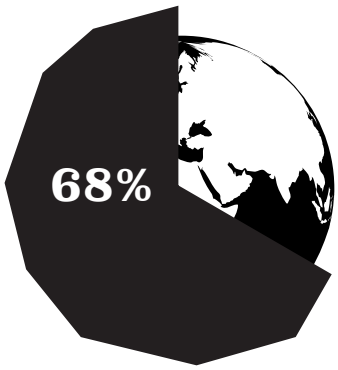
Creating a circular hub that facilitates interaction with other circular initiatives in the city also widens the scope of their operations. This (envisioned) intervention could become a milestone towards a more resource responsible and circular city. Ultimately, a multitude of this ‘prototype’ could become an exemplary typology in future cities that establish themselves as circular catalysts in different neighborhoods to activate and facilitate circular interactions.



2008: 6.7 billion people



2019: 7.7 billion people



2050: 9.7 billion people

Population growth and migration to urban areas.

iii. **A culmination of issues**

At this moment our planet has to cope with several problems that create a collective impact on our climate. The world population is growing exponentially and the way we consume natural resources leads to a rapid increase in exhaustion. The climate agreement in Paris 2015 changed our perspective toward climate change and led to a certain momentum in developments; the Circular Economy in particular. This gradually developed into *Circularity*, and the intrinsic link that the climate goals are impossible to reach without it. However, studies show that our current commitments are nowhere enough. The problem concerns everyone and can not be merely solved by changing the industry. A change of perspective and behavior of the public is imperative.

1) Population growth

As of January 2019 it is estimated that the world population has reached 7.7 billion people. This number is expected to reach 8.5 billion by 2030 and 9.7 billion by 2050. A significant shift has already resulted in 55% of the population living in urban areas. This is expected to rise to 68% by 2050, which means that more than two-third of the entire population will live in cities.

Urbanization has already brought about various challenges. Cities have to cope with population growth while maintaining accessibility and safety, preventing congestions and providing sufficient numbers of accommodation. Conventional solutions are not adequate and sustainable. Our current industry has led to climate change which has shown to have disastrous consequences. This puts a burden on us (as architects, urbanists, manufacturers and consumers), to urgently rethink the way we use/consume our resources (OECD iLibrary, 2016).

1x

1970: 31 December

1,7x

2017: 8 August

2x

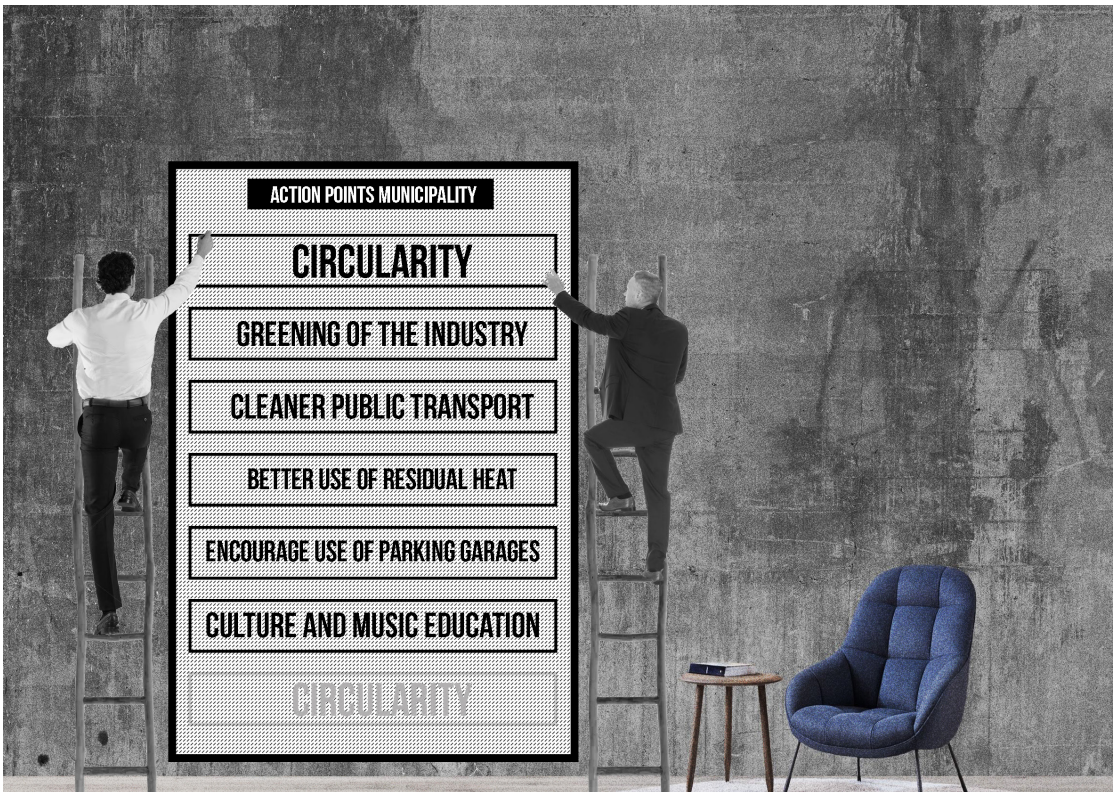
2030: the end of June

The Earth Overshoot Day proves that the resources we currently consume are equivalent to 1,7 planets.

2) Earth Overshoot Day

Our world is a closed (eco)system with finite resources. Although the planet is able to reprocess all the raw materials we use, it does need time to complete this process. However, our current industry and lifestyle does not allow that time.
We emit more CO2 per year than all trees and oceans can absorb at the same time. We use more raw materials than the earth can generate in a year. The speed at which we consume all resources our planet can produce in a year is unnatural, which means that we are demanding more from our planet that it can physically handle.

The Earth Overshoot Day is the day on which we have consumed all natural resources the earth can produce in one year. In 1970 we had reached that point. The overshoot day was exactly on the 31st of December. A study, conducted by Global Footprint Network, predicts that if we continue to live the way we are living now, in 2030 we basically need two planets to meet our needs (BlueCity, 2019). Preventing this requires us to use our resources in a more conscious and responsible way. Moreover, it also requires us to rethink our current economic system as there are many 'hidden environmental impacts' in our linear manufacturing and transport processes (Porcelijn, 2017). This validates that there is a close relationship between circularity and the climate crisis.



The Paris Agreement led municipalities to reorganize the priorities in their agenda.

3) Paris Climate Agreement

In 2015, 195 countries were united to declare a commitment to limit the rise of the earth's average temperature to a maximum of 1.5°C. It is evident that climate change is a threat to society, but also to our planet and the ability for future generations to thrive. In the past years we have witnessed that more (private) investors moved funds and implemented mitigation strategies. However, in order to effectively mitigate climate change, new paradigms need to be explored. This requires us to go beyond progressive improvements to urgently rethink the way products and services are manufactured and/or delivered.

So far, the focus of climate change has rightly been focused on renewable energy sources and the improvement of efficiency. The circular economy, however, has shifted our attention to maintaining value and using the resources that we already possess more efficiently by re-entering them into the system. The transition from fossil fuels to renewable sources has gradually gained a solid position on both a societal and a political level. The challenge now is to consider circularity just as critical in order to achieve the same transition (Circle Economy, 2016).

January
2018
9%

0% progress

January
2019
9%

Zero percent progress has been made in one year.

4) The Circularity Gap

Currently, we are living in a world that is 1°C warmer than pre-industrial levels. The Paris Climate Agreement was a response to seek solutions to limit global warming to 1.5°C. It was ultimately agreed that achieving this ambition would require "rapid, far-reaching and unprecedented changes in all aspects of society" (Circle Economy, 2019). The end goal to limit temperature rise to 1.5°C is by cutting greenhouse gas emissions from 65 to 39 billion tonnes CO2e per annum by 2030.

In 2018, Circle Economy conducted a research where they concluded that our world economy was only 9% circular. This means that three years after the Paris Agreement, the statistics showed that we were still nowhere near the desired pathway. After 12 months since the first publication of the Circularity Gap Report, they have observed that there are no signs that the circularity gap is closing. In fact, the gap is expanding as we are heading in the wrong direction. In their latest publication in January 2019, they stated that the extraction of resources and carbon emissions are still rising. Mainly due to the welded consequences of the linear economy in the global industry. But also due to the lack of political will and consensus. Urgent and massive action is still lacking. Climate change and circularity are tied together, which means that a 1.5°C future can only be a circular future (Circle Economy, 2019).

“How can a hybrid building facilitate circular behavior and activate interaction in order to exchange materials and knowledge?”

iv. **Activating circularity**

As systematic as 'activating' circularity sounds, it is not a switch that can be flipped on spontaneously. Unlike performance related circularity as in products and buildings, circularity here refers to the human behavior. Waste is a creation of human beings, in nature there is no such thing as waste or garbage. Every output becomes input in a different part of the natural ecosystem. A falling leaf will contribute by becoming a part of the soil (Kalundborg Symbiosis, 2019). Our world economy is founded on a linear system, which basically means that we take, make, use, and dispose our natural resources. Thomas Rau argues that this is not by accident. He states that the industry had to shorten lifespans of products in order to stimulate sales. If a product lasts a life time, no one would have to buy a 'new' one again. Rau states that the industry has made 'prducts' an organized 'problem' (Rau, 2016).

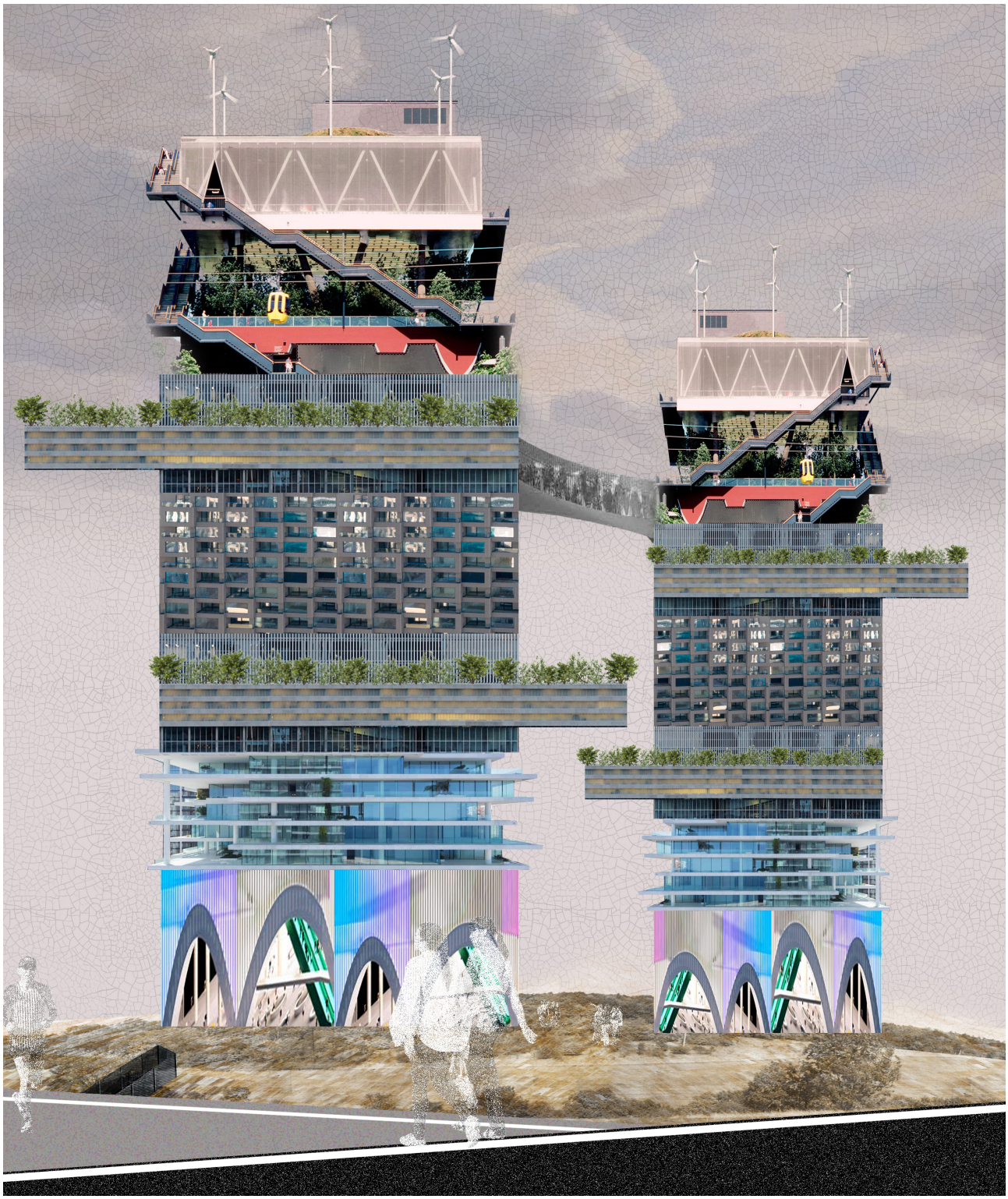
However, despite the linear system that is welded to our economy, many initiatives have emerged in the past century with specific circular ambitions. New economies have emerges that contribute to the Circular Economy, such as the Sharing & Service economy. More people are aware of circularity and the threats our current economic system poses to our climate. Yet there is still not enough movement. People who are actively contributing to the Circular Economy are a fraction of the population. If the rest of us continue to behave as we did, than the circular contributions of this small proportion of people will practically be insignificant. Activating circularity therefore refers to the activation of awareness of the public in order alter perspective and ultimately influence behavior.

Short-term goal – ***Raise awareness / Alter perspective***
Transparency, both literally and figuratively, evokes functional reactions through psychological stimuli. Ray Morose states that we humans are reactive, inuitive and intellectual creatures, who can, unlike animals, analyze information beyond reactive intellect. All living beings are perception conscious, however, humans possess the ability to manipulate knowledge, which makes us a volitional thinker.
In order to instigate a functional reaction, people have to come into contact with a particular sensory situation. Visibility is hereby essential in order to process the information, and ultimately react to it.

Making circular activities visibile to the public and providing dedicated workspaces where circular initiatives can showcase their work and transfer their knowlegde is critical to raise awareness. Educating people in order to show what is already being done within the Circular Economy, and what more is possible will contribute to alter their perspective.

Many people are unaware of circularity or do not know how they can contribute to it. Hesitancy also plays an important role as people are unable or even bad at realizing how much impact small acts of (domestic) circularity can mean for the whole. Because they think their efforts won't make a difference, they choose not to contribute at all.

Long-term goal – ***Influence behavior***
Influencing behavior is a long-term goal which is contingent on the involvement and participation of people. Therefore it is critical to make circularity visible and accessible to the public. As stated before, people are reactive intellects who analyze and manipulate the learned information by free will, making us accountable for our motivations thoughts and actions (Morose, 2007).
Activating circular habits is therefore dependant on the influence the building will have on the human behavior. Educating people spreads awareness and alters their perspective, which in turn leads to a change of behavior. Although evoking curiosity and reaching everyone through a physical manifestation remains an architectural challengde, it is highly plausible that an intervention with a mission to *activate* circularity will ultimately influence the vast majority.



A hybrid building as a new 'prototpye' for circular interactions.

Methodology

i. **An experimental research**

Connecting the characteristics of public space and hybrid buildings with circularity in order to instigate a proactive approach, could be a medium to create an urban connector within the context that stimulates circular behavior. This thesis is therefore an experimental research to seek possibilities to improve the connectivity and reachability within the public domain, in order to facilitate interaction for the activation of circular synergy in the area. However, it is critical to state that it is not the intention to investigate how circularity can be integrated into architecture, but how architecture can facilitate and stimulate circular activity.

Due to the unique and (seemingly) unprecedented approach to activating circular behavior through spatial interventions, there are no substantial examples to refer to. The starting position of the research therefore departs from studying similar innovations where circular processes are combined with spatial qualities, and theoretical frameworks that present comprehensive directions for a circular transition.

ii. **A strategy for a Prototype**

The primary aim of this thesis is not to dive into what circularity is and how exactly it can be integrated into the built environment. The aim is to take circularity, along with service & sharing concepts, as a condition to explore how they can influence architecture (and the way we combine programs to create mixed-use buildings).

This project focusses on approaching circularity in a proactive way, by connecting it with the characteristics of the public spaces and mixed programs to form urban connectors for the context that can facilitate circular interaction. It is an architectural/spatial challenge that endeavors to explore the possibilities of improving the connectivity and reachability within the public domain in order to activate circular synergy in the area. It is therefore not the intention to investigate how circularity can be integrated into architecture, but how architecture can play a key role in fostering circular activities.

The ultimate goal is to prosope a hybrid building that makes circularity visible and approachable for the public by providing various spaces and activities to facilitate circular interactions.

The building will become a house of circularity where resources are collected and exchanged between different initiatives and programs. Its strategy should be considered as a prototype that can be repeated around the city in order to expand the scope of other circular initiatives. Ultimately, the ambition of becoming a fully circular city (and rasing the overall circularity rate of our planet) becomes more realistic and achievable.

An exploratory quest

i. **Specifying the terminology**

Throughout this research and the master thesis, the words "circularity" and "hybrid building" are used repeatedly. In order to determine the framework of this project and to avoid any misconceptions, it is useful and important to define those terms.

Circularity
According to Ellen MacArthur Foundation, circular economy can be distinguished into two cycles; technical and biological. The biological cycle is based on consumption where food and biologically-based materials are fed back to the system through processes like composting, which return as regenerate living systems, such as soil, to provide renewable resources for the future. The technical cycle is based on recovering and restoring products, materials and components by applying strategies such as; reuse, repair, remanufacture and (as a last resort) recycle (Ellen MacArthur, 2017).

These are rather technical implementations based on systematic processes. However, circularity in this thesis is regarded as a dynamic system focused on cultivating circular behavior. It is oriented on promoting the circular economy to raise awareness, sharing the premises with circular actors to stimulate flexibility, creating an innovation platform for circular activities, forming a resource collecting-point for the neighborhood, and interacting with other (circular) initiatives to create joint value. "Activating circularity" in that regard refers to instigating specific activities that brings forth opportunities to exchange both knowledge and resources. Certain programs of the complex, complemented by the qualities of the public domain, are the medium to facilitate this dynamic. There are many circular buildings but no circular "activators". Therefore, circularity and behavior not only go together but each enhances the other.

Hybrid building
Hybrid buildings combine different programs to create new ways of organizing space. Rather than focusing on programmatic solutions, they provide updated answers to our way of living, working an entertaining (Caso & Cavallo, 2013). Hybrid buildings adapt to current needs and attenuates the separation between the inside and outside world. Moreover, the programmatic diversity of combining both private and public functions, especially at ground (plinth) level, contributes positively to the public sphere. Studies from the Danish architect and urbanist Jan Gehl proves that mixing programs lead to more dynamic structures that stimulate activity, facilitate interaction, improve social safety and thereby enhance the livability. (Gehl et al., 2016).

Therefore, the (semi-)open and interactive character of a hybrid building establishes the optimal ground for both circularity and diversity. A hybrid building in this thesis is regarded as a building that facilitates interaction by overcoming physical (infrastructural) barriers, and encompasses a mix of functions that serve to stimulate circular activities by making it accessible and transparent to the public, and responding to both contextual and social necessities.

PARIS CIRCULAR ECONOMY PLAN | 2017-2020

	Actions	Scale	Target	Impact
1	**Building materials:** develop territorial organisation for the recovery and reuse of materials	Territory	Professionals	Material recovery Money saved CO_2 avoided
2	**Building sites:** diagnosis, sorting and recovery of site resources	Administration Territory	Professionals	Material recovery Money saved CO_2 avoided
3	**Circular and sustainable construction:** lay the foundations of new economic models	Administration Territory	Professionals	Material recovery Money saved CO_2 avoided
4	**Waste reduction:** reduce disposable packaging use	Territory	Professionals Citizens	Waste reduction
5	**Repair:** promote the repairing of objects with a set of complementary initiatives	Territory	Professionals Citizens	Material recovery Money saved
6	**Reuse:** creation of a central municipal workshop for the reuse of building materials	Administration	Professionals	Material recovery Money saved
7	**Re-manufacturing:** develop recycling centres	Territory	Professionals Citizens	Material recovery Money saved
8	**Incubator:** create an innovation platform for the circular economy	Territory	Professionals	Networking of actors Synergies between actors
9	**Sharing:** organise sharing of premises for actors in the circular economy and social and solidarity economy	Territory	Professionals	Networking of actors Synergies between actors
10	**Promote and raise awareness:** create a place for actors of the circular, solidarity and innovative economies	Territory	Professionals Citizens	Awareness-raising Synergies between actors
11	**Inter-company synergies:** develop territorial synergies between economic actors	Territory	Professionals	Networking of actors Synergies between actors
12	**Network:** create an online platform for information on the circular economy	Metropolis Territory	Professionals	Awareness-raising Synergies between actors
13	**Sustainable purchases:** increase the proportion of ecode-signed products in public purchases and develop a functional economy approach in public procurement contracts	Administration	Professionals	Material recovery Money saved
14	**Clothing:** reform of clothing, extension of useful life and end-of-life recovery of occupational clothes	Administration	Professionals	Material recovery Money saved
15	**Responsible consumption:** promote circular consumption	Territory	Professionals Citizens	Waste reduction Job creation

source: World Economic Forum.

ii. **Relevant frameworks**

Three circular frameworks were critical for determining the definition of circularity for this project. Circularity is not entirely new. Many architects (and people from other disciplines) already started experimenting with 'circularity' many years ago. Circularity is the term we are using to refer to this approach today. Just like how unclear and undefined the term 'sustainability' is, the same can be said about circularity. There are no clear instructions or manuals explaining how we should operate in a circular way. According to Ronald Olthof, circularity is a matter of 'trial and error'. He states that currently, Dutch architecture is in a phase where everyone tries to find the right strategy (BNA, 2019).

Although we are collectively using the same term, we are not speaking the same language when in comes to circularity. The technical (material) cycle is a common aspect. However, this proved to be inadequate. Circularity is missing a critical layer. The following three aspects are roadmaps/frameworks that explain how to transition cities to the Circular Economy.

1) Paris Circular Economy Plan 2017-2020

In July 2017, the Paris City Council unveiled the Paris Circular Economy Plan. It is a roadmap devised in collaboration with 240 actors from private sector, civil society and academia. The roadmap consists of 15 practical actions to transition the city to a circular economy. The actions are aimed at eliminating waste by 2020, by making sustainable production and consumption possible (World Economic Forum, 2017).

The actions are divided into different scale levels, (administration, territory, and metropolis) and focused on two target groups (professionals and citizens). In order to understand what results are achievable through these actions, each action is linked to (a number of) expected impacts. Some impacts are closely related to economic growth such as, saving money and creating jobs. Other impacts are oriented on stimulating the circular economy such as, recovering materials, reducing waste, sharing information and raising awareness. But also creating a better network for actors and stimulating the synergy between them (World Economic Forum, 2017).

The goal of the Paris City Council to become circular by 2020 is quite ambitious. However, by involving citizens as active participants in this roadmap, they are introducing an important social dimension that can help build a circular economy.

Design for the Future

Adopt a systematic perspective during the design process, to employ the right materials for appropriate lifetime and extended future use

Incorporate Digital Technology

Track and optimise resource use and strengthen connections between supply-chain actors through digital, online platforms and technologies.

Sustain & preserve what's already there

Maintain, repair and upgrade resources in use to maximise their lifetime and give them a second life through take-back strategies, where applicable.

Rethink the Business Model

Consider opportunities to create greater value and align incentives through business models that build on the interaction between products and services.

Use waste as a Resource

Utilise waste streams as a source of secondary resources and recover waste for reuse and recycling.

Prioritise regenerative Resources

Ensure renewable, reusable, non-toxic resources are utilised as materials and energy in an efficient way.

Team up to create Joint Value

Work together throughout the supply chain, internally within organisations and with the public sector to increase transparency and create shared value.

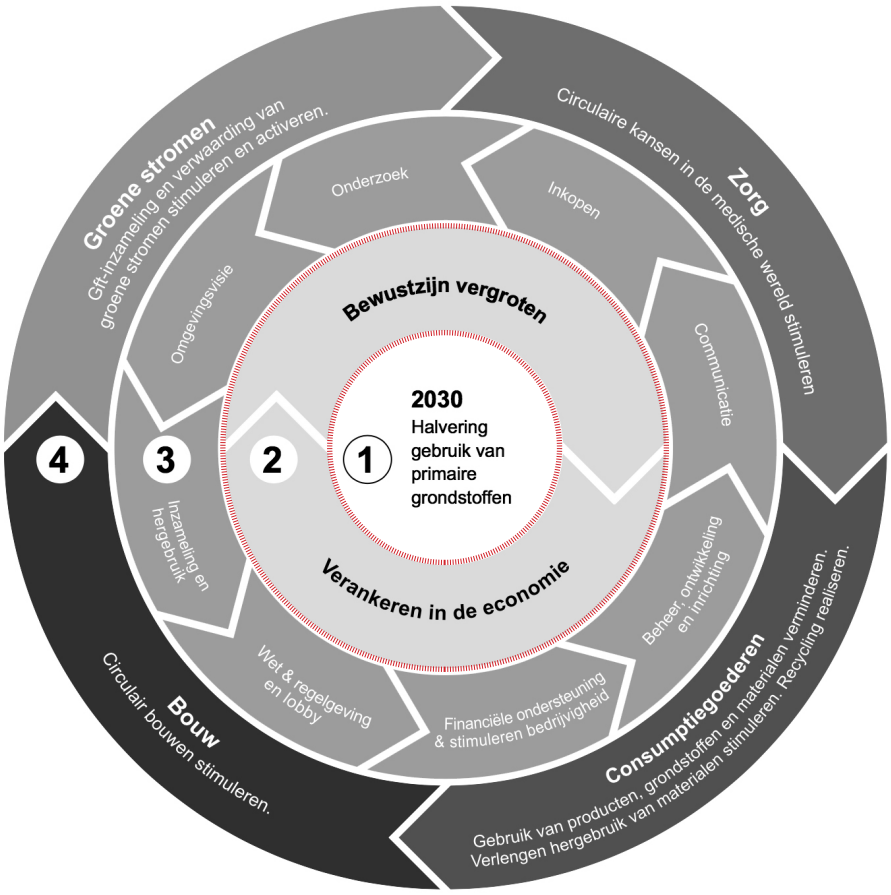
source: Circle Economy.

2) DISRUPT: 7 key elements of the Circular Economy

In 2016, Circle Economy published a research that consists of a framework of 7 key elements for a circular economy. After the circular economy increased in interest and gained significant momentum, Shyaam Ramkumar noticed that the terms "circular economy" or "circular principles" are often used without clearly defining them. Some organizations define it as closing material loops by material and resource management. Others define it as a new organizational strategy to devise new business models. And yet others view it as a new design strategy to create innovative products (Ramkumar, 2016).

The varying perceptions of the circular economy makes it difficult to understand the concept in simplified terms. It also makes it harder to make cross-industry connections. In order to acquire a clear understanding of the circular economy, and to create a universal framework that applies for various sectors, Ramkumar and Circle Economy studied the terms and definitions used by 20 organizations - from government agencies to academia, to consultancies. The process of interpreting and grouping these terms resulted in the 7 key elements that define the strategies to a circular economy (Ramkumar, 2016).

These key elements form an acronym for the word "disrupt". They are designed to give direction to this process of transformation, as the circular economy is not considered to have an end point but is accepted as a dynamic system. Like the Paris roadmap, this framework also embodies elements of varying scales aimed to achieve different impacts (Circle Economy, 2019).



1 Ambitie 2030 2 Twee hoofdroutes 3 Instrumenten 4 Sleutelsectoren met opgaven

source: Rotterdam Circulair.

3) Rotterdam Circulair: Twee hoofdroutes ernaartoe 2019-2023

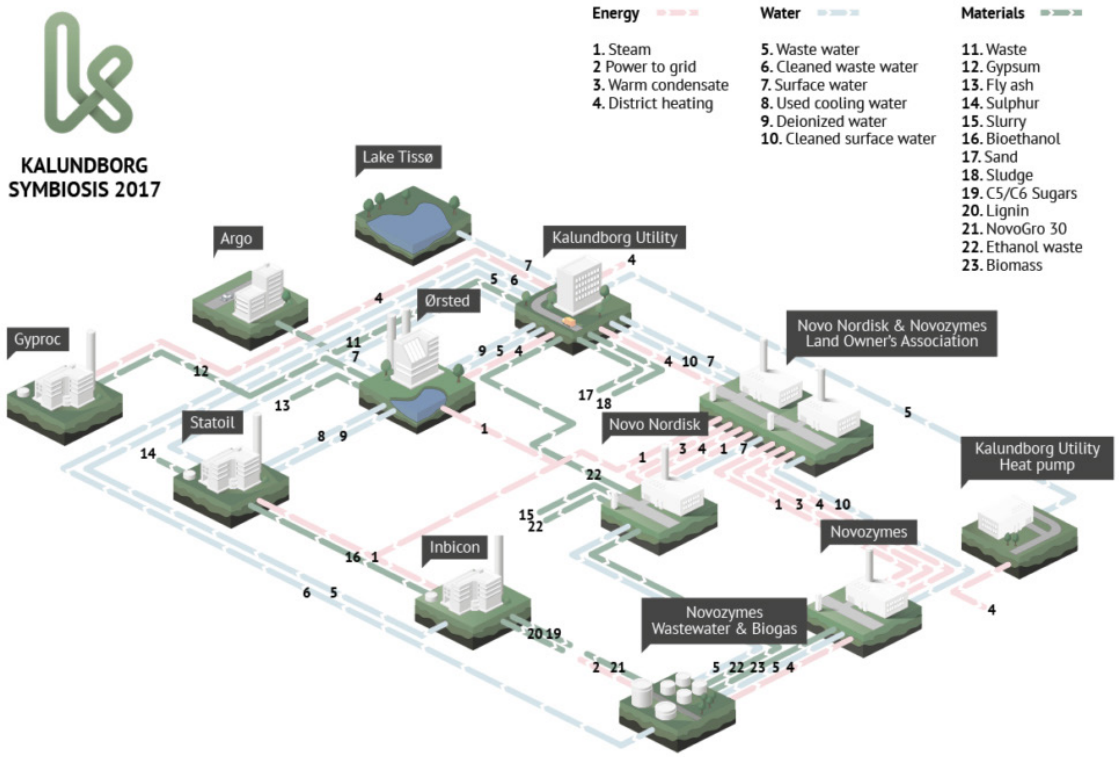
Rotterdam wants to become a fully circular city by 2050. In order to achieve that, they embrace ideas from companies and citizens in order to instigate new intiatives. Rotterdam considers himself a testing ground for circularity by experimenting with ideas in order to inspire people to further develop a circular society.

However, becoming a circular city entails a number of challenges. Two of them are essential and therefore have been prioritized as the main routes in order to pave the way.

1: Increase circular awareness
Raising awareness is critical in order to take the necessary steps towards circularity. People need to understand its urgency and why we should handle our natural resources and products more responsibly. In line with this ambition, Rotterdam has launched the 'Van zooi naar mooi' (From mess to beautiful) campaign based on the motto that 'waste will be worth money in the future'.
As the generation of the future, the campaign's main focus are young people. By making festivals circular they aim to increase awareness among them.
The municipality of Rotterdam works together with companies and citizens to find new (similar) ideas and offers support to people with similar initiatives that will contribute to spreading awareness.

2: Increasing employment and economic development in the circular economy
BlueCity and PlantOne are breeding grounds in Rotterdam that have proved themselves as new successful business-models and innovative circular initiatives. Therefore, the municipality introduced a 'broedplaatsenbeleid' (breeding ground policy) from 2019 to 2023.
Within this period the municipality encourages circular initiatives, improves the investment climate by setting up circular funds and supports breeding grounds for innovative start-ups. They consider the second main route a success if, by 2023, at least 40 new circular initiatives have been realized in the city.

(Rotterdam Circulair, 2019).



source: Kalundborg Symbiosis.

iii. **Exemplary initiatives**

Buildings that encourage circular collaboration and/or promote circularity are (unfortunately) limited. Today more attention is given to the former than the latter. Two commonalities that all three frameworks had is; *work together* & *raise awareness*. Kalundborg Symbiosis and BlueCity are two examplary initiatives that have made circularity their mission. They are collaborating with different companies by exchanging their residues in order to prevent waste production, and promoting circularity by sharing the advantages this process has both environmentally and economically.

Both initiatives are examples of different scales, one being industrial and the other neigborhood. The valuable lesson that can be distilled from both is that circularity can be applied on all kinds of scales, from a building to a city. The critical aspect however is founding a society where everyone, from citizens to companies, understand the urgency of circularity, and see it as an opportunity rather than an obstruction.

1) **Kalundborg Symbiosis, Denmark** *(industrial scale)*

Since 1972, Kalundborg Symbiosis has developed itself to become the world's first working industrial symbiosis with a circular approach to production. They have developed a system to solve the challenges of water consumption, waste management, and the use of natural resources.

It is a partnership between nine public and private companies. Their objective was to come up with new, intelligent ways of cooperating in order to create new opportunities to further economic growth, reduce the consumption of natural resources, and help to save the environment.
Together with the authorities and enterprises of Kalundborg, they have constructed a cooperative solution for these problems. Some of Denmark's largest industries situated in Kalundborg are affiliated with the Dong Energy power plant. Through collaboration, they have organized a system that utilizes each others waste products in a rotating local cycle. Residue and by-products flow in a minutely orchestrated system of production, where the by-product of one company becomes the resource of another company (Kalundborg Symbiosis, 2019).

This systematic cooperation of the symbiosis, which is based on sound business and environmental principles, has made the enterprises achieve economic advantages. The environmental benefit also results in an annual reduction of CO2 emissions by 635.000 tonnes. They aim to reach a full resource utilization in Kalundborg by connecting all streams to the symbiosis (Kalundborg Symbiosis, 2019).

Former swimming pool, source: brightbluefuture.nl

Flex workspaces, source: awkwardduckling.nl

Meeting spaces, source: awkwardduckling.nl

Circular initiatives, source: awkwardduckling.nl

Rentable offices, source: rotterdamarchitectuurprijs.nl

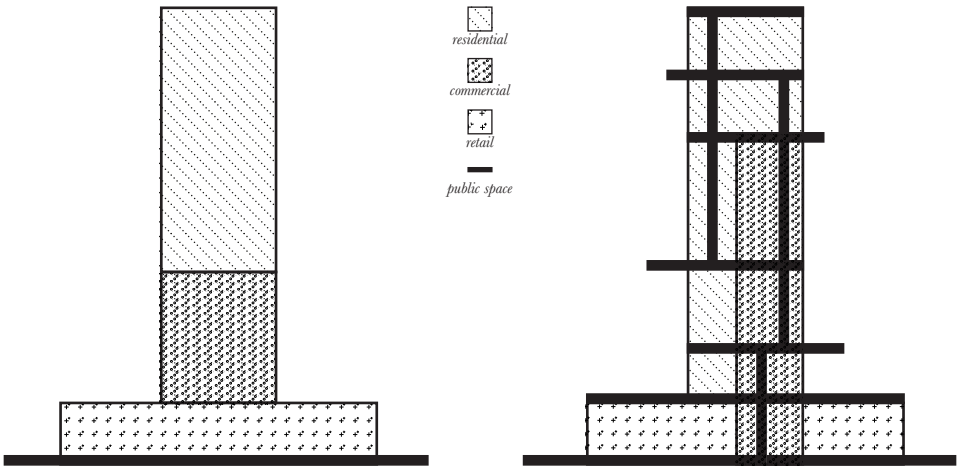
Flex workspaces, source: rotterdamarchitectuurprijs.nl

2) BlueCity, Rotterdam *(building and neighborhood scale)*

BlueCity is located in the former (sub-tropical) swimming complex Tropicana in Rotterdam where innovative, sustainable and circular entrepreneurs cooperate with each other. It is an incubator for circular entrepreneurs in and around Rotterdam. It is a breeding ground for 16 innovative and circular companies who want to make an impact within the circular economy, by linking their residues in order to prevent waste production. It is called BlueCity because it is largely based on the principles of the Blue Economy. They work with what is locally available, cooperate instead of compete and generate different income streams, for example by using output from one process as the input for another process. This different view opens up opportunities to revaluate "waste". Therefore, their ambition is to eliminate waste by seeing it as a valuable resource (BlueCity, n.d.).

Some examples are; a beer brewer of which the residue is being used for baking bread and cookies, and to serve granola. RotterZwam, who has converted 31.3 tonnes of coffee-grounds into 6201 kilos of mushrooms. FruitLeather, who has turned 9 tonnes of rotting fruit into 1175 meters of vegan leather. And Okkehout, who has provided 70 tonnes of used wood and old iron with a second life as a furniture.

Their mission is to become an inspiring and exemplary city for the circular economy where knowledge, skills and resources are exchanged. They aspire to help people alter their view on how they; consume products, and (consciously or unconsciously) are a part of the production of waste. Through the utilization of this process, BlueCity wants to demonstrate that we are able to keep creating new products and materials without endlessly extracting raw materials (Dif Connect, 2018).



Mixed-use

Hybrid

The difference between mixed-use and hybrid buildings.

own illustration, source: Alpert.

iv. **Hybrid building or Mixed-use?**

The research began with an ambiguity caused by two widely used terms among architects, mixed-use and hybrid. Both are characterized by a high programmatic complexity and react to the context of the city. What exactly are the differences between mixed-use and hybrid than? And is there even a difference?

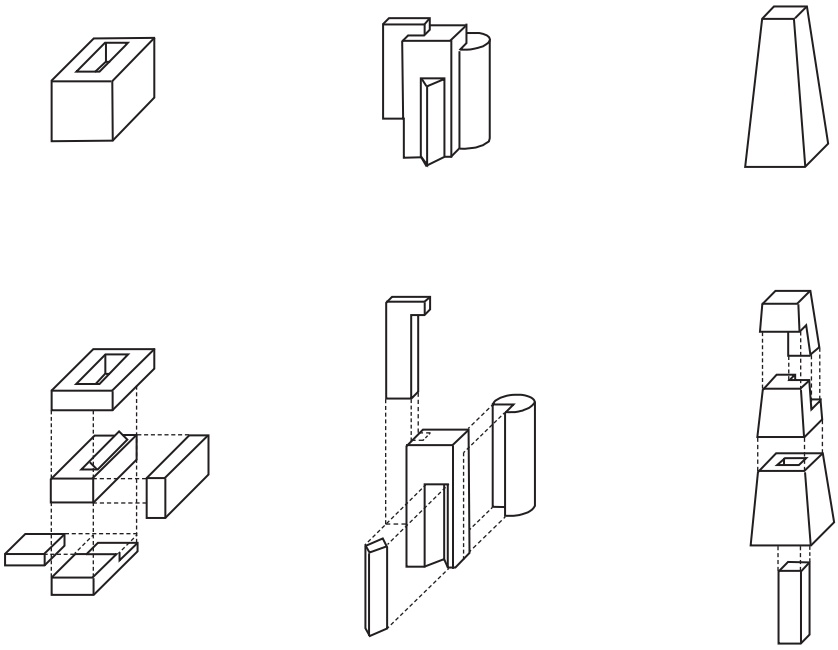
Mixed-use development is defined by Steve Suprenant as *"an appropriate combination of multiple uses, inside a single structure or place within a neighbourhood, where a variety of different living activities (live, work, shop and play) are in close proximity (walking distance) to most residents."* (Alpert D, 2010).

This could be imagend as a singel structure where a number of different programs are integrated without a specific connection between the functions. It's physical appearance can suggest a single building while the fuctions are separated. Steven Holl defined mixed-use as *"a strcutrure where interlinking does not exist ... Relationships are not meant to increase personal contact or exchange."* (Holl, p 21, 2009).

The book This is Hybrid seems to define hybrid buildings most clearly. It describes it as a cross-fertilized environment where a mixture of known genotypes and new genetic alliances create a new urban typology (Holl et al., 2011). A hybrid building *"turns against the combination of the usual programs and bases its whole raison d'etre on the unexpected mixing of functions."* It distinguish itself by a constant activity created by the intimacy of mixing private and public life that continuously dwells throughout the building. Unlike mixed-use, a hybrid is not a disciplinary protoype. It is a collection of interests, based on the future rather than on tradition (Holl et al., 2011).

The main difference between mixed-use and hybrids is the strategy of how the internal spaces and programs are organized and the way in which interaction between different users is arranged. Rather than only achieving basic, working, living, and leisure demands, hybrids need to engage with their context. Steven Holl states that *"hybrids are incomplete and necessarily rely on the organization of the whole in a way that reorganizes the social dimension of the building."* (Holl, p 23, 2009).

A hybrid building therefore distinguishes himself as a holistic entity with a well-organized program that consists of shared or interconnected spaces that add a social layer that promotes interaction between the different programs.



Fabric hybrids *Graft hybrids* *Monolith hybrids*

Fenton's classification of hybrid buildings

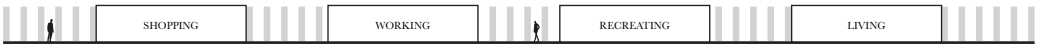
source: Fenton.

1) Hybrid typology and Studies

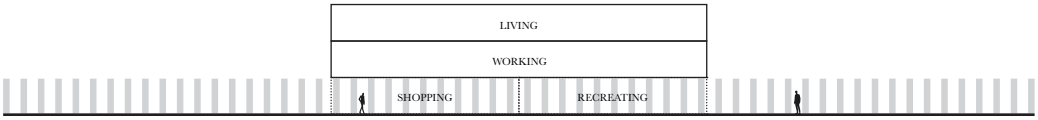
Throughout history, examples of combined function buildings are identifiable in various cultures and different ages, such as the house on top of a shop. True hybrid buildings, however, are undoubtedly a product of modernity and the advancements of construction techniques like concrete, steel frame and the elevator (Fenton, 1985).
Referring to the American context, Joseph Fenton states that the strategy of combining various functions within a single structure is repeated throughout history. However, hybrid buildings distinguish themselves through scale and form which was determined by the orthogonal grid of the city block and resulted from technological innovations, such as structural framing, central heating, electrical wiring and air conditioning (Fenton, 1985).
According to Fenton, two basic categories of program are identifiable, namely, thematic and disparate. Thematic combinations consist of various programs that collectively emphasize a singleness of function, while disparate programs are often composed of a combination based on economic advantages. Additionally, with regards to the form he distinguishes three basic types: graft, fabric and monolith. The programs of a graft hybrid are expressed through volumes, while the programs of fabric and monolith hybrids are accommodated within a continuous building envelope (Fenton, 1985).
The study Joseph Fenton conducted resulted in a pamphlet of hybrid buildings selected through a functional criterion and ultimately subdivided by their physical form.

Another remarkable study is the book "Tekenboek stadsgebouwen" which compares seven sets of similar buildings with each other and dissects the typological and morphological composition of the programs in order to understand the relationship between the public domain and the interior of the building. A hybrid building is considered as a compact urban block which increases the city's density and contributes to its public sphere. The study takes its departure from a number of statements, such as; *"a hybrid building is innovative because of its ambition, but also because of necessity"* and *"it enlarges the city and combines to activate"*. Moreover, the study interprets hybrid buildings as a product of their zeitgeist that attempts to respond to ever-changing (urban) conditions (Floris et al., 2011).

There are irrefutable certainties that hybrid buildings can contribute to the revitalization of existing cities and constitute as an outstanding architectural answer to new urban developments (Van Duin & Van Wegen, 1999). Their unconventional character is responsive to required programs, the context and necessities. In contrast to the twentieth century conviction for urban expansion, cities now seek resolution in densification. Hybrid buildings therefore constitute solutions to both densify and diversify the existing urban fabric. Regarding the prominence of hybrids buildings Joseph Fenton stated: *"The hybrid building is a barometer recoding the evolution of our society. Each new juxtaposition reflects a willingness to confront the present, and to extend exploration into the future"* (Fenton, 1985).



Modern city: (mono)funtional planning



Mixed-use: "a city in a city"

Functional separation of modern cities and the mixed-use "city in a city" building that extends the public domain.

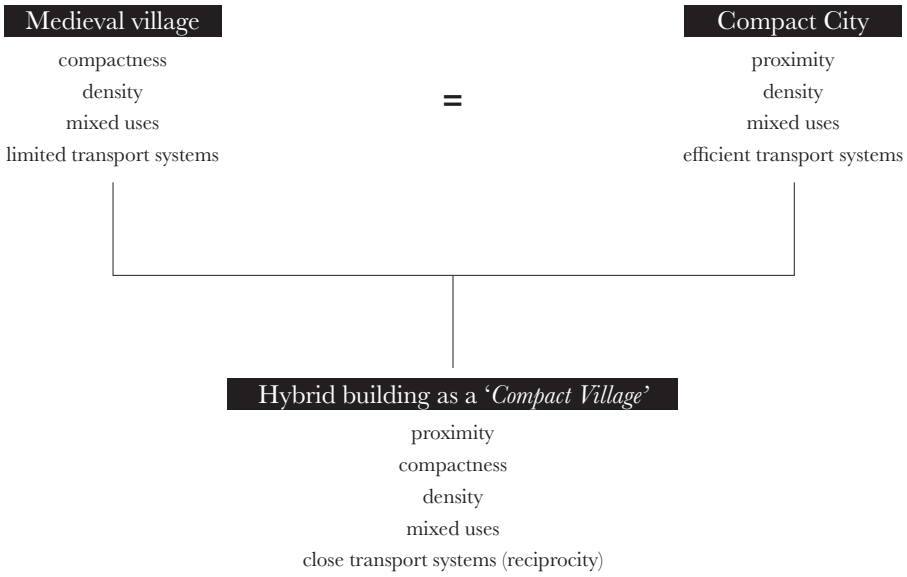
2) Hybrid building and Modern city

Due to its nature of mixing programs, such as living, working and leisure, a phrase that has become synonymous with hybrid buildings is "a city in a city." Often consisting of unexpected, and relatively contradictory, functions, like apartments in combination with a public swimming pool, made it an unconventional character representing an urban architectural typology. This character, however, was generally disapproved in the twentieth century due to its deviation from the 'purity' of form and function (Floris et al., 2011).

According to CIAM (International Congresses of Modern Architecture), based on their research they conducted on thirty-three cities, social problems in cities could be resolved by strict functional separation. The studies concluded a separation of four substantive functions; living, working, recreating and circulation, which became the fundamental principles for "The Functional City". Two well-known examples are Le Corbusier's Ville Radieuse, "Radiant City" and Athens Charter, which was a further elaboration of the former. The twentieth century modernist architect became an urban planner who looked at the city from above. While cities were designed through theoretical, utopian and idealistic concepts, top-down strategy became a common practice in urban planning. Although the theories and visions of these architects were intended as an improvement, many urban renewals based on these concepts resulted in a failure, mainly due to the neglect of the demands of the public (Almeida, 2013).

Today, we are more aware of both the social and physical qualities that is entailed in mixed programs. Although concepts such as compact city offer substantial answers for future cities, they demand new and innovative interpretations of building types that need to be investigated.

Hybrid buildings are condensed urban blocks that contribute to densification and the public domain. Due to their transparent public plinth and (partly) accessible interior, both skyscrapers and "ground scrapers" provide an extension of the city's public domain by connecting it with the inside (Komossa et al., 2014). Although their character is impactful on the city, it remains uncertain whether they will become an asset to the existing public domain or predominate by absorbing the city life (Floris et al., 2011).



The similarities between medieval villages and Compact City, and how hybrid buildings relate to the same key conditions.

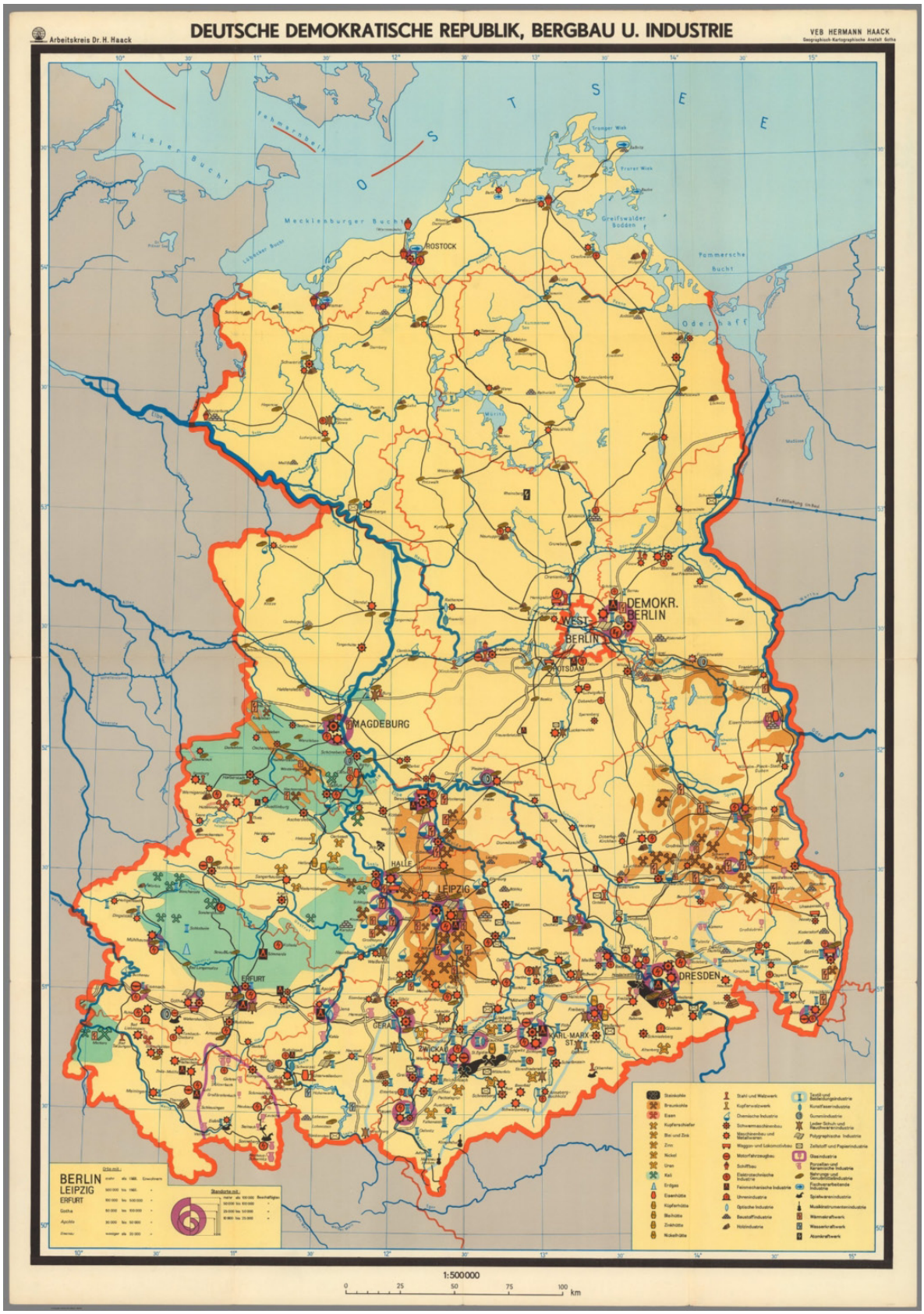
v. **Comparable structures**

In this paragraph the term 'comparable' is used to refer to the sections *Examplary initiatives* and *Hybrid buildings*. The two examples of the circular initiatives demonstrated how we can treat resources more efficiently and responsibly by exchanging residues. A hybrid building proved to be a more interlinked and diverse structure than mixed-use buildings. In this paragraph two structures are introduced that have similarities with circularity or hybridity.

1) Medieval village and Compact City

Optimizing the usability of buildings or neighborhoods by mixing different functions dates back as far as medieval villages, and perhaps even further. A medieval village, however, is a great example of a functional and productive community development. It was typically situated on a hill enclosed and protected by fortifications. The size of the circumference defined by the walls ultimately determined the density of the village, until no further growth could be contained within the boundaries of the fortification. Only then, new walls were constructed to expand the village (Ferrandi, 2013).
Medieval villages were fundamentally built upon four key aspects: compactness, density, mixed-uses and limited transportation systems. This strongly recalls the term "Compact City", which was first coined in 1973 by two mathematicians, George Bernard Dantzig and Thomas L. Saaty. This was a vision that aspired cities to make more efficient use of their resources (Dantzig & Saaty, 1973). Throughout the 1990s, the Commission of the European Communities and the United Nations agreed that compact forms of urbanization foster sustainable urban development. Many researchers and urban planners argued that a compact city is the most sustainable form because it is well connected. This leads to a better public infrastructure, which reduces energy consumption and thereby makes investments more feasible. Moreover, it leads to a reduction in land use, which allows agricultural areas to be preserved, and is positively associated with social diversity, and with cultural and economic development. Certain researchers, however, have reasons to express skepticism as there is not enough profound evidence to prove the supporters' arguments. Various international studies have investigated the relationship between transport, urban form and energy consumption, but unfortunately ended with inconclusive results (Nabielek, 2012).

Today, as we are concerned with "the city of the future", the ideas of the compact city are becoming more relevant. Future cities need to be developed in a way that they are less dependent on natural resources and consume significantly less energy. Developments on low energy public transport systems lead to highly congested multifunctional spots around traffic nodes. The exponential increase in population in urban areas requires the city to densify its existing fabric by mixing and stacking different functions while at the same time increase its livability. Due to its unconventional character and architectural type, hybrid buildings posses a distinctive quality to mix different programs, and thereby provide substantial possibilities to condense the urban block (Komossa et al., 2014).



source: https://www.davidrumsey.com/luna/servlet/detail/RUMSEY~8~1~289812~90061366:Deutsche-Demokratische-Republik,-Be

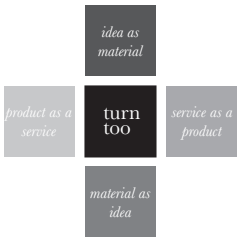
DDR (East-Germany) as a closed system

2) The DDR as a Medieval village

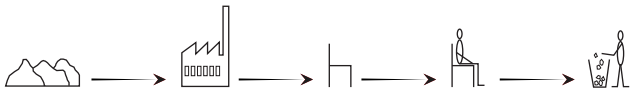
It has already been mentioned that Thomas Rau stated that the lifespan of a product is predetermined and that the product has become an organized problem. In his book Material Matters, Rau introduces a rather odd yet interesting example, the Deutsche Demokratische Republik (DDR). He states that in that time East-Germany had a reversed form of planned aging. In the former DDR it was stated by law that products had to last at least 25 years. This was not an ideological measure, but a necessary one. Because East-Germany was cut off from the West, trade and transport of goods were limited. Most everyday products were unavailable and some products, such as a car, took years to obtain. Due to the limited amount of resources the country had, the government decided that the quality of products needed to be improved. They decided that the manufacturer bears the responsibility for the quality (Rau, 2016).

This example in particular is quite intruiging as it has similarities with Medieval villages. In both situations the city and the village were enclosed. Expansion was impossible so densification was the only option. Both possessed limited amount of natural resources and had to survive with what they had. They were both *closed-systems*, (the DDR perhaps even a locked one).

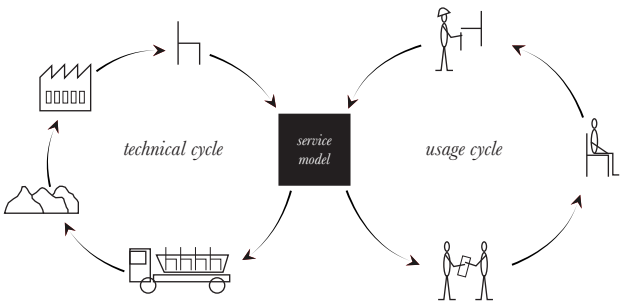
The valuable lesson that can be obtain by this odd example is that; if even an entire country, (although not caused by idealistic motives) can adjust their economy according to the availability of their resources, buildings can achieve the same by ensuring that components can be reused continuously for future purposes, and waste-production is managed within the building.



Turntoo model by Thomas Rau



The linear model: From raw material to waste



The new circular model: Based on service

The new circular (service) economy, based on Thomas Rau's Turntoo model.

own illustration, source: Turntoo.

vi. **Emerging economies**

Service and sharing are economies that gained significant momentum in the last decade. It allows people to *use* resources or products of any kind without having to own them. The main difference between the two economies is that *service* is more business related while *sharing* can even happen within a community. Service based businesses are not new, but it has usually been focused on human services. Today, service entails more and more companies that provide their products as a service for a certain contract duration, similar to leasing. However, the product then returns to the manufacturer. This business-model is mainly based on the principle of the Circular Economy. Therefore, these two economies consolidate circularity.

1) Service and Sharing

We live in a time of great and rapid change. Due to the digital age, especially with the advent of the internet and social media, new ideas and developments have established with physical presence around the globe. The world is not the same as 10 years ago and will certainly not be the same after 10 years.

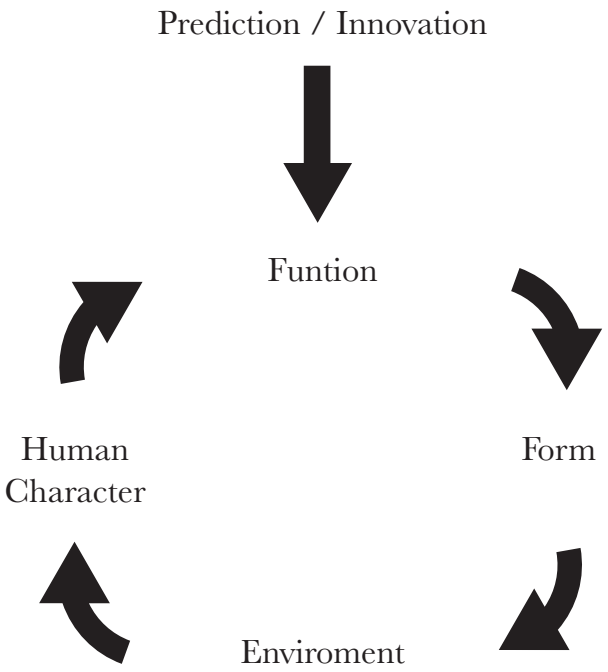
Economies such as *Service* and *Sharing* are becoming everyday businesses. Today, more and more startups with sharing as their business-model are popping up. We share office spaces with different companies, houses with strangers, cars within a community, and our skills, talents or knowledge with the world. The sharing economy is founded on simplifying the exchange of resources on demand. The efficiency that is created by this service allows people to (buy and) own fewer valuable products.

According to Thomas Rau, the product has become an organized problem in itself. The parameters for decision making of our (current) economic system is purely based on values of the profit and loss account. This one-sided economic thinking has created an economic system that is organized in a linear manufacturing process, wherein we take, make and waste our resources, resulting in loss of ecosystems and increase of the climate crisis (Rau, 2016). This consequence has been multiplied as a result of artificial shortening of the lifespan, rapid aging due to 'innovation', and ever changing (fashion) trends.

We separate waste in order to produce recycled products. However, during the manufacturing process the material loses a great portion of its value, which ultimately means that recycling is *down-cycling*. The linear system is still ongoing, its pace has only been reduced (Rau, 2016).
Rather than small-scale interventions, this linear system requires a fundamental reorganization and a different attitude towards products and ownership. By reinventing the industry, we can *use* materials in the future instead of *consuming* them (Rau, 2016).

After RAU Architects was founded in 1992, they realized that preserving a livable world requires more than just building energy producing and healthy buildings. This led to the foundation of Turntoo in 2010, which is fully focused on the circular economy and the development of business models that endeavor to ensure that valuable resources are no longer lost (Rau, 2016).
By treating products and buildings as a material bank, we can design in such a way that materials are able to be disassembled and reused for new products that better suit our changing necessities (Rau, 2016). The product remains the property of the manufacturer that only delivers them to provide a service. The manufacturer also remains responsible for the performance. This creates a turning point in the market strategy from 'selling as much as possible' to 'providing no more than is necessary'. In addition, the lifespan of products increases and materials are designed to be disassembled and reused.

Thomas Rau argues that everything is temporary, except for the consequences, they are permanent (Rau, 2016). In order to rectify the damage, we have to diagnose the cause of the problem and solve it in its core. This requires a fundamental change of our industry, but more importantly our *willingness* to make the change.



The Role of Architecture in Shaping Human Behaviour.

own illustration, source: Majekodunmi.

vii. **“Sensory design”**

Reacting to the human senses can bring about certain patterns of desired responses. Activating circularity therefore requires sensory stimuli in order to evoke action. Physical expressions, form language, colors, textures and light can have a leading influence on certain behavioral expressions. But how effective is architecture in changing human behavior, and is it even capable of influencing it? Influencing behavior reaches far beyond mere physical implementations. Attitude and perception are critical factors to understand and respond to in order to effectively predict functional effects. Therefore, honest manipulations and (slightly) confronting interventions are necessary to guide people to the desired path.

1) Can architecture influence Behavior?

“There is no doubt whatever about the influence of architecture and structure upon human character and action. We make our buildings and afterwards they make us. They regulate the course of our lives.” - Winston Churchill, 1924

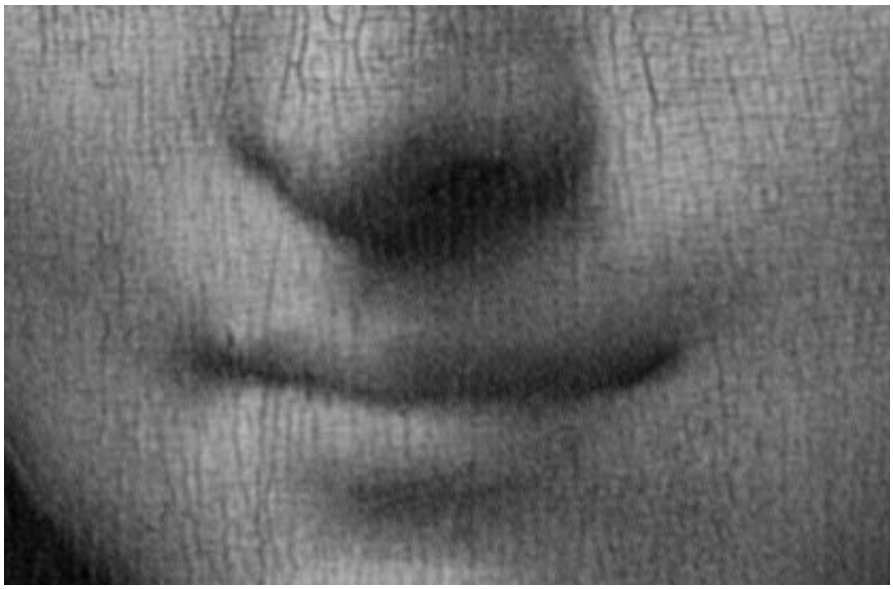
According to Churchill, environments do affect our behavior, regardless whether by accident or by design. Every building has a specific program with different functions that creates an environment regulated by the physical interpretation of the structure.
In many ways architecture (and environments) orchestrate our life, whether it is natural or artificial. However, understanding which factors are critical in influencing people enables possibilities to intentionally direct people in order to evoke specific behaviors (Majekodunmi, n.d.).

Tadao Ando says; *“I believe that the way people live can be directed a little by architecture”*. He argues that architecture can be a guide to organize the daily rituals in and around the structure. But behavior entails much more than only perceiving and interpreting the environment. Key-factors that affect human behavior are; attitude, genetics, culture, religion, coercion, social norms and ethics of a society, and influence by authority.

Attitude in particular is the most essential as it is directly linked to a person’s mindset. It refers to the mental-view of the way a person thinks or feels about something or someone based on the experience or observation of a certain situation. It is defined by education and the way we perceive things. Behavior is the outward expression of that attitude by action and conduct which can be internal or external, voluntary or involuntary, and conscious or subconscious (Surbhi, 2016).

Imagining a future always comes with the desire to instigate a certain behavior. But influencing behavior is strongly tied with attitude which is affected by factors, such as education, experience, and environment. Attitude is ultimately the mental tendency that largely determines our decisions, actions, and stimuli. In order for architecture to effectively influence behavior, it has to anticipate on attitude, which makes it less easy to control as attitude is a personal trait that differs per individual.

In a lecture about the role of architecture in shaping human behavior, architect David Majekodunmi stated that function, form, environment, and human character are interrelated and reliant on each other. He argues that all innovation, ultimately, is led by the imagination, and in order for architecture to predict functional effects, we have to take calculated risks (Majekodunmi, n.d.).



"Whose smile? Past experience helps us to recognize a whole image when looking at only a fragment of it."

The influence of perception

source: Von Meiss.

2) A matter of Perception

Cognition is the process by which people acquire knowledge and understanding through thought, experience and senses. It defines the way people 'understand' things. Cognition is directly connected to our ability to perceive ourself and the physical surrounding (Hinton, 2015).
In his book Elements of Architecture, Pierre von Meiss states that there is a difference between seeing and perceiving. He describes that perception is not neutral because of the natural mechanism of the human mind that continually compares what he sees with information acquired from situations he has previously met and assimilated. Our memory therefore acts on our perception and influences our judgements (Von Meiss, 1998).

Architecture is only an image in a drawing or photograph until it is built (Von Meiss, 1998). Once it is erected, it creates a new environment, which will, as already mentioned in the previous paragraph, affect our behavior due to the physical experience of the structure. Experiencing the environment is a multi-sensory sensation. Hearing, smell and tactility can even be more important in some situations where they are experienced with more intensity (Von Meiss, 1998). But *visual perception* makes the language of the architecture readable. However, some forms are more easy to register than others.

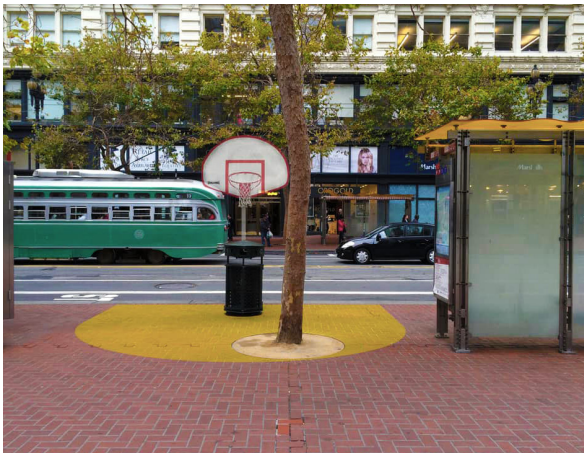
It therefore remains the architect's responsibility to avoid building structures that people can hardly understand. Complexity within architecture is one thing, but readability remains critical. Von Meiss therefore states that; "The didactic role of the architect can direct the people to perceive the built environment with greater subtlety" (Von Meiss, 1998).

The yellow staircase in the James Hunt Library to increase the use of the stairs (instead of the elevator).

source: Tilman

A playful nudge to prevent littering: An interactive "voting booth" installation to collect cigarette ends.

source: designweek.co.uk



A playful nudge to prevent littering: A trash can with a basketball hoop.

source: smart-online-marketing.nl

3) Nudging architecture

Everyday we are confronted with various situations where we have to make choices. Some more easy than others, such as taking the stairs instead of the elevator or throwing your garbage in a trashbin instead of on the ground. But where are these everday-choises based on and how do we make them? Recent behavioral economic studies have shown that the way choices are presented has a huge impact on our decisions.

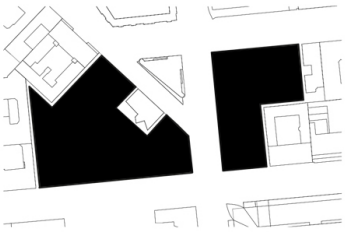
Within marketing and the creative sector this strategy of 'choice architecture' (Dutch; keuzearchitectuur) is being used for decades to guide people through their choice processes. In 2008, Richard Thaler and Cass Sunstein published the book *Nudge* which revealed how classic marketing techniques from behavioral economics are translated to the public sector (Didenko, 2016). This also introduced the term 'nudge' which is described by Thaler en Sunstein as: "A nudge is any aspect of the choice architecture that alters people's behaviour in a predictable way without forbidding any options or significantly changing their economic incentives. To count as a mere nudge, the intervention must be easy and cheap to avoid. Nudges are not mandates. Putting the fruit at eye level counts as a nudge. Banning junk food does not." (Thaler, R., & Sunstein, C., 2008).

Behavioral economists and psychologists, such as Daniel Kahneman, have proved that people do not always make rationally well-considered choices. He dintinguishes two types of thinking, automatic (system 1) and rational (system 2), and concludes that many of our decisions are mainly guided by our automatic and intuitive mind (Kahneman, 2011).
A nudge responds to our automatic and unconscious behavior. Understanding the irrational decisions of people helps to form simple measures to gently push behavior in the desired direction without excluding different options. A great advantage of nudging is that it maintains the possibility of an independent choice (Didenko, 2016).

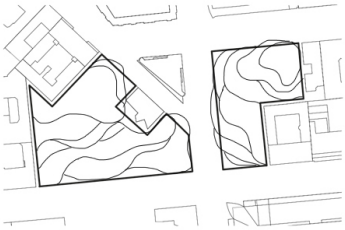
The litteral definition of nudging can be described as a light touch to draw one's attention to something. Within architecture nudging can be a used as an gentle way of encouraging or persuading someone to do something by implicit guidance. A nudge tries to alter the context of a decision but not the environment.

Within a work environment, nudging can gently guide people to use the space in the intended way that aligns with the workprocess. This creates a more open and friendly atmosphere where people are implicitly guided, rather than a formal setting regulated and monitored by behavioral agreements.
The 'office' as we know has evolved from a cubicle to a room, to an open interactive landscape. Nudging is a tool that can be used to develop a language that is effective in the new working environment. Color, textures, materials, and light are means for this. But the general perception of a working environment has also undergone a major change. Buildings today are increasingly associated with natural environments. Examples are public routes through buildings that connect to unexpected gardens and courtyards (Tilman, 2018).

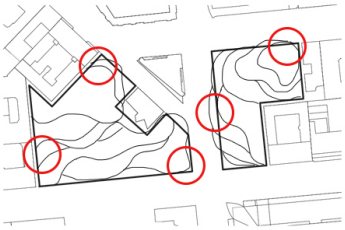
Nudging is an attempt to instigate an 'process' that optimizes the use of the environment in a more consistent and coherent way. This means that the interior organization and experience of a building gains more importance. This would essentially mean that it is less about the physical appearance of a building and more about the experience of it (Tilman, 2018).



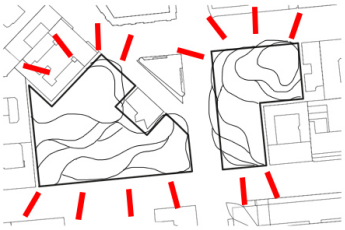
SINGULARITY
Contrast with its context



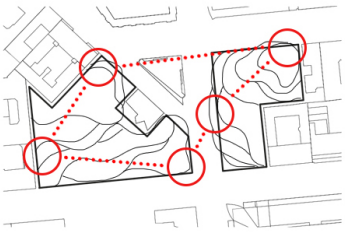
SIMPLICITY
Recognizability of the form



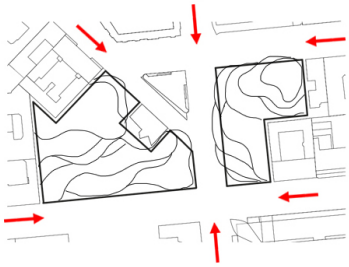
CONTINUITY
Perceiving smaller elements as a whole



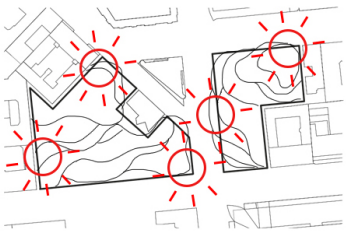
DOMINANCE
Standing out from surrounding objects



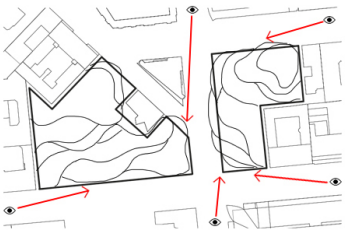
CONNECTION
Clear relation and interconnection between elements



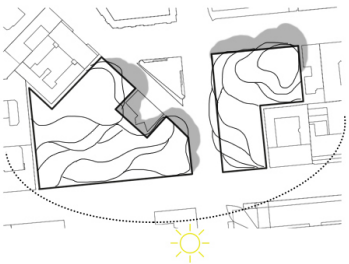
DIRECTIONAL DIFFERANTIATION
Paths and nodes creating direction and accessibility



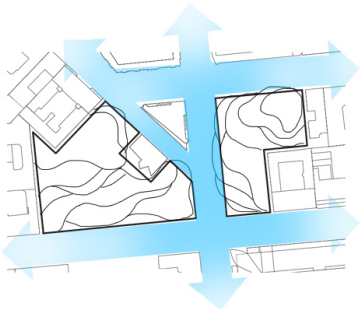
VISUAL SCOPE
Expressing the meaning of elements



MOTION AWARENESS
The continuous changing perception of approach



TIME SERIES
The continuous change of light and shade on materials and textures



NAMES & MEANINGS
Non-physical characteristics which may enhance the imageability of an element

The 10 form qualities defined by Kevin Lynch.

own illustration, source: Lynch

4) Legibility of the environment

Understanding the physical environment is highly contingent on the readability of what is perceptible. In his book, The Image of The City, Kevin Lynch calls this the legibility. When moving through the city, people use many kinds of cues to structure and identify the environment. "The visual sensations of color, shape, motion, polarization of light, as well as other senses such as smell, sound, touch, kinesthesia, sense of gravity, and perhaps of electric or magnetic fields." (Lynch, 1960).

Although Lynch refers to a bigger context, the clarity and legibility of the city from the perspective of the inhabitants, the same principles apply when we approach a building. In order to analyze legibility, he has broken it down into three components: identity, structure, and meaning. However, he points out that in reality they always appear simultaneously.
Lynch describes *identity* as an object that distincts itself from other things and is recognized as a seperable entitiy. The *structure* creates a spatial relation of the object to other objects and the observer. The object then has some practical or sentimental *meaning* for the observer. Although meaning is also a form of relation, it is different from spatial relation (Lynch, 1960).

Compared to identity and structure, meaning is less easy to influence by physical manipulations. It is possible to separate meaning from form because it depends on perception. Lynch therefore points out that it is perhaps even wise to allow meaning to develop without our direct guidance (Lynch, 1960).

Understanding the physical environment requires (form) qualities (see illustration) that relate to the characteristics of identity and structure. It is critical for these qualities to work in conjunction. Conflicting or isolated qualities may weaken the whole or make it more difficult to identify and structure (Lynch, 1960). This will have a negative impact on the perception which ultimtely affects the meaning of the object(s).

Although Lynch states that the meaning is less controllable, nudging offers a greater possibility than just physical (form) expressions. It allows for (physical) manipulations that can evoke emotional or functional effects which makes the identity, structure, and meaning of the 'object(s)' interrelated and therefore more understandable as a whole.

3

with a
Rotterdam | City ~~of the~~ Future

Rotterdam as a fully circular city by 2050.

Rotterdam as the precursor

i. **Circularity for Rotterdam**

Rotterdam is a city that stands out with its dynamic character and contemporary architecture. It a city with never-ending constructions and it is the city with the largest port in Europe. However, the other side of the coin reveals that the building industry alone is responsible for more than 60% of the waste in Rotterdam. Collecting domestic waste (gft) is also a challenge with all the high-rise buildings in the city.

Rotterdam sees circularity both as an opportunity to create more job opportunities and to contribute to the climate goals. There are already more circular jobs in Rotterdam (10%) than the average in the Netherlands (8,1%). Rotterdam has major ambitions in the field of circularity. By 2030 the use of fossil resources will be reduces with 50% and circularity will become standard. Moreover, the city aims for a growth of 3.500 to 7.000 new jobs that will have a direct contribution to the circular economy. By 2050, Rotterdam aims to close material cycles and become a fully circular city (Rotterdam Circulair, 2019).

Rotterdam wants to achieve this goal by following down two main routes: 1. By raising awareness in the city and 2. By anchoring circularity into the economy.

Separating domestic waste more responsibly, and creating hubs "upcycle malls" where people can deliver products or get recycled products, are some of the initial ambitions of the city. Therefore, the municipality is supporting circular initiatives and companies by facilitating circular meeting places where new ideas and projects can emerge. Ultimately, by 2023, this plan will enrich Rotterdam with forty new circular companies and initiatives (Rotterdam Circulair, 2019).

- Upcycle mall -

We introduceren de Upcycle Mall: het milieupark nieuwe stijl. Daar breng je je afval naartoe zodat van de oude materialen weer nieuwe producten kunnen worden ge- maakt. Je kunt er ook gerecyclede materialen halen om zelf mee aan de slag te gaan. De Upcycle Mall wordt een soort marktplaats voor grondstoffen en producten die nog een tweede leven verdienen. Niet alleen fysiek, maar ook digitaal. Om dit voor de Rotterdammer nog makkelijker te maken, komen er in de stad verschillen hubs. Grondstof- fen en oude producten worden hierheen gebracht en nieu- we materialen en producten worden hier weer opgehaald. Deze hubs kunnen ook doelgroeps- en gebiedsgewijs worden ingezet. Bijvoorbeeld als studenten wisselen van woning of in aangewezen gebieden die al actief zijn met circulariteit en duurzaamheid, zoals de wijk Reijeroord.

(Rotterdam Circulair, p. 19, 2019).

SLIM VERVANGEN RIOLERING

DUURZAAM RIOOLWERK

UIT JE EIGEN STAD

DE VOEDSELPRODUCTIE TERUG NAAR DE STAD

AFVAL LOONT

SAMEN SPAREN WE DE NATUUR!

PIEKFIJN

WARENHUIZEN VOOR TWEEDEHANDS SPULLEN

NESTE

RENEWABLE DIESEL BIJ NESTE IN ROTTERDAMSE HAVEN

SUGU WAREHOUSE

KLEINSCHALIG, LOKAAL EN CIRCULAIR PRODUCEREN

RINEW

HERGEBRUIKEN VAN NUTRIËNTEN, ENERGIE EN WATER UIT AFVALWATER

BUURMAN

BUURMAN: MATERIAAL MET EEN VERHAAL

GOODFUELS

BIOBRANDSTOFFEN VOOR DUURZAME SCHEEPSVAARTINDUSTRIE

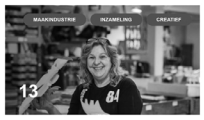
COMMUNITY & VOEDSELSURPLUS

AFVAL SCHEIDEN IN HOOGBOUW

PILOT AFVAL SCHEIDEN IN HOOGBOUW

BETTER FUTURE FACTORY

BETTER FUTURE FACTORY: CREATIEVE, REALISTISCHE DUURZAME ONTWERPEN



SCRAPXL

SCRAPXL:INDUSTRIEEL AFVAL EN RESTMATERIAAL TE KOOP

KEES

KEES: SLOW FASHION

BEAT THE BAG

VERMINDERT HET GEBRUIK VAN PLASTIC TASJES ÉN GEEFT PROMOTIEMATERIAAL EEN TWEEDE LEVEN

TINY HOUSE OP CONCEPT HOUSE VILLAGE

DUURZAAM BOUWEN, WONEN EN DUURZAME GEBIEDSONTWIKKELING

ICDUBO

INNOVATIECENTRUM DUURZAAM BOUWEN

SEW EURODRIVE

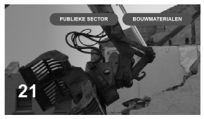
REPAREREN, REVISEREN EN OMBOUWEN

GEMEENTE ROTTERDAM

VERLENGEN LEVENSDUUR BRUGGEN

FOCUSED SKATEBOARD WOODWORKS

DESIGN GEMAAKT VAN OUDE SKATEBOARDS



DUURZAME SLOOP MARTHALAAN

EEN NIEUWE MANIER VAN SLOPEN

ECOEUROS

ECOEUROS: RECYCLEN STIMULEREN DOOR BELONEN

RETOURETTE

GESCHEIDEN INZAMELEN VAN SCHOON AFVAL

RECYCLED PARK

PLASTIC AFVAL IN DE NIEUWE MAAS OPVANGEN

OKKEHOUT

SLOOP-, REST- EN SNOEIHOUT KRIJGT EEN TWEEDE LEVEN

POLYTENTIAL

PLASTIC VOLLEDIG CIRCULAIR HERGEBRUIKEN

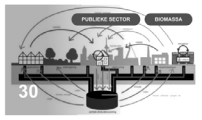
PLASTICIET

OP EEN BETERE MANIER OMGAAN MET PLASTICAFVAL

RDM

RDM: DÉ PLEK VOOR INNOVATIE IN DE HAVEN

VAN AFVAL TOT DESIGN VAN DE BOUWPLAATS



ROSA

WATERGERELATEERDE KRINGLOPEN IN REGIO ROTTERDAM SLUITEN

MEYER-SAN INTERIEUR VERHUUR

GEMEENTE ROTTERDAM

3 MILJOEN BETONTEGELS MILIEUVRIENDELIJK AANBESTEED

M4H

100% GERECYCLED ASFALT IN M4H

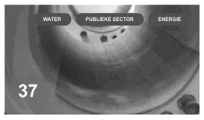
GRONDSTOFFENBANK ORANJE

HOOGWAARDIG HERGEBRUIK VAN SLOOP- EN RESTMATERIAAL

FOODITIVE

MATERIALENDEPOT

ARTIKELEN UIT DE GROND-, WEG- EN WATERBOUW HERGEBRUIKEN



RIOTHERMIE

TERUGWINNEN VAN WARMTE UIT AFVALWATER

BLUE CITY

BLUE CITY: BROEDPLAATS VOOR CIRCULAIRE BEDRIJVEN

BROODNODIG

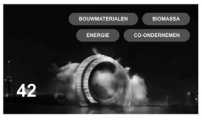
BROODNODIG: EEN OPLOSSING VOOR BROODAFVAL

COMMUNITY PLASTICS

HUISHOUDELIJK PLASTIC VERWERKEN TOT NIEUWE PRODUCTEN

MARCONIA

OPENBARE EXPERIMENTEERRUIMTE VOOR VERNIEUWERS



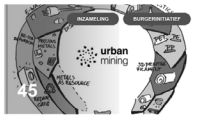
DUTCH WINDWHEEL

CIRKELVORMIGE WOLKENKRABBER CIRCULAIR GEBOUWD

TROEP-COUP: KIDS OP CIRCULAIRE MISSIE

GEMEENTE ZORGT VOOR GESCHEIDEN HUISAFVAL

GROND- EN RESTSTOFFEN CIRCULAIR HERGEBRUIKEN

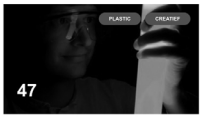


URBAN MINING

CROWDFUNDEN, MET ALS INZET DE WAARDE VAN JE AFVAL!

MILIEUPARKEN

AFVAL VERZAMELEN, SCHEIDEN EN HERGEBRUIKEN



SPIREAUX

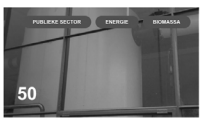
VERSE SPIRULINAPASTA

ROTTERZWAM

OESTERZWAMMEN OP KOFFIEDIK

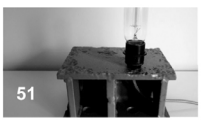
CIRKELSTAD

STEDEN ZONDER AFVAL ÉN ZONDER UITVAL



BIOMASSAKETEL IN KETELHUIS KLEINPOLDERPLEIN

BIOMASSAKETEL IN KETELHUIS KLEINPOLDERPLEIN



TTOTT

INTERIEURPRODUCTEN VAN RESTMATERIAAL VAN ROTTERDAMSE ICONEN

DOBBEREND BOS

GEMAAKT VAN AFGEDANKTE ZEEBOEIEN

PERPETUAL PLASTIC 010

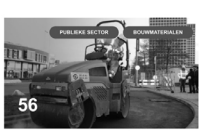
PERPETUAL PLASTIC 010

THUISRECYCLING.NL

STIJLVOLLE PRODUCTEN OM AFVAL TE REDUCEREN, HERGEBRUIKEN EN SCHEIDEN

TRIOBAKKEN

AFVAL SCHEIDEN IN DE PUBLIEKE RUIMTE



RUBBERPAVE

ULTRASTIL WEGDEK VAN GERECYCLEDE AUTOBANDEN

VERDRAAIDGOED

PRODUCTEN VAN RESTMATERIAAL

SCHILLENBOER

NIEUWE TOEKOMST VOOR GROENAFVAL

LAB OP STRAAT

INNOVATIEVE PRODUCTEN ONDER PRAKTIJKOMSTANDIGHEDEN TESTEN

WASTE SHARK

DE PLASTIC SOUP OPRUIMEN

ii. **Circularity in Rotterdam**

Currently there are more than 60 companies and initiatives in Rotterdam that are involved in Circularity. From collecting resources, recycling products and reusing materials, to innovating with 'waste' and producing new products out of it. All these companies try to contribute to the circular economy in their own specific way. What they all have in common is that they, through their ambitions, express their disapproval of the current economic system.

However, most of these companies, with the exception of among others; BlueCity, Better Future Factory, PlantOne, RDM, and M4H, are individual and local initiatives. The municipality of Rotterdam believes that by working together, a circular synergy can be formed which will increase the effect each individual company has on the city.

Companies can rely on each other's knowledge in order to find new ways to use less materials and team up to create shared value. Moreover, collaborations can help increase each other's network and public awareness. This is crucial for achieving ambitions such as creating a fully circular society.

Next Economy

• An important characteristic of this innovation is 'unblocking' on many different fronts. **Blurring boundaries** between living, working and leisure.
• Residential areas also become work areas, and work areas also become residential areas.
• There is a strong need for places where meeting is realized in a comfortable, spontaneous and relaxed manner, in so- called **interaction environments**.
• Strengthening/enhancing the interaction environments by creating the right **mix of functions**.
• All ingredients for a successful mix are present in Rotterdam, but there is still **lack of** coherence, cooperation, **spatial connections**, and meeting places.
• Three areas that are economically of great importance, but still stand on their own, would be a major addition to the larger whole: Erasmus Medical Center, Rotterdam Central District, and EUR. A better connection of these economic motors with the rest of the **interaction** environment adds mass and unique components to the mix.

Growth

• The population of Rotterdam will grow with **50.000 inhabitants** to 676.000 **by 2030**. This growth has to be absorbed within the existing city.
• Population growth after 2030 must also be absorbed in a **healthy and livable city**.
• There are **parts in the inner city** that are still **underutilized**.
• There are opportunities to **attach** the city center to **the surrounding districts** in order to create densification and differentiation.
• The **railway** as well as the motorway are **monofunctional structures** that form barriers and obstacles. Smart ways need to be devised to bridge or **overcome these barriers**.

Mobility

• Rotterdam is also known as a bicycle city across the border. The number of **cyclists and pedestrians** has risen spectacularly in the last 10 years, while car traffic -from and to the city center- has not been growing for decades.
• The enhancement of the bicycle **network** in the city center and **between** the **city center and** the **surrounding districts** is important in order to steer the changing mobility behavior in the right direction and to stimulate the optimal use of the inner city.
• The city center can have better attachment with the surrounding districts by **removing barriers**.
• The city needs to undergo organic growth and provide **smart new connections** for pedestrians and cyclists.

Next Economy

• An important characteristic of this innovation is 'unblocking' on many different fronts. **Blurring boundaries** between living, working and leisure.
• Residential areas also become work areas, and work areas also become residential areas.
• There is a strong need for places where meeting is realized in a comfortable, spontaneous and relaxed manner, in so- called **interaction environments**.
• Strengthening/enhancing the interaction environments by creating the right **mix of functions**.
• All ingredients for a successful mix are present in Rotterdam, but there is still **lack of** coherence, cooperation, **spatial connections**, and meeting places.
• Three areas that are economically of great importance, but still stand on their own, would be a major addition to the larger whole: Erasmus Medical Center, Rotterdam Central District, and EUR. A better connection of these economic motors with the rest of the **interaction** environment adds mass and unique components to the mix.

Growth

• The population of Rotterdam will grow with **50.000 inhabitants** to 676.000 **by 2030**. This growth has to be absorbed within the existing city.
• Population growth after 2030 must also be absorbed in a **healthy and livable city**.
• There are **parts in the inner city** that are still **underutilized**.
• There are opportunities to **attach** the city center to **the surrounding districts** in order to create densification and differentiation.
• The **railway** as well as the motorway are **monofunctional structures** that form barriers and obstacles. Smart ways need to be devised to bridge or **overcome these barriers**.

Mobility

• Rotterdam is also known as a bicycle city across the border. The number of **cyclists and pedestrians** has risen spectacularly in the last 10 years, while car traffic -from and to the city center- has not been growing for decades.
• The enhancement of the bicycle **network** in the city center and **between** the **city center and** the **surrounding districts** is important in order to steer the changing mobility behavior in the right direction and to stimulate the optimal use of the inner city.
• The city center can have better attachment with the surrounding districts by **removing barriers**.
• The city needs to undergo organic growth and provide **smart new connections** for pedestrians and cyclists.

A summary of the points of interest of the city and the overlapping subjects between the categories.

iii. **The points of interest of Rotterdam**

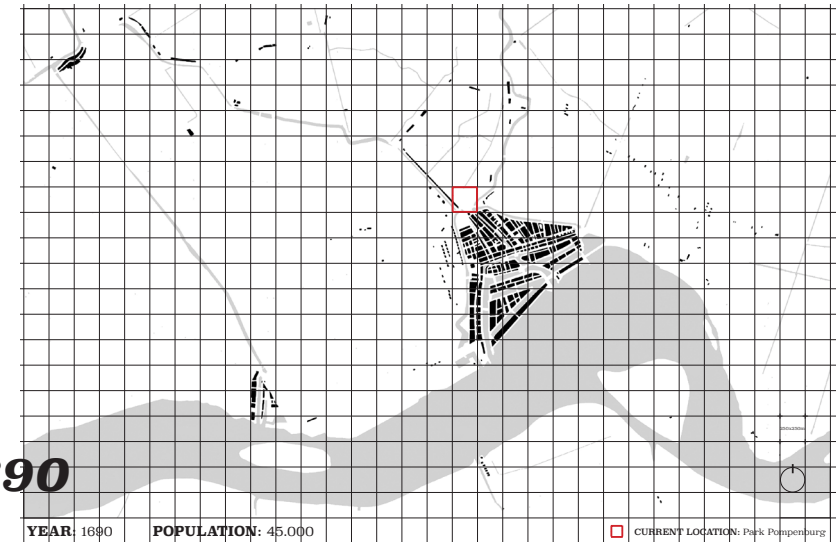
The population of Rotterdam will grow with 50.000 inhabitants (to 691.300) by 2030. A large portion of this growth has to be absorbed within the existing city center. The question remains whether the current city is prepared sufficiently to cope with the increasing number.

Besides preparing for the necessary accommodation, the population growth has also an impact on the liveability of the city as is threatens to decrease if not treated carefully. Rather than continuous expansion, mixed environments offer possibilities for densification while creating active and safe interaction environments.

In order to anticipate on the current problems of the city center and to develop it in an appropriate way for the future, the municipality of Rotterdam has formulated its insights and goals in three categories: Next Economy, Growth, and Mobility (Gemeente Rotterdam, 2016).

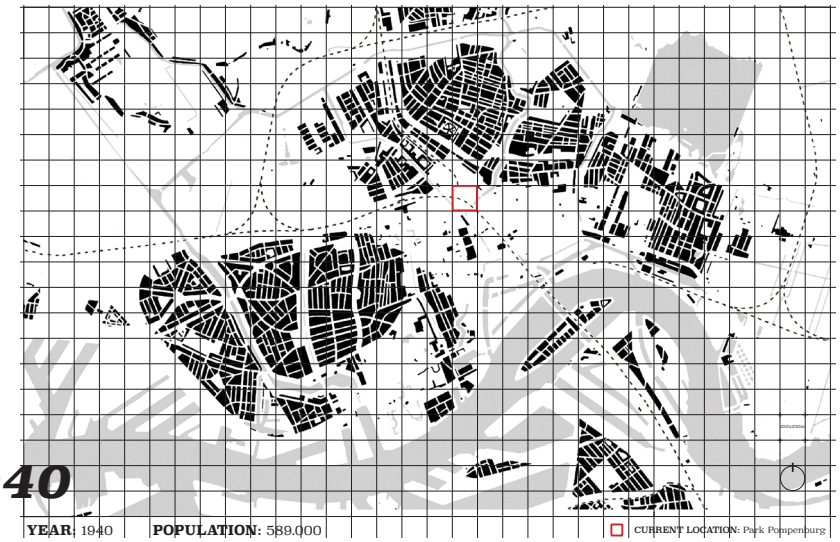
These categories are interrelated because most problems or areas for attention point to solutions that depend on each other. Investigating the categories separately unveils specific key aspect that correlate with others. The *Next Economy*, for example, points out that the city lacks coherence and spatial connections. They want to remove physical boundaries between living, working, and leisure by creating more mixed-use environments that foster spontaneous interactions. *Growth* has a corresponding view on these ambitions. They state that the inner city still has many underutilized parts where the possibilites lie to attach them with the surrounding districts. This creates opportunities for both densification and diversification, creating interactive environments and overcoming barriers at the same time. *Mobility* also supports the argument that removing physical barriers can optimize the cycling and pedestrian network within the city center and between the surrounding districts. This reveals possibilities to create new (smart) connections that will increase the city's organic growth and foster (economic) interactions.

The common thread uniting these categories are removing physical barriers, creating optimized connections between inner city and surrounding districts, and creating mixed-use interaction environments. In order for the city to prepare for the future, it requires complementary solutions that address multiple problems in different areas.



1690

YEAR: 1690 **POPULATION**: 45.000 **CURRENT LOCATION**: Park Pompenburg



1940

YEAR: 1940 **POPULATION**: 589.000 **CURRENT LOCATION**: Park Pompenburg

2000

YEAR: 2000 **POPULATION**: 592.600 **CURRENT LOCATION**: Park Pompenburg

Investigating Rotterdam

i. **Rotterdam**

Rotterdam started around the early 14th century as a small village near the river the Rotte. Untill the 16th century it expanded into a port city. The late 19th and early 20th century was a period of economic growth for Rotterdam. Also in terms of population, Rotterdam grew exponentially. However, the bombardment of May 14, 1940 (World War II) destroyed the entire inner city.

Plans to reconstruct the city started immediately. On May 18, 1940, four days after the bombardment, city architect Willem Gerrit Witteveen was commissioned by the city council to make a plan for a completely new city center. In September 1940 he presented the plan that was declared official. However, in 1942 his plan recieved criticism. The reconstruction of Rotterdam seemed much more an economic issue than an aesthetic one. The proposed plan also seemed unable to accommodate the expected population growth to a million people (PWR, n.d).

Witteveen's plan was cancelled and he was put out of commission. He was succeeded by his assistant Cornelis van Traa. Departing from Witteveen's ideas, Van Traa made a radically functional city plan which became the new Reconstruction plan: Het Basisplan. It was based on CIAM's Functional City that believed that strict functional separation was the solution to solve social problems in cities (PWR, n.d).

Within 15-20 years the city center was almost completely reconstructed and the line of Rotterdam's growth started rising again.

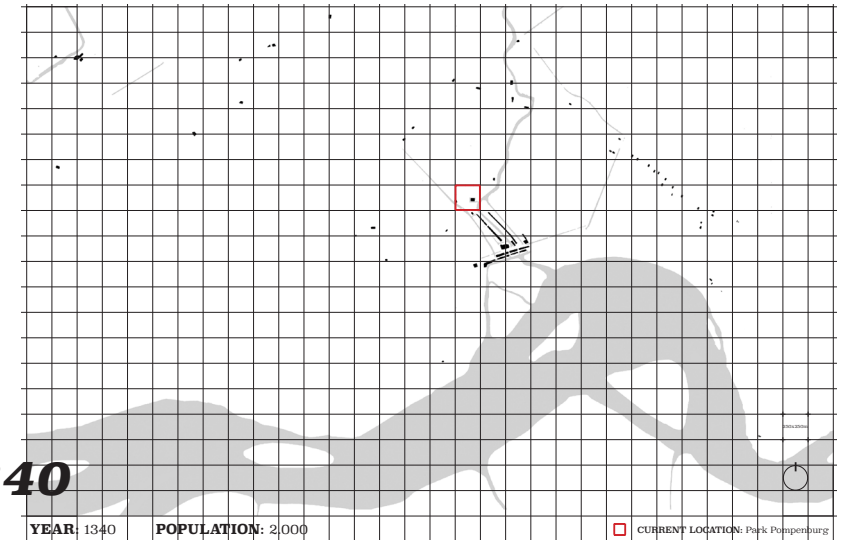
May 14, 1940

Below is a list of all the buildings that were destroyed during the Rotterdam Blitz.

+ + +

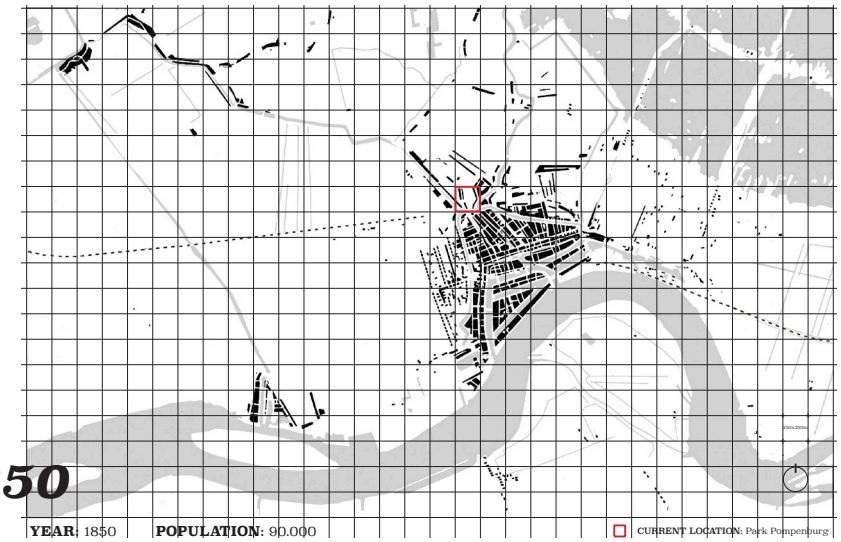
- houses: 25.479
- hotels: 26
- pensions: 117
- hostels: 44
- department stores: 31
- small stores: 2.320
- factories: 31
- workplaces: 1.319
- warehouses and docks: 675
- offices: 1.437
- bank buildings: 13
- consulates: 19
- schools: 69
- hospital facilities: 13
- churches: 24
- charity establishments: 10
- cafes and restaurants: 517
- train stations: 4
- newspaper companies: 4
- museums: 2
- party buildings: 22
- cinemas and theaters: 12 and 2
- other business premises: 184
- municipal and government buildings: 25

+ + +



1340

YEAR: 1340 **POPULATION**: 2,000 **CURRENT LOCATION**: Park Pompenburg



1850

YEAR: 1850 **POPULATION**: 90.000 **CURRENT LOCATION**: Park Pompenburg

1970

YEAR: 1970 **POPULATION**: 670.000 **CURRENT LOCATION**: Park Pompenburg

ii. **Its growth**

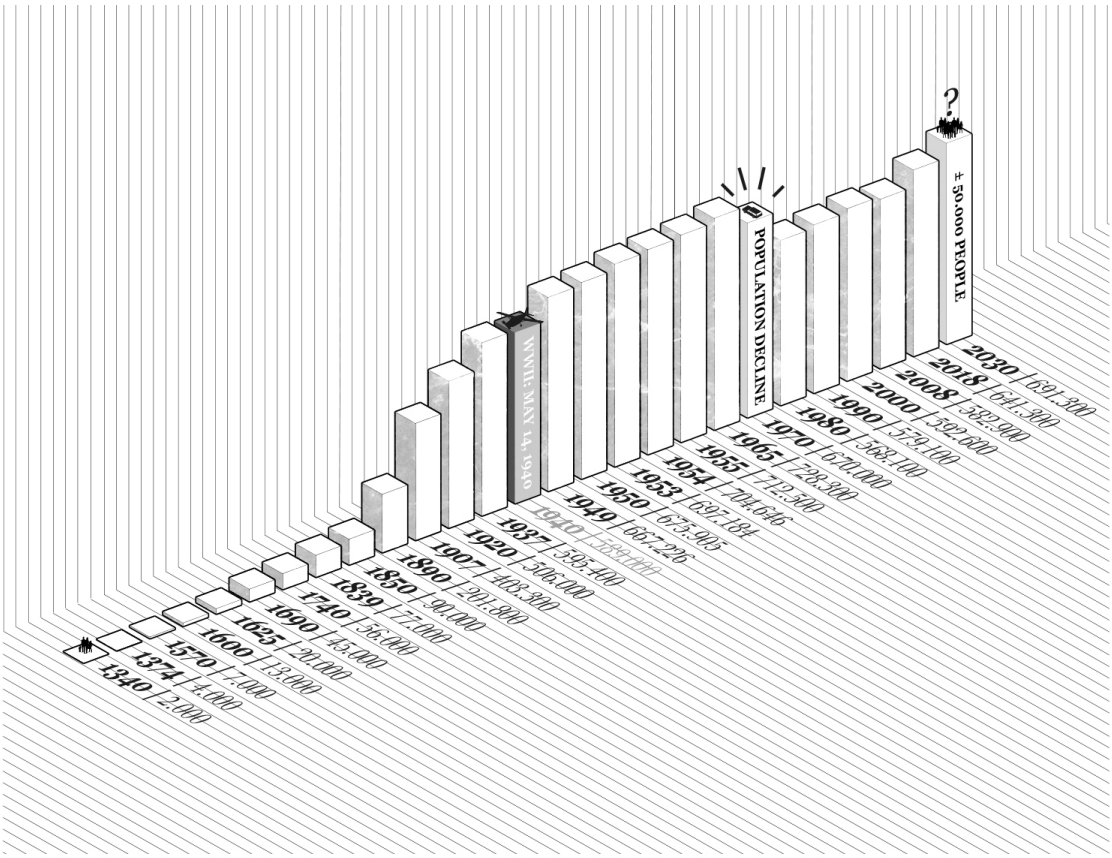
Rotterdam started as a small village with 2.000 inhabitants. Between 1850 and 1940 (Wold Warr II), within a timespan of ± 90 years, the population grew exponentially from 90.000 to almost 600.000 people. The Blitz, however, caused a major decline in the prosperity of the city. An estimated 850 people lost their lives after the bombing of the center of Rotterdam on May 14, 1940 and the fire that followed. About 80.000 people, approximately 13% of the population, became homeless (PWR, n.d).

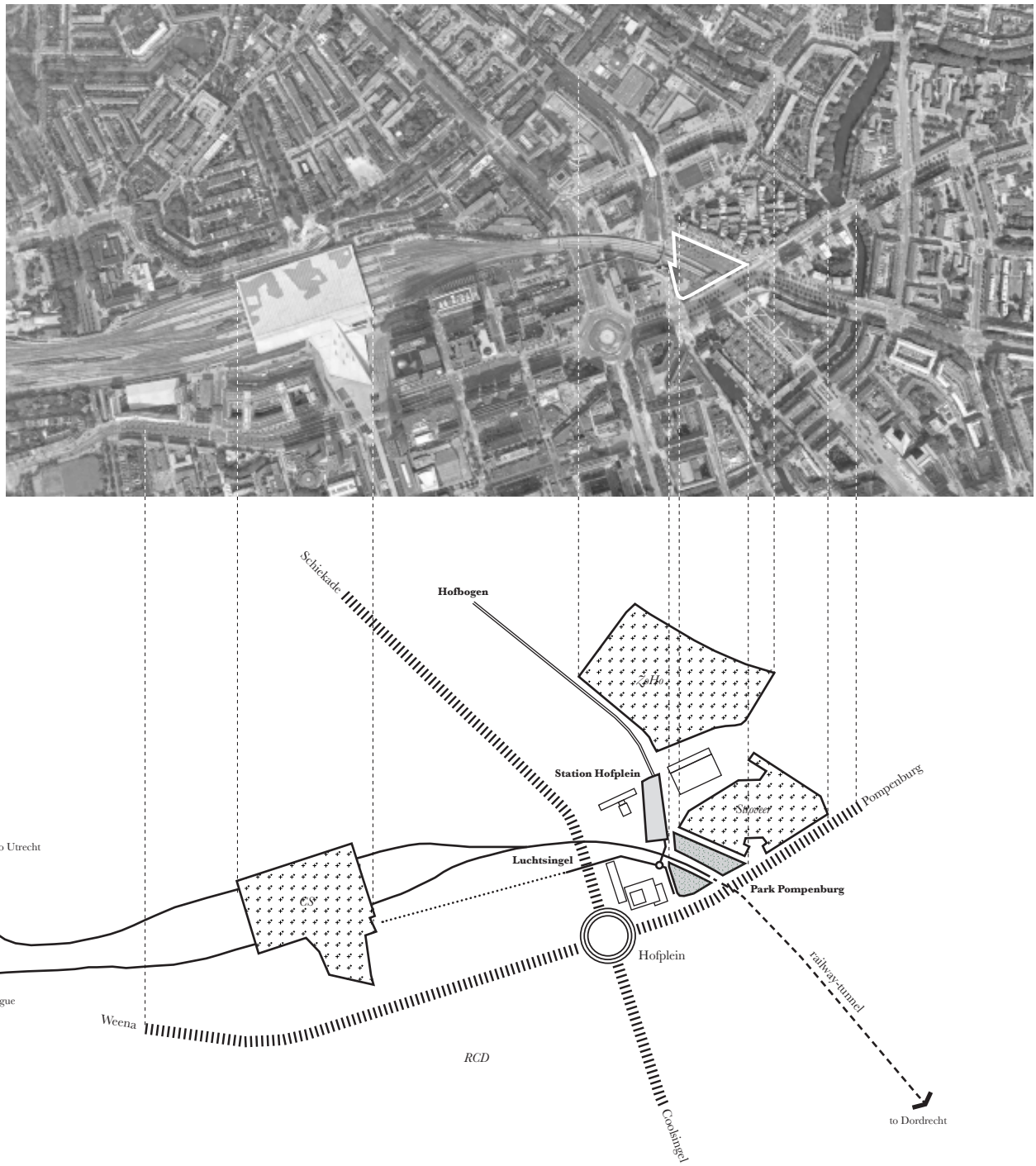
After the reconstruction of the city the population started to grow again. In 1965, Rotterdam again became a prosperous business and a port city and reached a population of 728,000 people.

However, Van Traa's Basisplan resulted in a monofunctional inner city that recieved criticism from people as being unsociable, somber and lacking diversity. After 1965 people started to leave Rotterdam, which caused a drastic economic decline. The population had dropped with 160.000 people, from 728.000 to 568.000.

Various actions were taken by the city throughout the 1970s and 80s to make the city center more attractive, social and greener. More recreational facilities, and especially housing, were needed. Different architects were approached throughout the 1970s with the challenge to add more homes and make the center more mixed, attractive and lively. More and more dwellings and mixed-use buildings, such as Piet Blom's Kubuswoningen, Passchier Vandensteen's Weenahof and Jan Hoogstad's Haagseveer Housing, started to emerge (PWR, n.d).

Today, Rotterdam has reclaimed its position as a business city but has also became a more livable one. It has regained economic and population growth. The city counts 641.300 inhabitants and expects an increase of 50.000 people until 2030.




Schiekade
Hofbogen
Station Hofplein
Pompenburg
Luchtsingel
Park Pompenburg
to Utrecht
to The Hague
Hofplein
railway-tunnel
to Dordrecht
Weena
RCD
Coolsingel

iii. **Pompenburg**

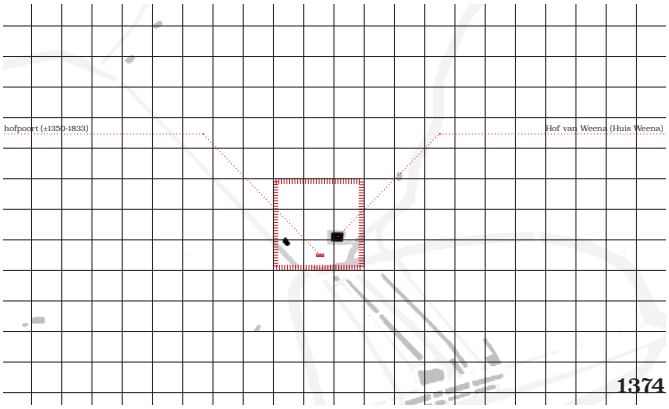
Pompenburg is situated on the east side of Rotterdam Central District (RCD), an area with large densification plans oriented on living, working and recreating. This area is in direct connection with Pompenburg through 'De luchtsingel'. Pompenburg lies at the intersection of two important city axes: in the north-south direction it is the connection between Schiekade - Coolsingel, and in east-west direction the connection between Pompenburg - Weena.

Currently the location functions as a relatively incoherent transit area surrounded by the backsides of the renovated former Shell offices with the gas station, the Grafisch Lyceum Rotterdam, Stadsarchief Rotterdam (City archives), and the Heliport complex at the Stroveer and is dominated by the barrier of the railway-tunnel that rises above ground at this location.

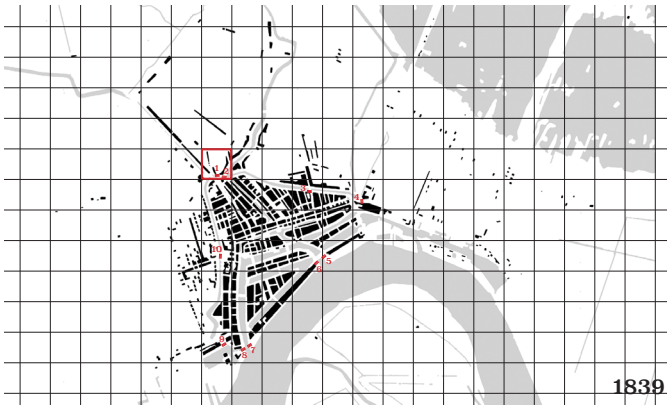
Besides its historical significance it had, as one of the most prominent entertainment areas in the city and a public transportation hub, Pompenburg also has a potential significance to become a connection point between the city center and the surrounding neighborhoods such as the Oude Noorden and the Agniesebuurt. A substantial densification (400 to 600 homes) is already planned in the nearby Zomerhofkwartier (ZoHo) located northeast of the Hofplein Station. The former business area will be redeveloped into a mixed zone for living, working and recreation and will become a breeding ground for 80 creative workplaces.

Currently the Pompenburg area offers a mix of economic activities, education and culture but not a high-quality urban living yet. The goal of the municipality is to develop the area into an attractive environment for interaction, where a mix of commercial functions (shops, hotels and hospitality), housing, and public (recreational) amenities will contribute to make Pompenburg an integral part of the city center of Rotterdam.

The development at Pompenburg together with the Hofplein station and the 1,9 km long Hofbogen can play a pivotal role in connecting different neighborhoods together, enhancing the accessibility and interaction with the city center, and contributing to the ambition of the municipality.


hofpoort (±1350-1833)
Hof van Weena (Huis Weena)
1374


Hof van Weena


1839


Hofpoort


2019


Hofpoort Tower

iv. **Its history**

Until circa 1839, Rotterdam counted 10 city gates. Around the 14th century, a castle was situated just outside the 'Stadsdriehoek' as we know it today. Hofplein got its name from the city gate that protected the castle Hof van Weena: De Hofpoort. After being redesigned and restaurated many times, the Hofpoort was eventually demolished permanently in 1833.

Over the years, Rotterdam started to grow and expand around the location where the city gate was situated. The river around Hofpoort was damped an the square that was created was called Hofpoortplein (Hofpoort square). After 1868 it was changed to Hofplein (Hof square).

Pompenburg, originally called Pompenburgsingel, was the water between the city and the northern city wall. Around 1589 the area adopted the name Pompenburg. Currently, Pompenburg is known as the last remaining development area within 'de brandgrens'. While Pompenburg used to have an important key role as a public transportation hub, between on the one hand the Rotterdam-Dordrecht air-rail line and on the other hand the railway between Hofplein and Scheveningen/The Hague, it never completely recovered from the devastating consequences of World War II (Dura Vermeer et al., 2018).

The station building, which also housed café Loos, was prominently situated at Hofplein. This square was originally situated more towards northeast, at the spot where the Shell-tower (Hofpoort) is currently located. Hofplein was, together with café-restaurant Loos, a very bustling square, and was one of the best places to go out in Rotterdam. The area used to be very densely built and the Hofplein station was located in the middle of the houses. The Schiekade was bounded by the water and the Hofplein was situated as the center of the city.

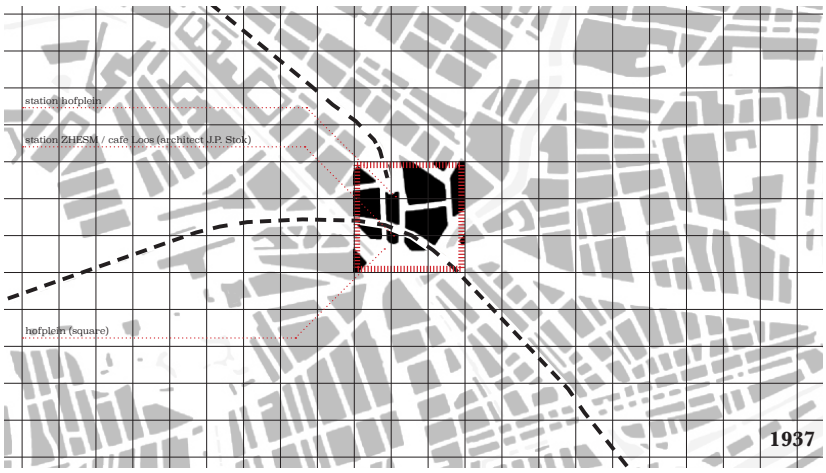
After the bombardment, the station building, the front part where also café Loos was situated, was completely destroyed. During the reconstruction of the city, a new station building was designed in a similar style as the Central Station by the architect Sybold van Ravesteyn in 1956.
In 1960, the first Shell building, Hofplein 19, was realized, which was accompanied by the 95-meter high Hofpoort tower in 1976, also built for Shell. In the early 1980s, the residential district of Stroveer, also known as Little Volendam, was built on the old Heliport site. At the same time preparations were started to place the railway underground, which removed the 'barrier-effect' of the air-rail between Hofplein and Rotterdam-North. This railway-tunnel was realized in the early 1990s. However, the track rises above ground exactly at the Pompenburg area, creating a new barrier between the neighborhoods.

Since the 1980s, many studies have been conducted to redevelop the Pompenburg area. The construction of the railway-tunnel was the reason to suspend and postpone the development plans. The construction of the light-rail line between Rotterdam CS and The Hague CS at the beginning of this century made the Hofplein-line no longer necessary. The Hofplein station and the air-railway (the 1,9 km Hofbogen, until the motorway A20) was taken over from NS (Dutch Railways) by four corporations that eventually fused together to become Hofbogen BV. After the restoration of the monumental station building and the new functions within the 'bogen' (arches), it was declared a national monument in 2002. (Dura Vermeer et al., 2018).

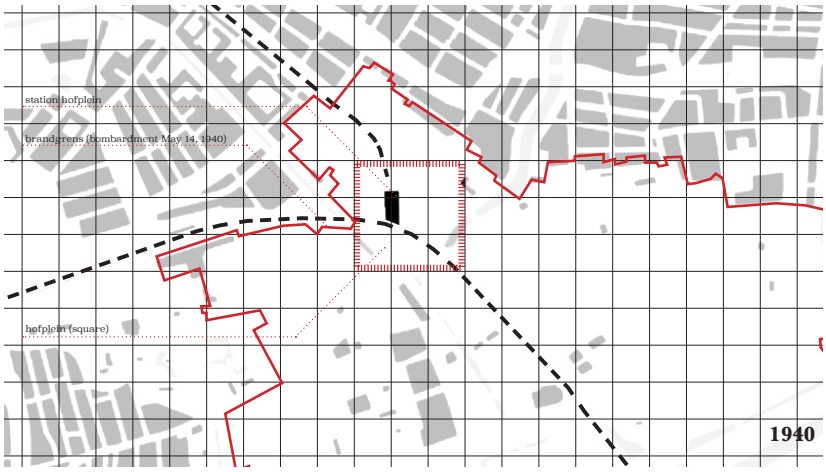
CITY CENTER

POMPENBURG

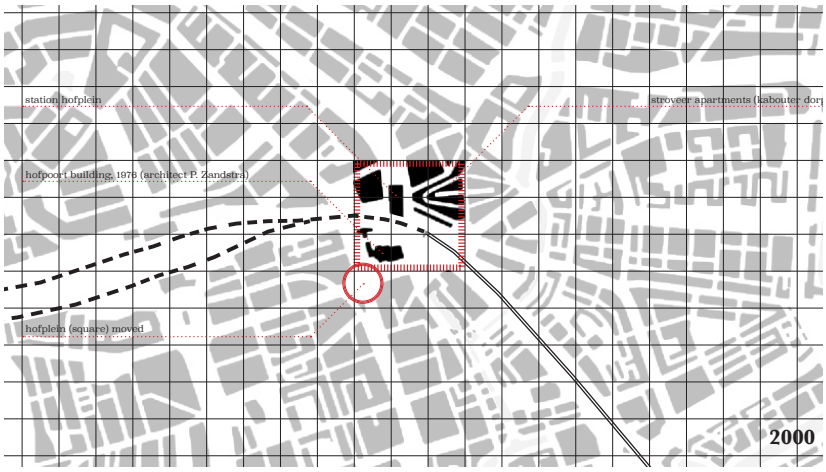
PRE WAR



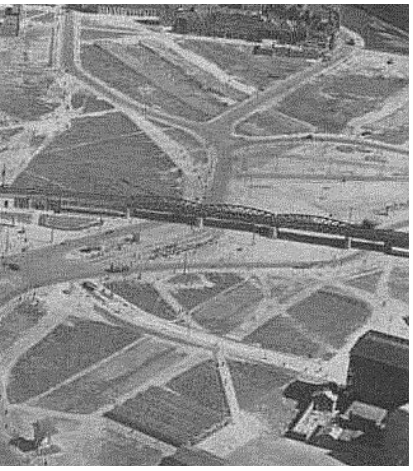
POST WAR

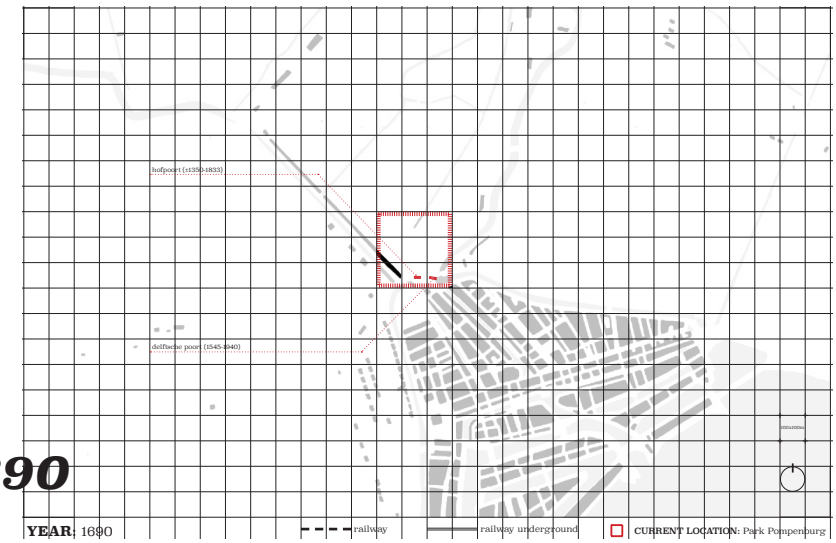


CURRENTLY



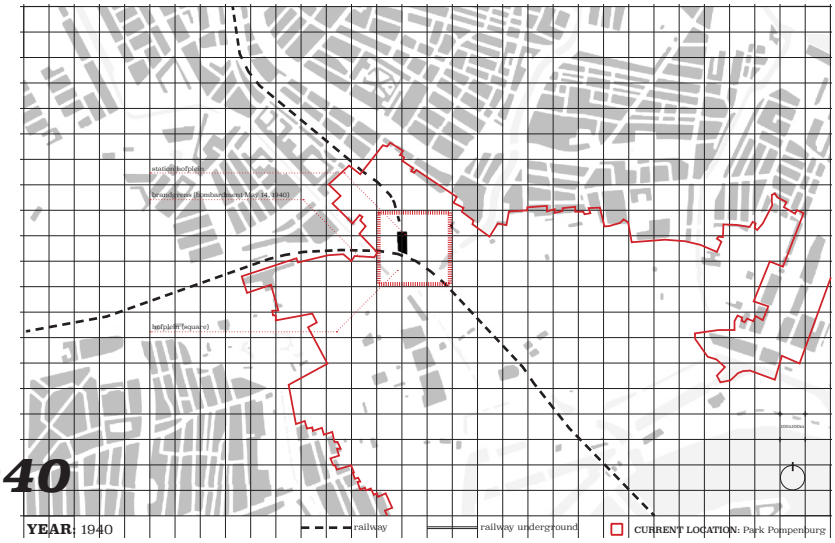
(FORMER) HOFPLEIN





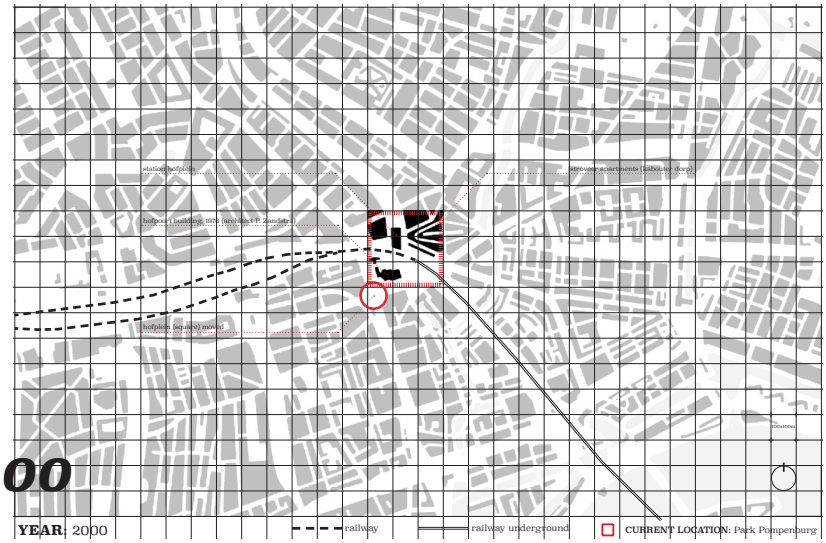
1690

YEAR: 1690



1940

YEAR: 1940



2000

YEAR: 2000

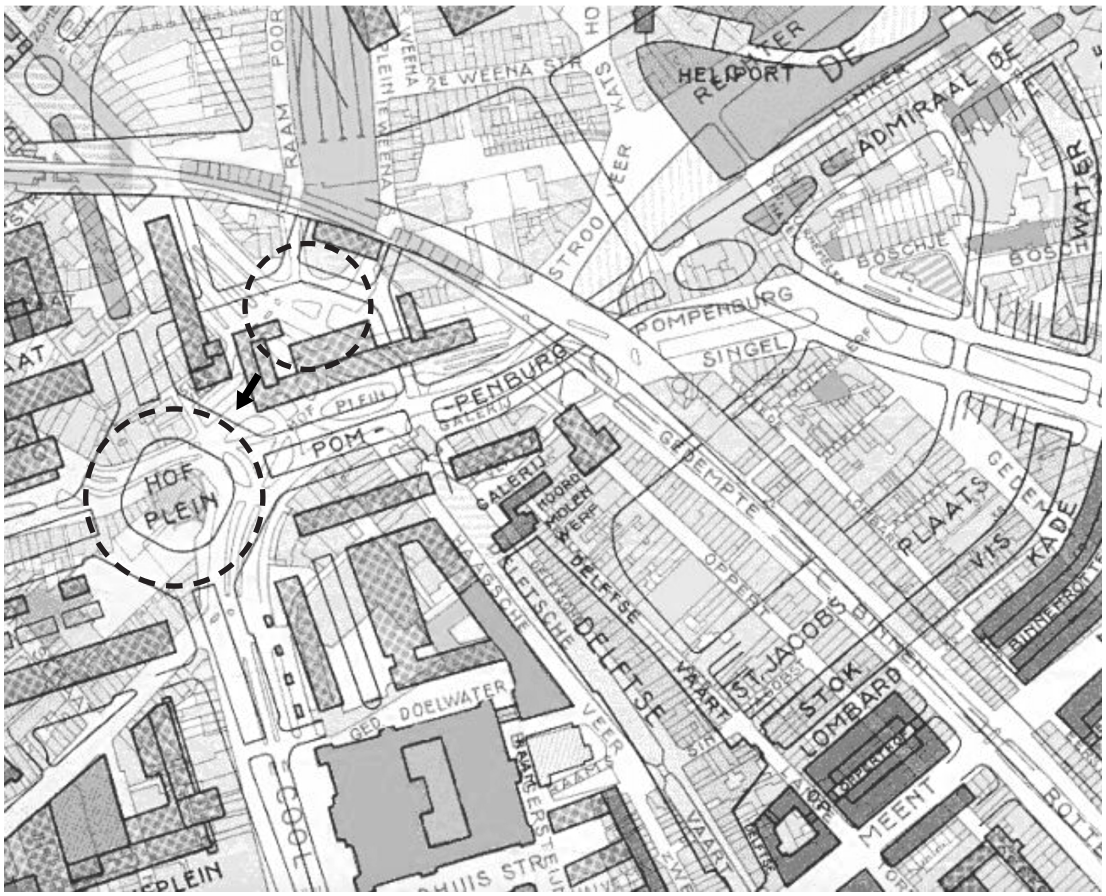
v. **Its development**

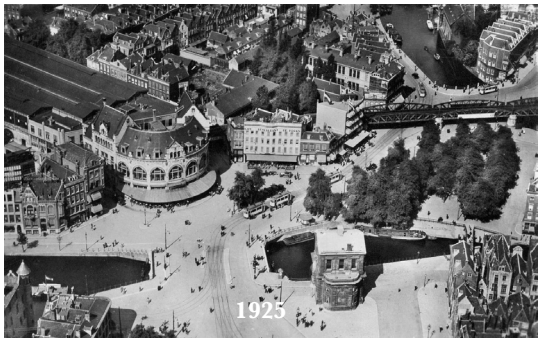
Until 1690, Rotterdam was still bounded by two rivers, creating the well-known city triangle ('stadsdriehoek'). The current location of Pompenburg then was just outside the triangle. From the 18th to the 20th century, Rotterdam had expanded enormously. These fragmented and dynamic expansions in different directions made Pompenburg position himself in the very center of the city fabric.

The patterns of the expansions created a morphology that seemed to grow out from Hofplein, situated in Pompenburg, and made the area a pivot point in the city center.

After the bombardment and the reconstruction of the city, Hofplein shifted away from Station Hofplein towards the southwest. This separation was emphasized when the Shell building and the Hofpoort tower physically detached the two namesakes. Hofplein, which was a bustling pulic square pre Wold War II, became a multimodal transport node.

Today, Pompenburg is still situated as a pivot point in the city center and has a great potential to play a key role in connecting different neighborhoods together.





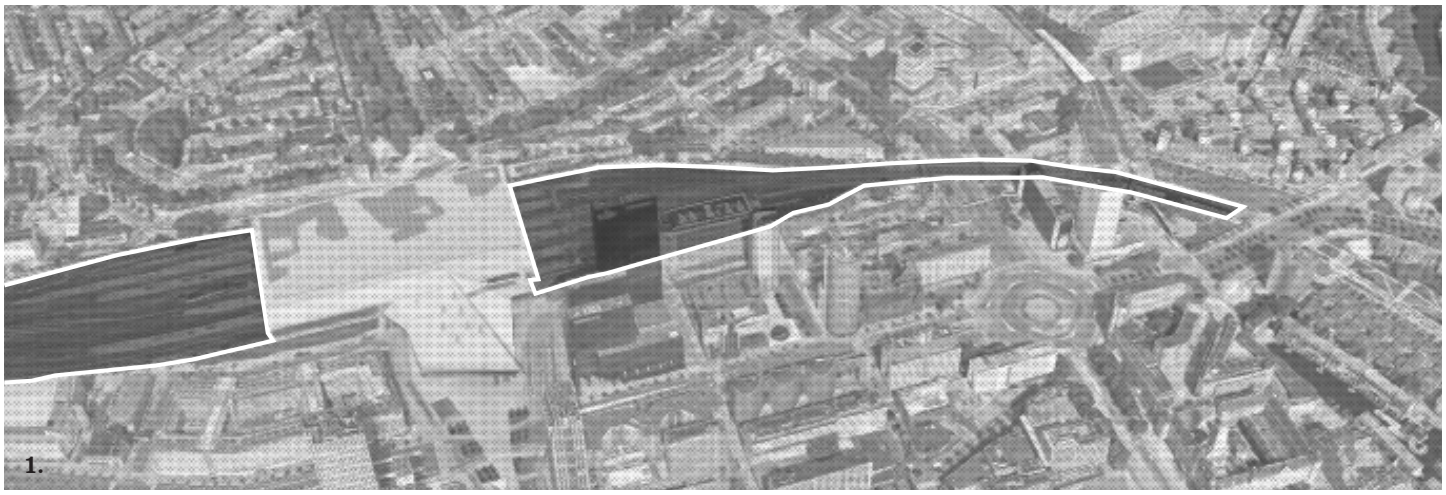
Park Pompenburg overlaps 3 neighborhoods and is a pivot point in the center of the city

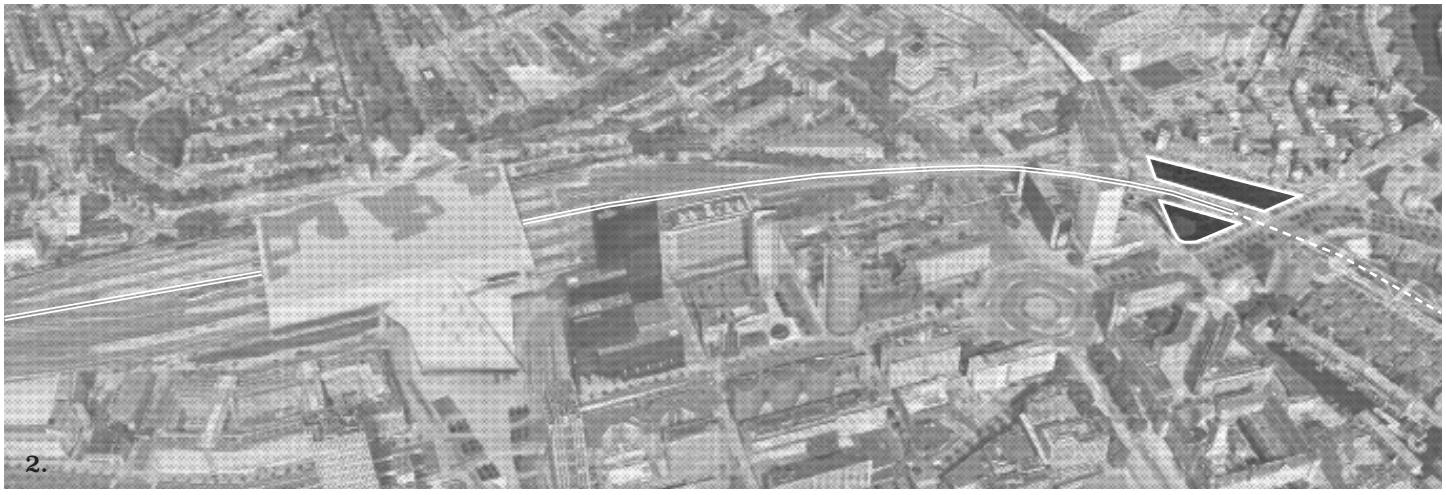
vi. **Its position**

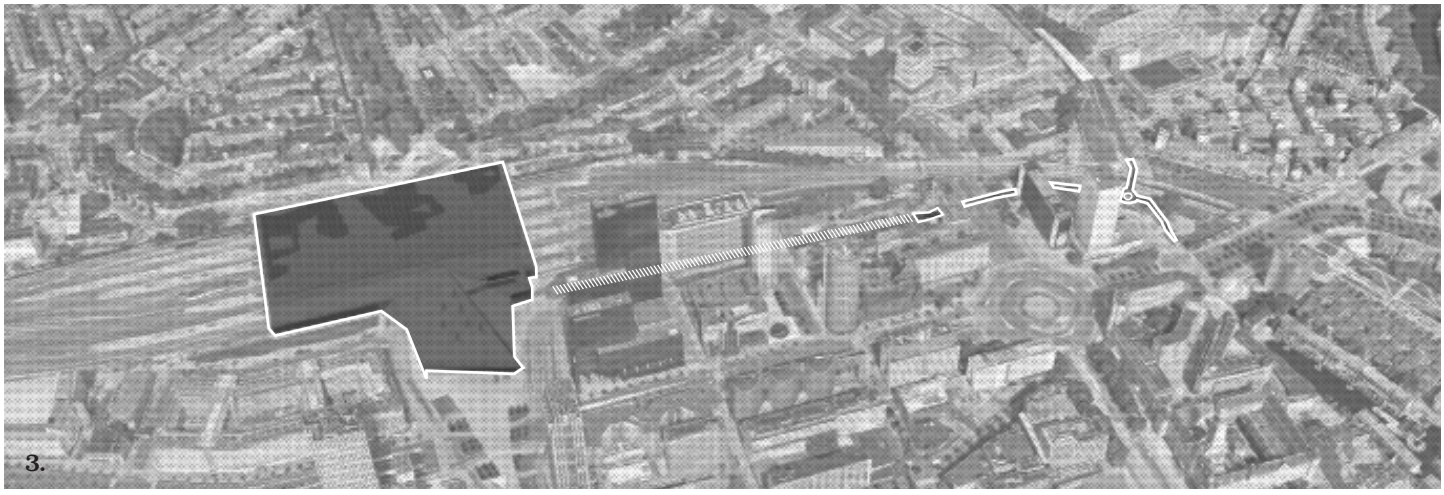
Park Pompenburg has a unique position in the city fabric that overlaps and connects three different neighborhoods: Stadsdriehoek, Agniesebuurt and Oude Noorden. It is also in close proximity to two economically important neighborhoods: Stationskwartier and Cool. Considering the *Hofbogen* (the former station and air railway) as a physical extension, from Pompenburg to motorway A20, it also reaches the neighborhoods Bergpolder and Liskwartier and connects them through the spine to the city center.

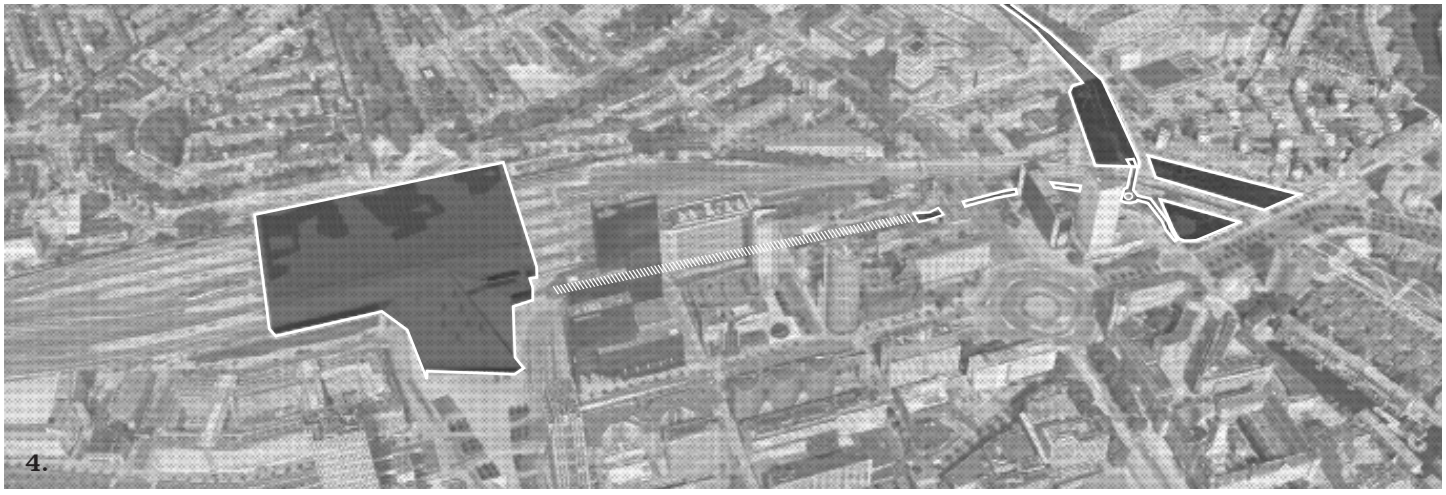
Being in a position that stands in direct connection with 7 different neighborhoods enables various (economic) opportunities, such as optimized mutual accessibility (from neighborhoods to city center and vice versa), business interactions due to proximity and reachability, and physical stimulation for reciprocity. Pompenburg, when removed the physical barriers, can become pivot point for the city that attaches the inner city with Rotterdam North.

The prominent location of Park Pompenburg, in combination with the connecting 'urban spine' quality of the 1.9 km long Hofbogen, can form an important node that can contribute to cultivate both physical and economic benefits for the city.


1.


2.


3.


4.

vii. **Its problems and potentials**

Problems

1. The railway forms a physical barrier

The railway forms a border between the districts Rotterdam North and the city center. It functions as a barrier in the area, splitting various neighborhoods and breaking the continuity both physically and visually.

2. The railway tunnel ends at Park Pompenburg

Park Pompenburg that overlaps three different neighborhoods has the potential to become a connecting factor. However, the railway-tunnel, that ends exatly below the park, rises above ground and creates a physical barrier and obstacle.

3. The Luchtsingel as a temporary connector

Two interventions in the area that connects the districts are the Central Station, which funtions as a passage/portal, and the Luchtsingel, which extends as a path from the Central Station, transitions into a bridge, goes through the Schieblok (building), connects with Park Pompenburg and crosses the railway to connect with Station Hofplein/Rotterdam North.

4. Park Pompenburg as the permanent answer for connectivity

The Luchtsingel was intended as a temporary wooden structure that responded to the (practical) need of connecting the two districts. It endavoured to prove the importance of creating a physical link to optimize the accesibility of the areas. Although the bridge is (mainly) intended as a connecting pedestrian bridge, it is not accessible for everyone. Because of the stairs, people who are less mobile, e.g. with wheelchairs, rollators, and perambulators, are not able to benefit from the convenience.

Potentials

As already mentioned in the previous paragraph, Park Pompenburg has the potential to become an interactive node that connects different urban tissues together by linking various paths from different directions to the park.

The goal of the (temporary) Luchtsingel was to become an attractor for new developments and the catalyst for economic growth in the area. Using the potential of Park Pompenburg's position within the urban fabric can provide a permanent solution to the main ambition of The Luchtsingel.

source: Dura Vermeer

The vision for Pompenburg

i. **Current developments**

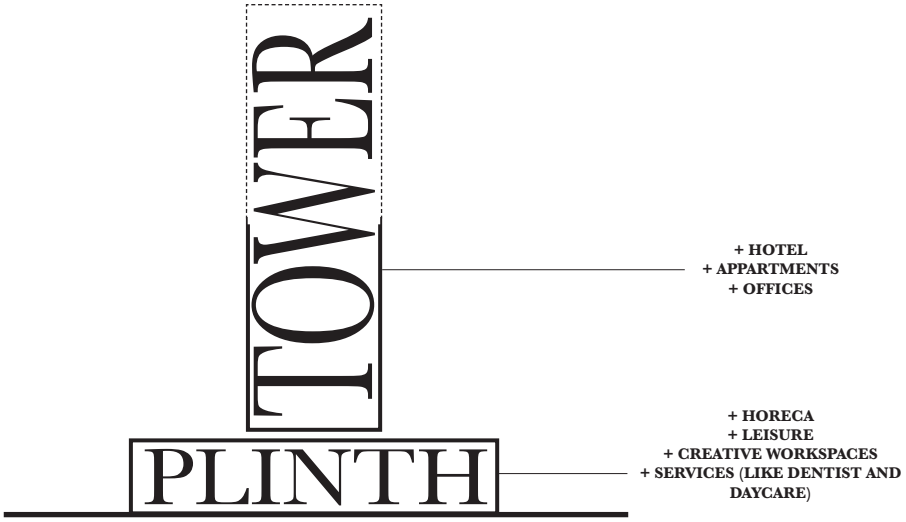
Already since the early 1990s studies have been conducted to transform the area around Station Hofplein and connect the surrounding neighborhoods to the city center. The last study, "Manifest Pompenburg" was developed in 2009. However, partly due to the economic crisis, this plan was put on hold.

In 2011, a number of basic agreements for the area development were formulated with the parties involved. At the end of 2017, the parties decided to reestablish the vision for Pompenburg. In October 2018, the new plans for Pompenburg were revealed to the public (Dura Vermeer et al., 2018).

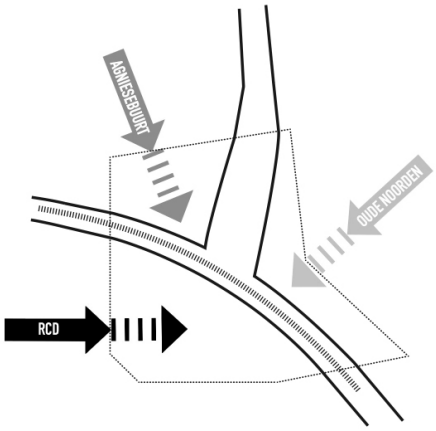
The program
The program is based on the municipality's vision of "City center as a City Lounge" (Binnenstad als Citylounge). The plinths are dedicated to public programs that contribute to the attractiveness and quality of the area. The towers will accommodate hotels, offices, and apartments. A large proportion of this (75-80%) is dedicated to living, catogorized into three different groups: 1. single and two-person households (mostly young people), 2. families, and 3. seniors and pensioners. These are again, devided into rental and owner-occupied apartments.

The program consists of approximately 95.500 m2 gfa consiting of:
- Commercial functions (retail, shops, cafes, restaurants, hotel, offices, and service oriented businesses): 22.500 m2 gfa.
- Living rental and owner-occupied apartments, devided into social 20%, middle 50%, and expensive segment 30%): 73.000 m2 gfa.

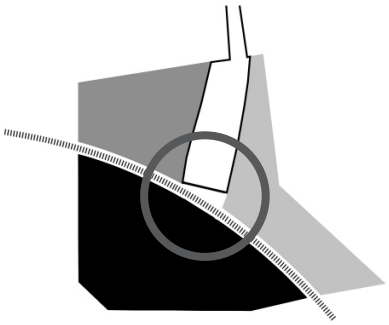
The vision
The main ambition of the current development is to transform Pompenburg into an active and lively environment that becomes an intrinsic part of the city center. The vision is to create an area with a variety of activities where space can be offered to different target groups at different times of the day.
By proposing a mix of programs oriented to living, working, retail, and hospitality, the ambition is to create a dynamic area with constant changing activities during the day.



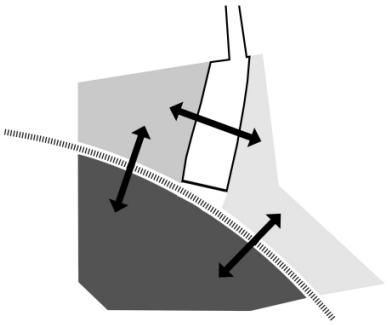
source: own illustration



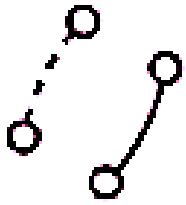
MEETING OF 3 DIFFERENT IDENTITIES



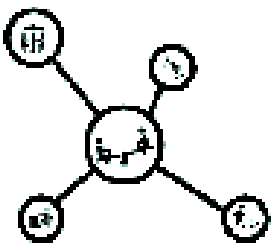
THE CENTER OF THE AREA



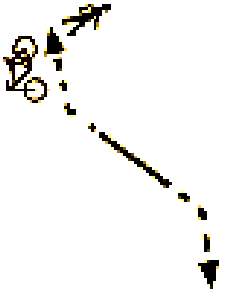
ATTACHING SURROUNDING IDENTITIES



BLURRING PHYSICAL BARRIERS



MAKING PLACES TO STAY



OPTIMIZE THE SLOW TRAFFIC NETWORK

source: Dura Vermeer

Negative critique
The current plans for Pompenburg is a typical example of an inner-city area transformation in a very traditional and rational way. The program is a short-term and immediate response to the current housing problem and a pursue to invigorate the area by adding public facilities.

However, we are currently living in an era where we must consider the climate and the future of our planet with every decision we make, especially when it comes down to such impactful interventions as buildings. Our world is currently 9% circular, and the progress in this area is too slow to achieve the climate goals on time. Circularity is still in a very low state in terms of awareness of the citizens. It must become one of the *leading factors* in the communication with the client and the design process. It, however, remains one of the greatest challanges of our industry to convey and spread the urgency of circularity. Therefore, architects, developers, municipalities and the goverment must addopt a leading and steering role.

The term 'circularity' is not mentioned once in the documents explaining the vision for Pompenburg. Perhaps it is integrated into the elaboration of the project, but the relevance is not expressed and emphasized as an essential part of the story.
However, climate adaptation in terms of the local environmental conditions and context recurs multiple times throughout the document. But climate measures concerning the bigger picture is disregarded.

Considering the enormous negative footprint the existing built environment already has, the climate goals we must achieve, and the way we treat and consume the recources we currently possess, it is a completely missed opportunity to purely create a new island of attraction for Rotterdam, because that is what (we think) the city needs. This location, with its connecting quality and potential, is by far the most valuable and most fitting area in the city to establish an unprecedented circular manifestation. That, today, is what Rotterdam, The Netherlands, Europe, and the world needs.

Positive critique
In the current developments, they recognize Pompenburg as a pivot point that connects three different neighborhoods. The idea is to make Station Hofplein the heart of the overlapping area where the three different neighborhoods with their own specific identity will merge.
The public zone will become a essential node for the bike and pedastrian network of the city center. The car is excluded in specific areas and is only considered as a 'guest'.

They also recognize the railway as a physical barrier in the location. The ambition is to create pleasant places to stay, and stitch the area with the surrounding urban fabric by improving and integrating the slow-traffic through the public space. Therefore, in order to connect the different neighborhoods in a logical way, the barrier that cuts the area in two must be bridged.

Something we often forget is that;

> “We are not only designing for *our* generation, but we are laying the foundation for change for *future generations*.”

We will reach a certain point of time where
the *Generations of the Future* will not know any better.

- authors own perspective

i. **Personal vision**

Our ability to take action is critical for the future of our planet. Many individuals and local initiatives, worldwide but also in Rotterdam, are trying to become a part of the 'solution'. However, failing this mission is inevitable if our current society, economic system, and politics never change. We have a responsibility to leave for future generations a healthy and livable planet.

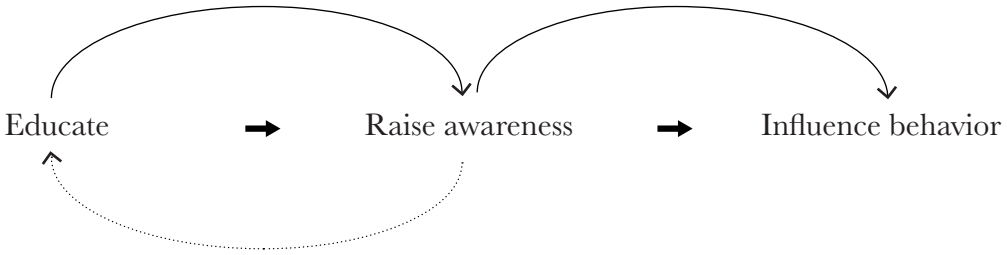
Our actions to date have still proved insufficient. Recent studies show that our world is currently 9% circular. There is a circularity gap that keeps getting bigger if appropriate action and measures are not taken. The climate goal is to limit the global temperature to 1.5°C by 2050. However, the impact of our current commitments and the pace at which we operate now will lead to a world that, by 2100, will reach 4°C above pre-industrial levels (Circle Economy, 2016).

Sustaining a healthy and livabale world is therefore strongly dependant on resolving the negative side-effects of our linear economic system and limiting/controling the consequences of climate change. Therefore, sustainability is considered critical. However, designing energy producing and healthy buildings alone are not enough to preserve a livable world. It requires a change of attitude towards materials, resources, and most importantly 'waste'. Circularity of the former two can prevent the latter. Thomas Rau said during a lecture at BlueCity in Rotterdam: *"People are saying that we are now dealing with material scarcity, and that we must use our resources in a more responsible manner so that we can reduce waste. But the earth has always been a closed system, almost everything on this planet is a limited edition. Scarcity has always been the case, only we now realize it."*

He thus argues that we should change our perception towards the resources we currently possess, and that *circularity* is the only effective way to preserve the materials within this closed system. However, this requires radical changes in our industry. One way to achieve this is by treating buildings as material banks so that we can design in such ways that materials/elements are able to be disassembled and reused (remountable design) for new products that better suit our changing demands. Secondly, designing buildings more flexible in order to facilitate possibilities for change or to combine different use and functions, reduces the need for and dependence on extra space. But these are rather *hard* characteristics of circularity.

Hard and *Soft* characteristics

Hard → Short-term	*Soft* → Long-term
Measurable	Spreading awareness
Performance	Education
Recyclable	Interaction
Reusable	(House) rules
Modular	Job opportunities
Demountable	Flexibility



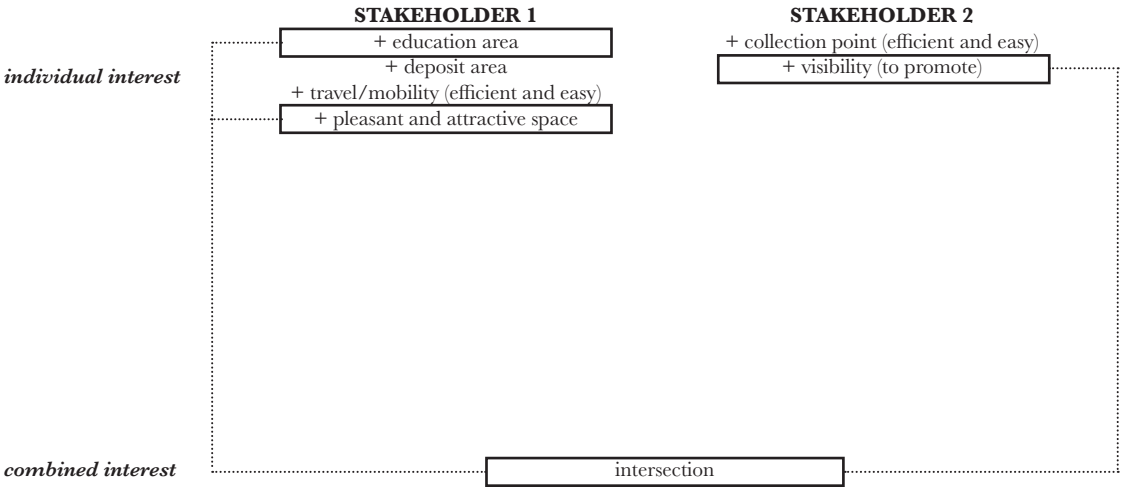
Characteristics of circularity
In this research circularity is divided into two categories of characteristics: **hard** and *soft*. Hard characteristics refer to the measurable and substantial measures related to circularity. Measures that have become synonymous and self-evident with circularity, such as the amount of recycled and reused materials, flexible design, modular structures, and designed to disassemble. Soft characteristics refer to measures related to spreading awareness, educating the public, rules, regulations and politics, new business models to create (circular) job opportunities, and interaction between business and consumer sector to create joint value.

Our current measures and commitments are mainly hard-characteristics driven. Usually limited by the idea that "Everything we build from now on must be circular!" While that is absolutely right, it is also the reason why we are making so slow progress in the Circular Economy.
Achieving the climate goals, or aspiring to become a fully circular city is absolutely impossible if circularity is limited to individual accomplishments, such as a circular building, or when it is calculated based on our current economic sytem.

The soft characteristics could be considered as "the brain" for circularity. Our mindset and perception are the most challenging thresholds for understanding the importance of circularity. Understanding the WHY, eases the pain and discomfort in the process of taking necessary steps to change certain behavior. It is an unfortunate fact that people are selfish creations. We usually think along the lines of "What's in it for me?" even if it is a crucial matter. But conveying the right information to the public in order to raise awareness and alter their perception can influence people's behavior which can ultimately lead to new "circular" habits.

Short-term and Long-term
Although they have two different purposes, both the hard and soft characteristics are mutually important for the process. The hard characteristics is more of a short-term achievement. For example, a building (apartment block) is designed and built completely circular. But everything keeps operating rather traditionally, meaning that the building still produces "waste". In this case not much has been accomplished. We have only "saved" some resources by reintroducing them into the system, but created another "factory" where we produce more.
In contrast to the hard characteristics, the soft characteristics are long-term achievements. These could be translated into specific interventions, set up with a certain program that aims to educate the public in the field of circularity. A program that provides space for people with circular ambitions and ideas. A program that offers a place where circular interactions can happen. A program where "like minded" people can meet and share their knowledge. A program that promotes and instigates circular behavior. These kinds of interventions will in the long-term alter our perception, teach us about the importance of circularity, and activate circular behavior, while at the same time forming an example for the public.

Circularity is a collective, and not an individual, responsibility that also rests on the shoulders of the citizens. Just focusing on designing buildings or products with reused or recycled materials is not sufficient. A change of mindset and behavior towards circularity is critical. People must first be educated about circularity in order to raise awareness. This in turn increases the chance of influencing behavior in the long-term. Therefore, this graduation project focuses primarily on the soft characteristics of circularity.


STAKEHOLDER 1
+ education area
+ deposit area
+ travel/mobility (efficient and easy)
+ pleasant and attractive space
STAKEHOLDER 2
+ collection point (efficient and easy)
+ visibility (to promote)
individual interest
combined interest
intersection

Pompenburg, a hub for circularity
As stated earlier, Pompenburg is by far the most valuable and most fitting location in the city to establish an unprecedented circular manifestation. A manifestation that encompasses both the hard and soft characteristics of circularity and aims to fulfill both short and long-term achievements.

Currently, Rotterdam counts 60+ circular initiatives around the city. The municipality offers its support by collaborating with companies and initiatives to find possibilities to increase this number to 100+ by 2023.

Pompenburg is a pivot point that overlaps three different neighborhoods and extends through three axes all the way to Rotterdam North, Blaak, and the Central District. This makes the location a central point in this network that is highly accessible for the public. Pompenburg could become a hub for circularity. A center where circular minds come together to educate new minds.

A large quantity of the 40+ extra spaces that the municipality wants to create, in order to boost circular developments, could be accommodated at Pompenburg. These circular initiatives will also have an educational role. Promoting the accessibility of circularity by making it visible and transparent to the public will arouse curiosity and attraction. In the long-term, these educational and circular interactions will transform Pompenburg, from only a meeting point in the area, to a collection and distribution point that serves more circular initiatives than just the ones he houses.

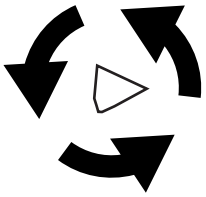
The target-group and stakeholders
The project aims to address three types of people. (1.) people who want to learn more about circularity and want to participate; (2.) children who must be educated to learn about circularity at a young age; and (3.) people who are already involved in the circular economy.

Like in many "businesses", this is also a situation of "demand & supply". There are two stakeholders in this model. *Stakeholder 1*; the people, who are the supplier of materials, and *Stakeholder 2*; the initiatives, who demand the materials. Both stakeholders have individual interests and combined interest. The latter is where the two intersect and come together.
Stakeholder 2 is visible to stakeholder 1 and transfers information to educate them. Stakeholder 1 grows in terms of awareness and is willing to support stakeholder 2 by supplying materials. However, as mentioned earlier, people are usually willing to participate if they receive something in return. This is a matter that far exceeds the framework of this graduation project and could become a separate investigation. In the chapter "Design strategy" however, a few speculative ideas are proposed to incentivize participation.

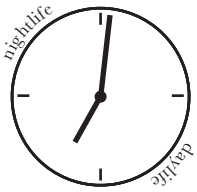
This vision, as described in this chapter is, undoubtedly, a development process and will not operate entirely as intended from the start. But the ambition and intention will result in a building that is designed to foster circularity in the long term. The *Generations of the Future* will not know any better.

4

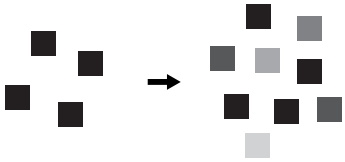
Pompenburg | House of Circularity



1. Activate circularity

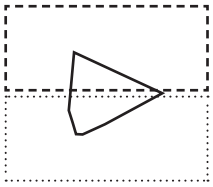


2. Activate the area (public life)

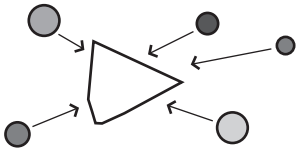


3. Change the identity (diversity) (from only work to mixed-use)

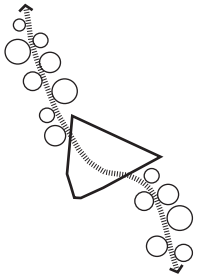
4. The link between two districts



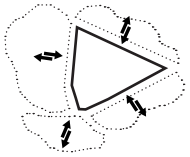
5. The area as the center of two districts



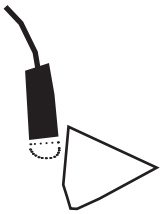
6. Pompenburg as a meeting point



7. Improve accessibility to facilitate interaction



8. Use the qualities of the surrounding



9. Respect and revive the historical value of the area

Design strategy

i. **The Design criteria**

In order to frame the intended end result of the project, a design criteria is formulated. It is a set of functional conditions the building should establish. The criteria is intended to inform the design through evaluations and assessments.
The set of conditions are prerequisites for the building in relation with the site. A similar building elsewhere with the same program might require different conditions.

The design criteria is determined as described below:

1. Activate circularity
The building must have a program that initiates, promotes, and teaches circularity. 'Activation' can therefore have a broad meaning. The main criteria is that the building instigates circular interaction between actors and the public.

2. Activate the area (public life)
The area must have a certain quality of stay. Due to the backside of the Shell buildings, Park Pompenburg feels like an industrial area. There is not much public life, except the people who are using the Luchtsingel to cross the railway or take a shortcut to the Central Station.

3. Change the identity (add diversity)
Currently the area is mainly business and retail oriented. Pompenburg is one of the underutilized areas of Rotterdam as the municipality states. The area needs to be tansformed from a 'business park' to a mixed-use interaction environment.

4. The link between two districts
The area overlaps the Central District and Rotterdam North. Currently the Luchtsingel and the tunnel below the railway at the Raampoortstraat are the only two possibilities to cross the barrier. The building must become a connector that links the two districts together.

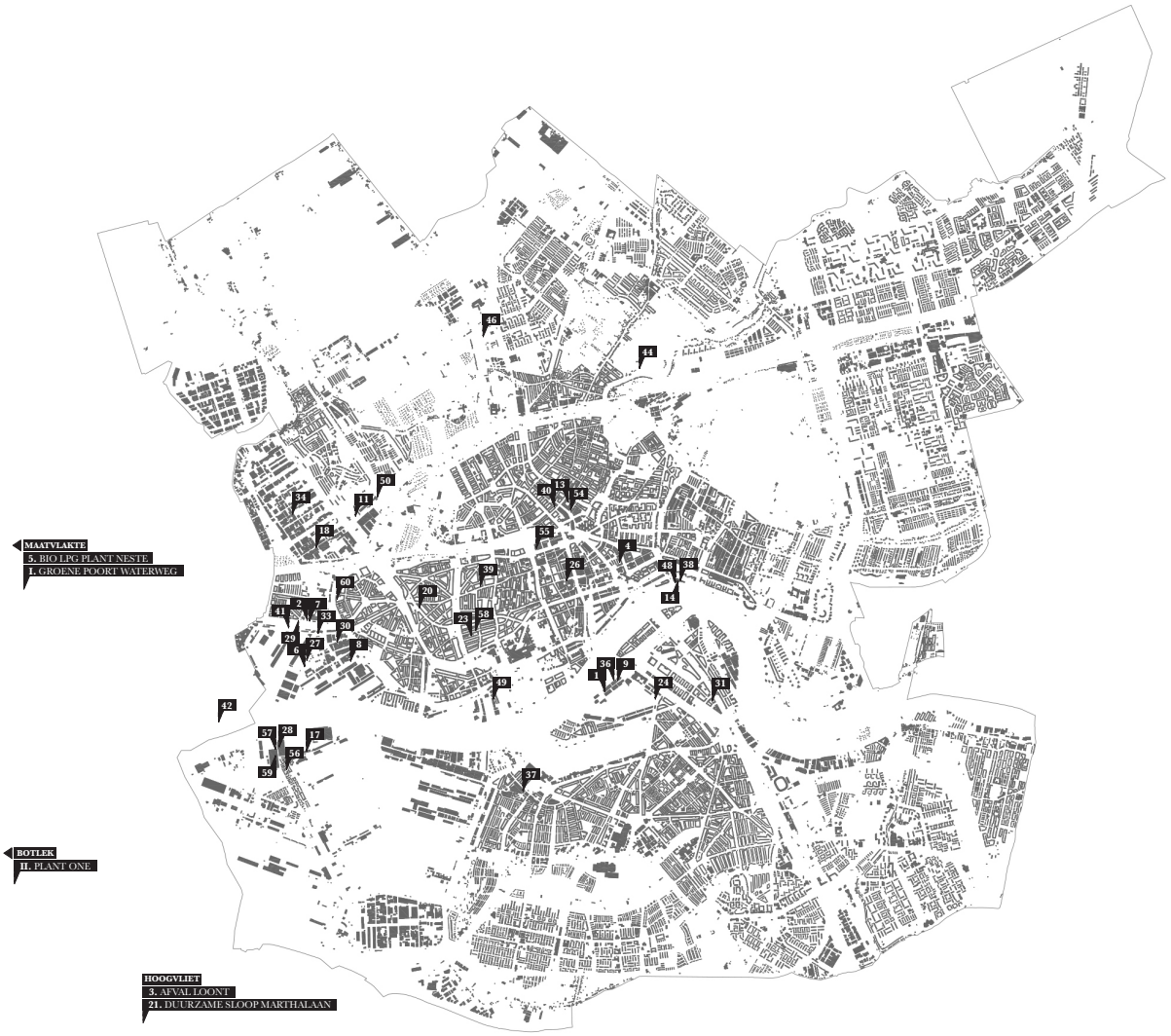
5. The area as the center of two districts
The building must bridge the barrier that is created by the railway that cuts through the park. Park Pompenburg must become a multi-district center that is reachable from various directions.

6. Pompenburg as a meeting point
The connecting element between the two districts must become a meeting point for the public. The various path must be directed towards this element.

7. Improve accessibility to facilitate interaction
In order to facilitate circular interaction, the building must be easily approachable. Making the accessibility convenient and pleasant for the public stimulates the flow and the willingness to participate.

8. Use the qualities of the surrounding
There are specific qualities in the area that can contribute to effectuate certain conditions of the building. Station Hofplein, the Hofbogen, and the Luchtsingel are crucial elements that can have a key role in the accessibility of the area.

9. Respect and revive the historical value of the area
Pompenburg has both a rich and tragic history. From its development in the 14th century, to its destruction during the Second World War. Before the war, the buzzling Hofplein was besides Park Pompenburg. The area must regain its public status and once again become a lively part of Rotterdam.



Circular organizations and initiatives in Rotterdam

ii. **Circular initiatives in Rotterdam**

Rotterdam counts more than 60 circular initiatives and already offers more circular job opportunities (10%) than the national average (8,1%). The municipality has expressed its ambition to become a frontrunner in the field of the circular economy. Therefore, they consider the city as a 'living lab' where they embrace circular ideas, experiments, and initiatives.

Large urban areas are critical for the circular economy. Even though they only cover a small proportion of the land surface area, practically all raw material consumption takes place there. This is even further increased by the port, which is accountable for all the import and export, and the industrial consumption of raw materials (Rotterdam Circulair, 2019).

Currently there is an increasing circular dynamic in Rotterdam. However, most of these initiatives, organizations, or companies are concentrated in the harbor areas. There is a small number of initiatives located within the inner city and almost nothing in the surrounding neighborhoods.
Every initiative who e.g. creates new materials or products out of (domestic) waste needs to collect it from its surrounding. Everything they can not collect, is collected by waste companies and end up at waste incineration plants to generate 'renewable' energy. In that case, waste is literally wasted.

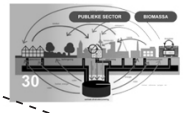
Most houses are located within the districts Rotterdam North and Rotterdam South where no circular activities are taking place. Which means that huge amounts of potentially reusable or recyclable materials are practically unattainable for the companies.

If the municipality aims to become a fully circular city, every neighborhood needs interventions with an intermediary role to assist in collecting resources for the initiatives. They expand the scope of these organizations and thereby prevent depletion of valuable resources.

2019
60+

LAB OP STRAAT

INNOVATIEVE PRODUCTEN ONDER PRAKTIJKOMSTANDIGHEDEN TESTEN



ROSA

WATERGERELATEERDE KRINGLOPEN IN REGIO ROTTERDAM SLUITEN

CIRKELSTAD

STEDEN ZONDER AFVAL EN ZONDER UITVAL

RINEW

HERGEBRUIKEN VAN NUTRIËNTEN, ENERGIE EN WATER UIT AFVALWATER

ORKEHOUT

SLOOP-, REST- EN SNOEIHOUT KRIJGT EEN TWEEDE LEVEN

AFVAL LOONT

SAMEN SPAREN WE DE NATUUR!

THUISRECY

STIJLVO OM AFVA REDUCE HERGEB SCHEIDE

DUTCH WINDWHEEL

CIRKELVORMIGE WOLKENKRABBER CIRCULAIR GEBOUWD

ICDUBO

INNOVATIECENTRUM DUURZAAM BOUWEN

SEW EURODRIVE

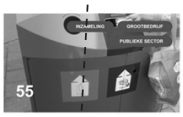
REPAREREN, REVISEREN EN OMBOUWEN

FOCUSED SKATEBOARD WOODWORKS

DESIGN GEMAAKT VAN OUDE SKATEBOARDS

SLIM VERVANGEN RIOLERING

DUURZAAM RIOOLWERK



TRIOBAKKEN

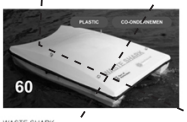
AFVAL SCHEIDEN IN DE PUBLIEKE RUIMTE

GOODFUELS

BIOBRANDSTOFFEN VOOR DUURZAME SCHEEPSVAARTINDUSTRIE

NESTE

RENEWABLE DIESEL BIJ NESTE IN ROTTERDAMSE HAVEN



WASTE SHARK

DE PLASTIC SOUP OPRUIMEN

TROEP-COUP: KIDS OP CIRCULAIRE MISSIE

M4H

100% GERECYCLED ASFALT IN M4H

UIT JE EIGEN STAD

DE VOEDSELPRODUCTIE TERUG NAAR DE STAD

FOODITIVE

SPIREAUX

VERSE SPI

RDM

RDM: DÉ PLEK VOOR INNOVATIE IN DE HAVEN

GRONDSTOFFENBANK ORANJE

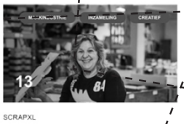
HOOGWAARDIG HERGEBRUIK VAN SLOOP- EN RESTMATERIAAL

BIOMASSAKETEL IN KETELHUIS KLEINPOLDERPLEIN

BIOMASSAKETEL IN KETELHUIS KLEINPOLDERPLEIN

MILIEUPARKEN

AFVAL VERZAMELEN, SCHEIDEN EN HERGEBRUIKEN



SCRAPXL

SCRAPXL:INDUSTRIEEL AFVAL EN RESTMATERIAAL TE KOOP

MARCONIA

OPENBARE EXPERIMENTEERI VOOR VERNIEUW

DOBBEREND BOS

GEMAAKT VAN AFGEDANKTE ZEEBOEIEN

AFVAL SCHEIDEN IN HOOGBOUW

PILOT AFVAL SCHEIDEN IN HOOGBOUW

SCHILLENBOER

NIEUWE TOEKOMST VOOR GROENAFVAL

BROODNODIG

BROODNODIG: EEN OPLOSSING VOOR BROODAFVAL

DUURZAME SLOOP MARTHAL

EEN NIEUWE MANIE SLOPEN

VERDRAAIDGOED

PRODUCTEN VAN RESTMATERIAAL

TTOTT

INTERIEURPRODUCTEN VAN RESTMATERIAAL VAN ROTTERDAMSE ICONEN

COMMUNITY & VOEDSELSURPLUS

CLING NL

LLE PRODUCTEN AL TE REN, RUIKEN EN EN

TINY HOUSE OP CONCEPT HOUSE VILLAGE

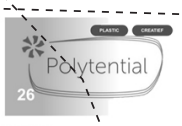
DUURZAAM BOUWEN, WONEN EN DUURZAME GEBIEDSONTWIKKELING

PIEKFIJN

WARENHUIZEN VOOR TWEEDEHANDS SPULLEN

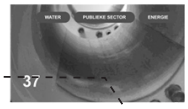
SUGU WAREHOUSE

KLEINSCHALIG, LOKAAL EN CIRCULAIR PRODUCEREN



POLYTENTIAL

PLASTIC VOLLEDIG CIRCULAIR HERGEBRUIKEN



RIOTHERMIE

TERUGWINNEN VAN WARMTE UIT AFVALWATER

GEMEENTE ROTTERDAM

VERLENGEN LEVENSDUUR BRUGGEN

MEYER-SAN INTERIEUR VERHUUR

PERPETUAL PLASTIC 010

PERPETUAL PLASTIC 010

PLASTICIET

OP EEN BETERE MANIER OMGAAN MET PLASTICAFVAL

BLUE CITY

BLUE CITY: BROEDPLAATS VOOR CIRCULAIRE BEDRIJVEN

VAN AFVAL TOT DESIGN VAN DE BOUWPLAATS

BEAT THE BAG

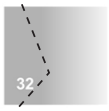
VERMINDERT HET GEBRUIK VAN PLASTIC TASJES EN GEEFT PROMOTIEMATERIAAL EEN TWEEDE LEVEN

ROTTERZWAM

OESTERZWAMMEN OP KOFFIEDIK

RUBBERPAVE

ULTRASTIL WEGDEK VAN GERECYCLEDE AUTOBANDEN



GEMEENTE ROTTERDAM

3 MILJOEN BETONTEGELS MILIEUVRIENDELIJK AANBESTEED

RULINAPASTA

GEMEENTE ZORGT VOOR GESCHEIDEN HUISAFVAL

GROND- EN RESTSTOFFEN CIRCULAIR HERGEBRUIKEN

ECOEUROS

ECOEUROS: RECYCLEN STIMULEREN DOOR BELONEN

KEES

KEES: SLOW FASHION

BUURMAN

BUURMAN: MATERIAAL MET EEN VERHAAL

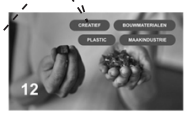
RUIMTE ERS

RETOURETTE

GESCHEIDEN INZAMELEN VAN SCHOON AFVAL

RECYCLED PARK

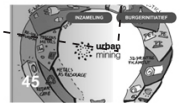
PLASTIC AFVAL IN DE NIEUWE MAAS OPVANGEN



BETTER FUTURE FACTORY

BETTER FUTURE FACTORY: CREATIEVE, REALISTISCHE DUURZAME ONTWERPEN

AAN R VAN



URBAN MINING

CROWDFUNDEN, MET ALS INZET DE WAARDE VAN JE AFVAL!

MATERIALENDEPOT

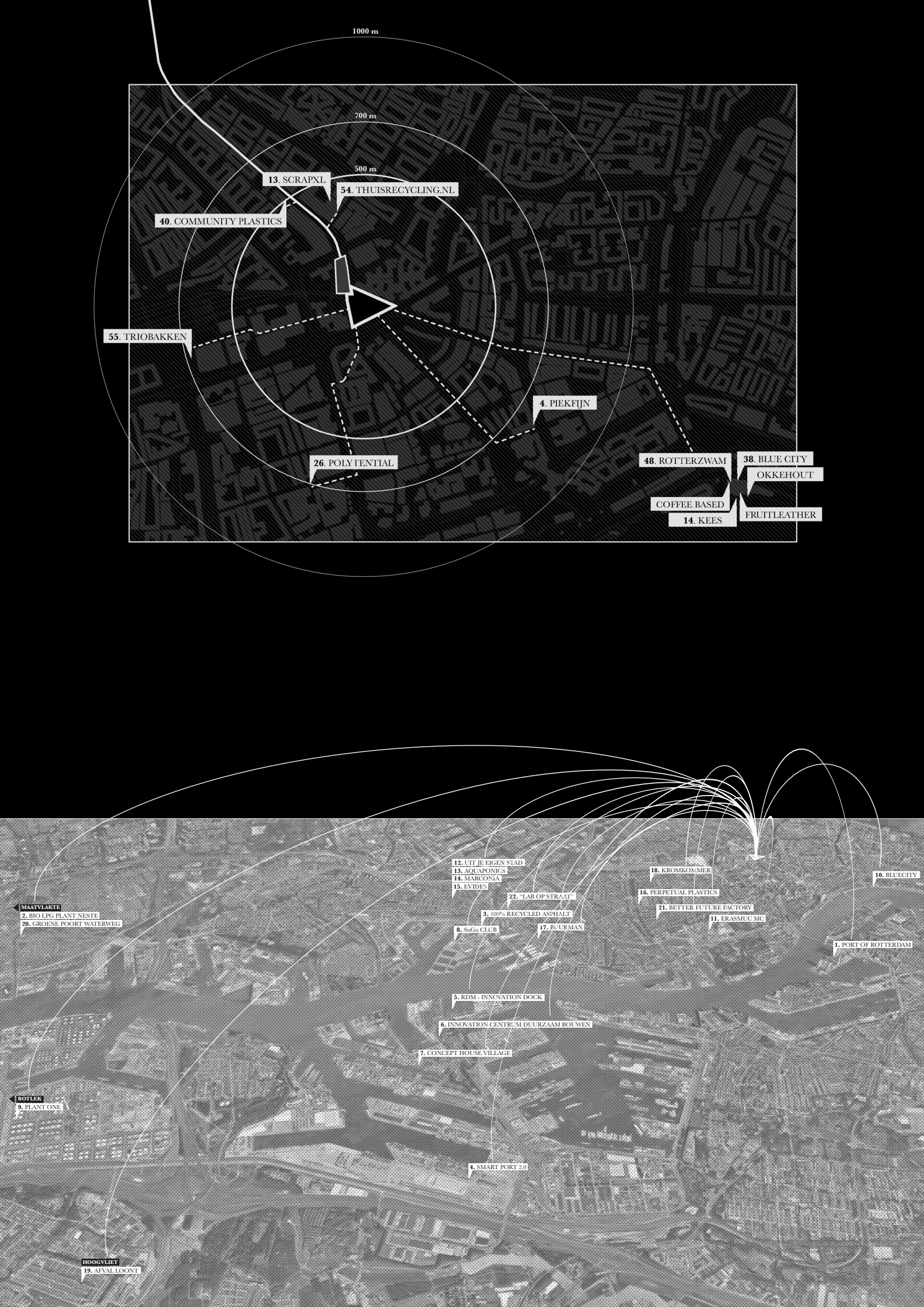
ARTIKELEN UIT DE GROND-, WEG- EN WATERBOUW HERGEBRUIKEN

COMMUNITY PLASTICS

HUISHOUDELIJK PLASTIC VERWERKEN TOT NIEUWE PRODUCTEN

enburg

2023
100+

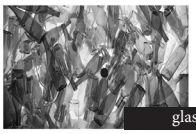

1000 m
700 m
500 m
13. SCRAPXL
54. THUISRECYCLING.NL
40. COMMUNITY PLASTICS
55. TRIOBAKKEN
4. PIEKFIJN
26. POLYTENTIAL
48. ROTTERZWAM
38. BLUE CITY
OKKEHOUT
COFFEE BASED
FRUITLEATHER
14. KEES
MAATVLAKTE
2. BIO LPG PLANT NESTE
20. GROENE POORT WATERWEG
BOTLEK
9. PLANT ONE
HOOGVLIET
19. AFVAL LOONT
12. UIT JE EIGEN STAD
13. AQUAPONICS
14. MARCONIA
15. EVIDES
22. "LAB OP STRAAT"
3. 100% RECYCLED ASPHALT
8. SuGu CLUB
17. BUURMAN
18. KROMKONIMER
16. PERPETUAL PLASTICS
21. BETTER FUTURE FACTORY
11. ERASMUC MC
10. BLUECITY
1. PORT OF ROTTERDAM
5. RDM - INNOVATION DOCK
6. INNOVATION CENTRUM DUURZAAM BOUWEN
7. CONCEPT HOUSE VILLAGE
4. SMART PORT 2.0

iii. **Interact with other initiatives**

The House of Circularity can become a structure that adopts this intermediary role. Park Pompenburg's position within the city, along with the qualities of the Hofbogen and the Luchtsingel makes the area highly accessible from different directions.

The building can have an 'immediate' interaction area where the approachability is optimal for the public. Resources collected both within the building and from the surrounding can be stored and redirected to the right initiative. The interaction with initiatives around the city in order to exchange materials broadens their scope. This might even lead to an up-scale of their business, which even further fosters the development of the circular economy.

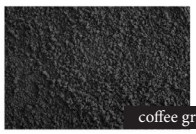
BETTER FUTURE FACTORY



BETTER FUTURE FACTORY

refil & PERPETUAL PLASTIC PROJECT & BETTER FUTURE FACTORY & COMMUNITY PLASTICS

okkehout



ROTTERZWAM & COFFEE BASED

FRUITLEATHER ROTTERDAM

Verdraaid Goed MAAKT WAARDELOOS WEER WAARDEVOL & Piekfijn Het leukste 2e hands warenhuis & SCRAP

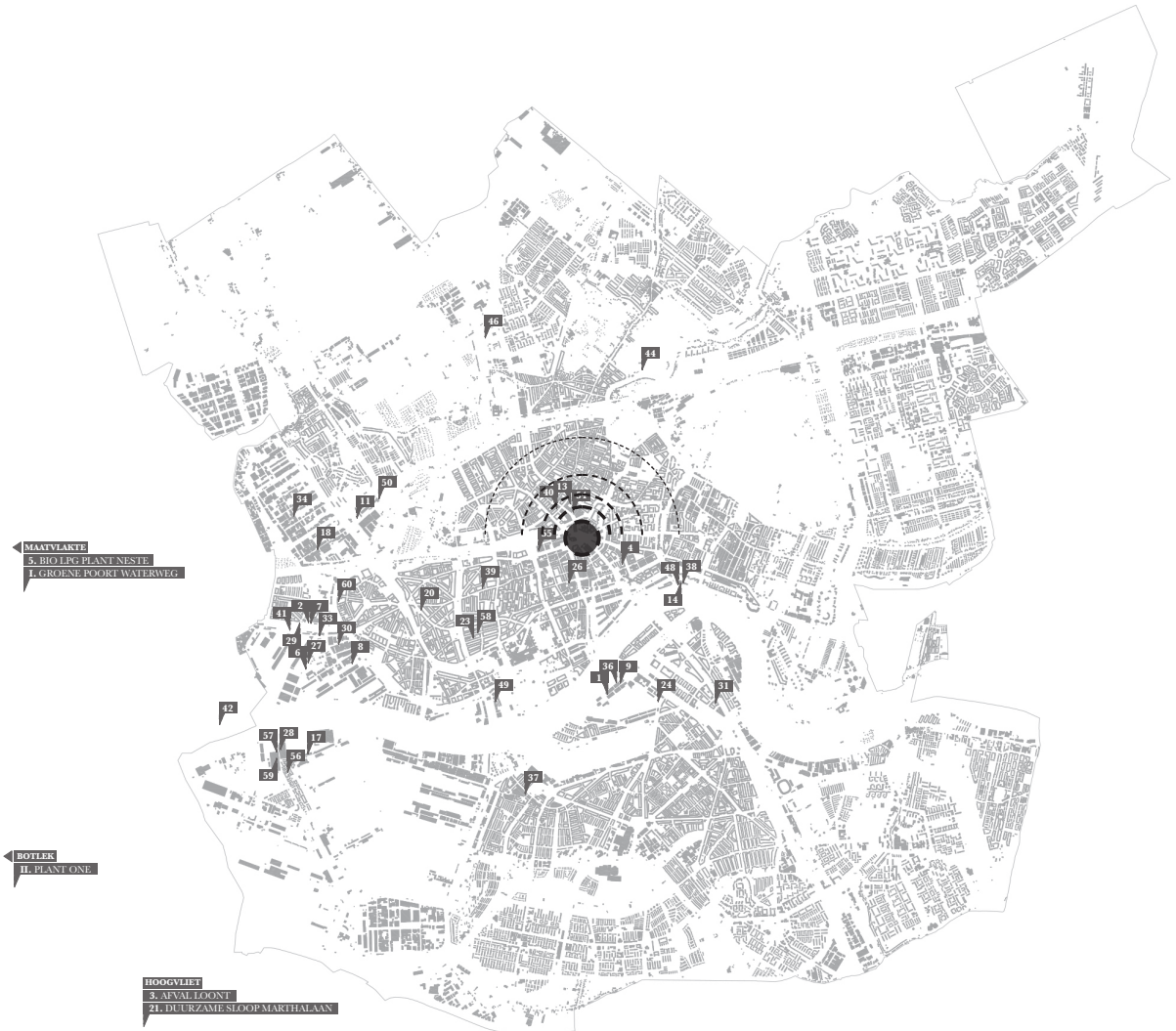
iv. **Collect resources and exchange waste-streams**

There are already 12 initiatives located, within a 1500 m radius from Park Pompenburg which can be supported by the House of Circularity. Most of these initiatives make use of plastic and electronic waste. However, paper, glass, wood, and even coffee grounds, and fruit remains are suitable for various purposes.

These 7 materials that we consider 'waste', are very valuable resources for at least 11 initiatives to create new products. RotterZwam, for example, converts offee-grounds into mushrooms. FruitLeather turns rotting fruit and fruit remains into vegan leather. And Okkehout creates new furniture out of used wood and old iron.

But in order for their work to be meaningful and significant for the circular economy, they have to manufacture their products out of 'waste'. Which means that their productivity and circular impact depends on the resources they can save.

Local resource collectors will operate as material banks for the initiatives. However, this does not mean that the resource collector must become separate structures. On the contrary, they have to be integrated within mixed structures. This both facilitates the process of collection, and enables the collection of various resources from different programs.


MAATVLAKTE
3. BIO LPG PLANT NESTE
1. GROENE POORT WATERWEG
BOTLEK
11. PLANT ONE
HOOGVLIET
3. AFVAL LOONT
21. DUURZAME SLOOP MARTHALAAN

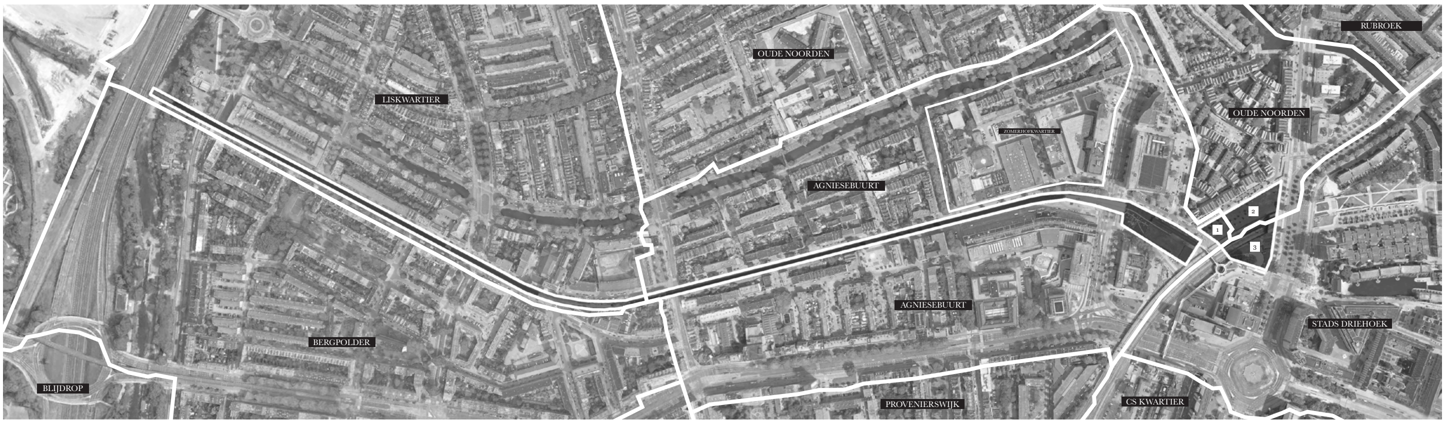
v. **Blur boundaries and remove barriers**

Highways and railways are monofunctional structures that create barriers within the city (BNA, 2017). These barriers are a huge limitation for reciprocity.

Currently building on top of railways is a hot topic in the Netherlands. It can form a solution for the pressing housing shortage many cities in the Randstad have to deal with in the upcoming years. The four major cities have consulted the Dutch Railways (NS) to discuss how the valuable space above the railways can be used for living, working and recreation.

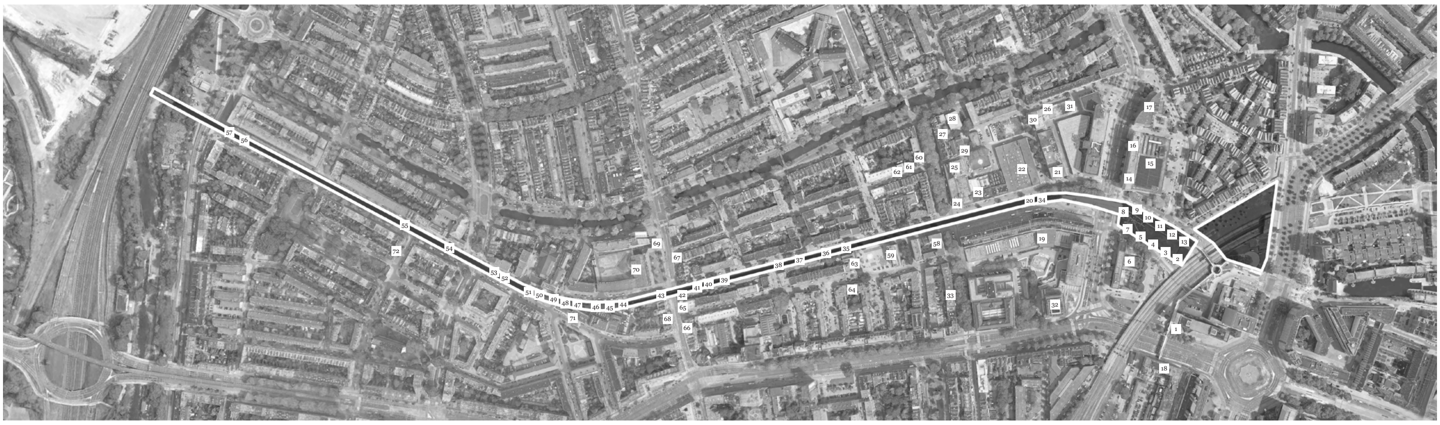
Building above railways entail a number of advantages. Due to the existing public transport system, new roads and public transport connections are not required, which is often the case with new residential areas on the outskirts of the city. Moreover, removing the physical barrier can also improve the cohesion of the area. The space above the railway can turn into a lively environment with a mix between living, working and recreation that adds life to the area 24/7 (NOS, 2019).

The future station plans in the Netherlands are mainly: break through barriers, build an icon, and create public functions (Van Mastrigt, 2017). However, Ton Venhoeven states that it is important not to build randomly above all tracks. Central locations in cities are critical as they contribute to the accessibility of the city and decrease the use of the car. Moreover, the residents will also get streets and squares instead of a noisy rail yard (NOS, 2019).



PARK POMPENBURG | 1 AGNIESEBUURT 2 OUDE NOORDEN 3 STADS DRIEHOEK (CENTER)

Community center · Culture · Retail · Hospitality · Sports · Education · Religious



1 Starbucks
2 Restaurant De Jong
3 Misura Sartoria Maatpakken M/V
4 Esto Food and Drinks
5 FG Okonomiyaki Bar
6 BIRD club & restaurant
7 Kevin Murphy retail
8 Clone Music BV
9 Restaurant Opporto
10 CrossFit Hofplein
11 Chinnoe & Vlemmix Art gallery
12 Lokaal 1e klas koffie
13 FG Food Labs/Restaurant
14 Dentist
15 City Archive
16 Business services
17 OCA Rotterdam (physiotherapy)
18 DakAkker urban farm/restaurant
19 Grafisch Lyceum / Zadkine / MediaCollege
20 Eurotrash (Brewery)
21 MONO Cafe
22 Scrap (Art)
23 Fries 'n Falafel (restaurant)
24 De Mafkees (hostel)
25 Magnetronbar (restaurant)
26 Opfleuren Bloem & Styling (florist)
27 't Puntje (cafe)
28 Chr. Geref. Rehobothkerk (church)
29 Cuartito Azul (dance studio)
30 Fit For Free (fitness center)
31 Ruthless Fightcompany
32 David Lloyd (fitness center)
33 Street with restaurants/cafes/shops
34 Toko Trash restaurant
35 Xia Quan (fighting school)
36 Man met Bril Koffie (coffee house)
37 Linja Meubelstoffeerderij (furniture company)
38 Stof Rotterdam (comercial company)
39 Elok Meubelmakerij (furniture company)
40 Budelinc (graphic designer)
41 Parallel Handbuilt (bike store)
42 Drukjoenit (copy shop)
43 Happy Italy
44 Curio & Bicudo (animal shop)
45 Fietsenwerkplaats (bike shop)
46 We Say Cheese (shop)
47 Boog Drukkerij (copy shop)
48 Mindfulness (yoga studio)
49 Foto Vakprint (photo shop)
50 Tafel Design (furniture store)
51 De Oorzaak (vinyl shop)
52 Into Interiors (furniture store)
53 Hill Knives Holland (knife store)
54 Keizer Culinair (restaurant)
55 Clone (music store)
56 Tutti Timbri (toy store)
57 Parket Rotterdam (carpet store)
58 Glamour Chick (store)
59 Bas Snack (cafeteria)
60 VOF Cuts & Locks (hair studio)
61 Geerders Wildhandel (butcher)
62 I Tuned (store)
63 Siberia (theater)
64 Dataquib (software company)
65 Coppi koffie & fietsen (coffee house)
66 L'Ambassadeurtje (bar)
67 Hg Telecom (electronics)
68 Cut N' Go Hairstyling (hair studio)
69 Bagels & Beans (cafe)
70 Albert Heijn (super market)
71 Partijhal Rotterdam (whole sale)
72 ZJU & Zo (bakery)

CONNECTIVITY | < LISKWARTIER - BERGPOLDER > < AGNIESEBUURT > < ZOHO > < CITY CENTER >

vi. **The Hofbogen as an Urban Connector**

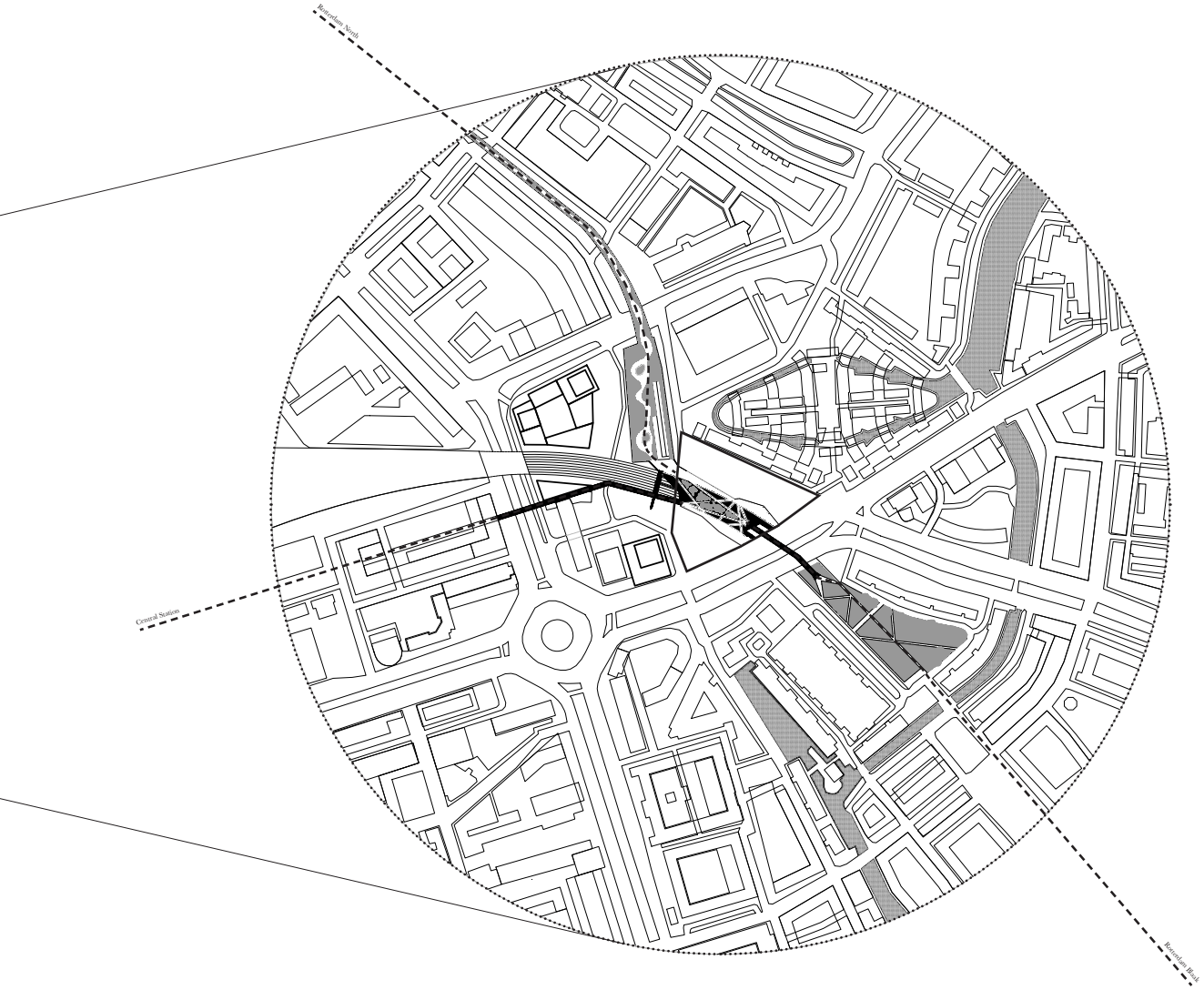
The Hofbogen is the former public transportation line between Rotterdam - Dordrecht, and Rotterdam - Scheveningen/The Hague. Currently this unutilized air-rail line starts at Pompenburg and extends to the A20 towards Rotterdam North. From Pompenburg to the A20, the Hofbogen goes through the Agniesebuurt and crosses between the neighborhoods Liskwartier ad Bergpolder.

In the past decade many studies have been conducted to transform the Hofbogen into a similar structure as the Highline in New York or the Promenade Plantée in Paris. However, besides merely introducing nature to the urban environment, the Hofbogen can also have a practical purpose.

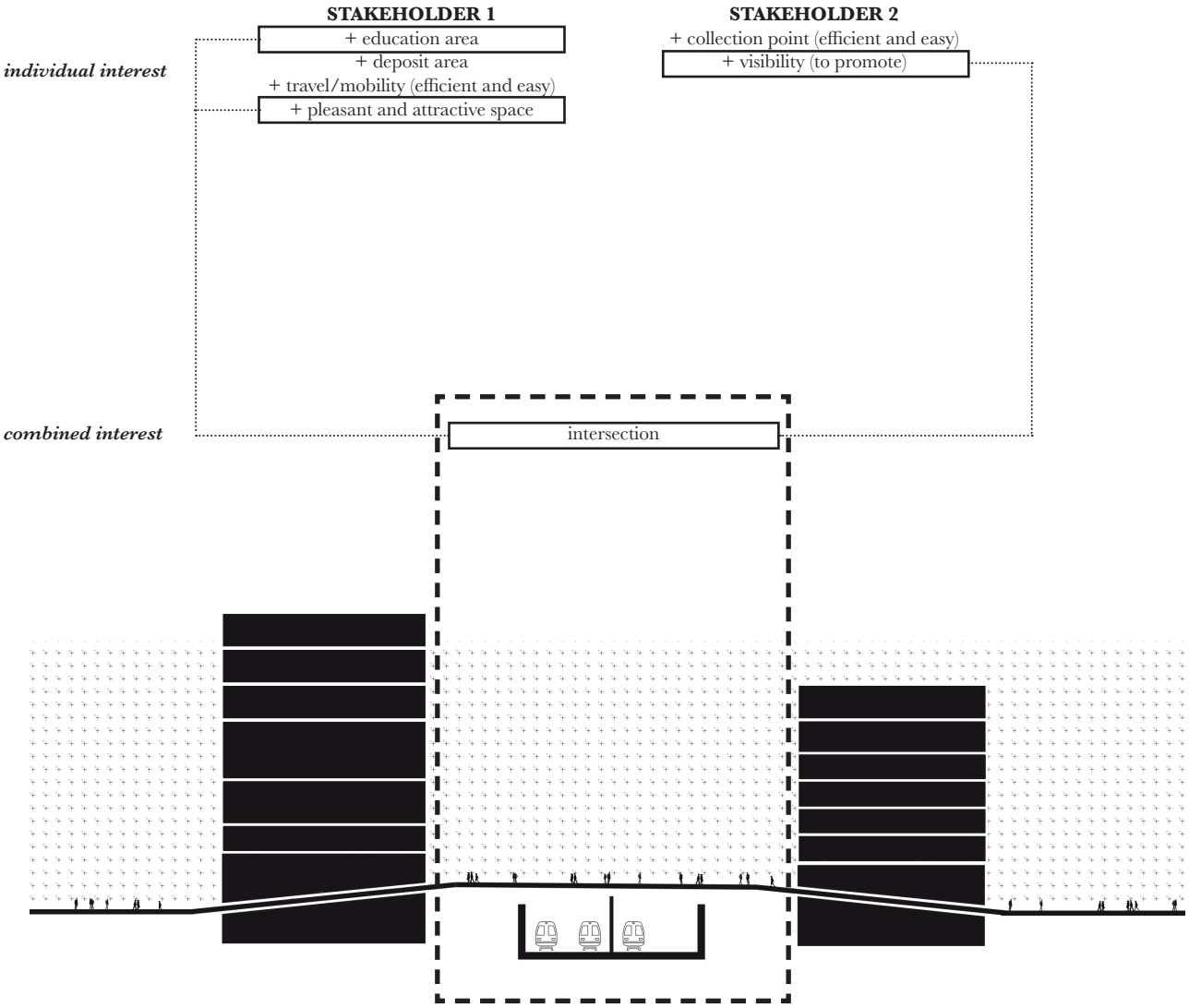
There is a wide variety of functions adjacent to the extended line of the structure. Hospitality, education, retail, sports, religion, culture etc. Al these functions possess valuable resources that are just 'waste' for them. The Hofbogen can become an Urban Connector that attaches to the House of Circularity where resources are collected. The Hofbogen than becomes an *air-line* for exchange.

The Hofbogen can have a critical role in the reachability of Pompenburg. It facilitates the process of exchanging resources which ultimately boosts the interaction that takes place above the railway.
Normally people are willing to travel a distance of 500 meters by foot. Therefore, it constitutes the immediate interaction area. Ideally, another collection point should be positioned around the periphery to extend the range. The Hofbogen extends 1,9 km towards the North. The convenience, however, is that the urban connector is a linear pathway that leads directly to the building.

vii. **Improve the reachability**



Besides the Hofbogen, the Luchtsingel will also have a significant role to optimize the reachability. The yellow wooden structure is a direct connection towards the Central Station which is located in the neighborhood Stationskwartier. The immediate connection between Stationskwartier and Pompenburg is emphasized through the striking yellow structure, which also functions as a form of nudging.
An extension of the Luchtsingel can bridge the road Pompenburg to create an axis parallel to the rail tunnel towards Rotterdam Blaak.


STAKEHOLDER 1
+ education area
+ deposit area
+ travel/mobility (efficient and easy)
+ pleasant and attractive space
STAKEHOLDER 2
+ collection point (efficient and easy)
+ visibility (to promote)
individual interest
combined interest
intersection

viii. **Accessibility and visibility**

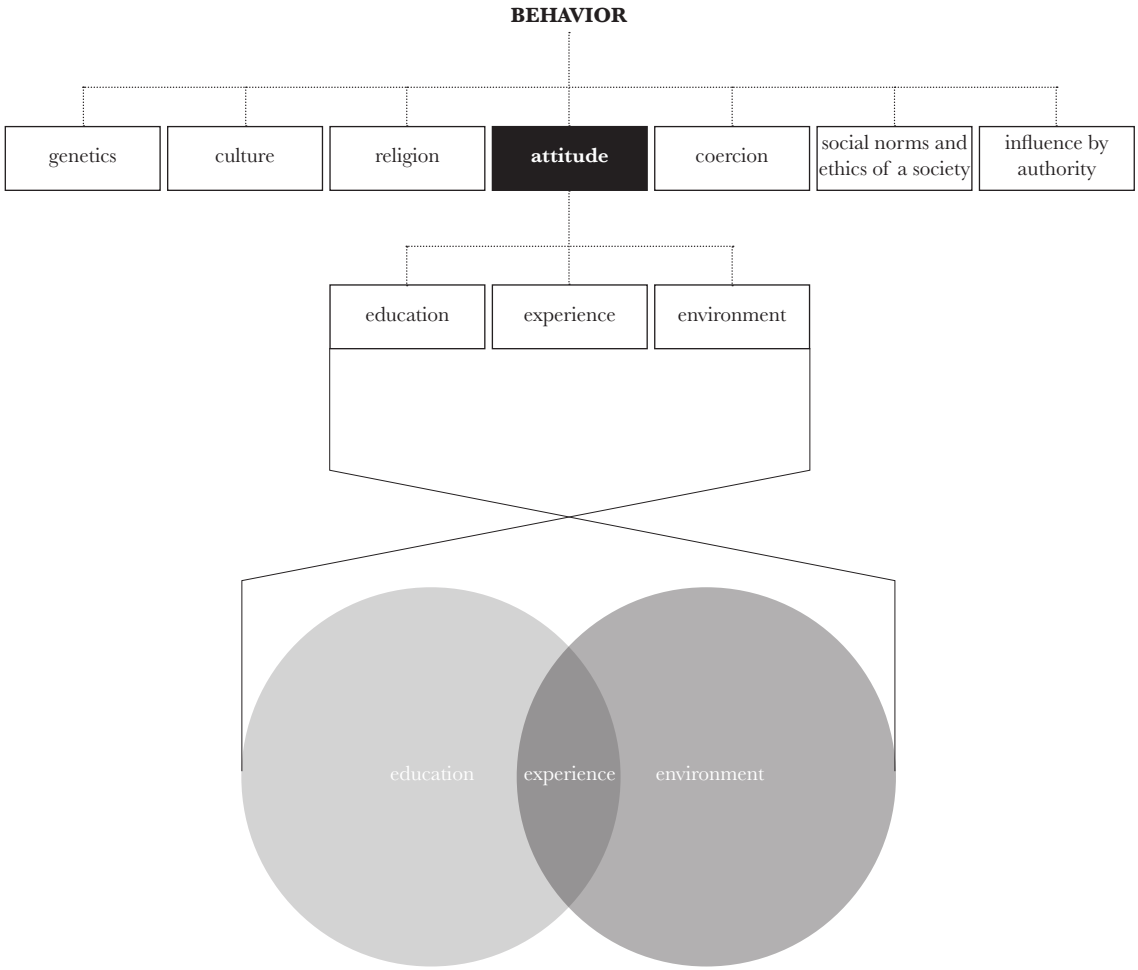
In the paragragh *the target-group and stakeholders* it has been mentioned that both stakeholders have individual interests and a combined interest. The latter is practically where the two stakeholders intersect and meet.

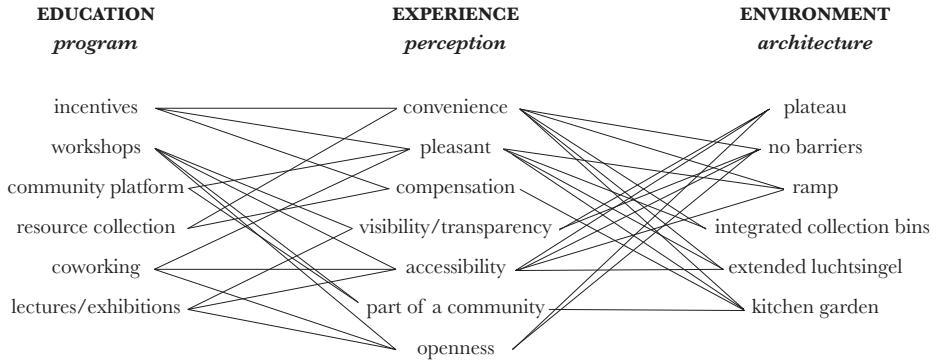
The railway cuts the park in two and forms both a physical and a visual barrier between the Central District and Rotterdam North. In order to actualize the reachability of the building using the Hofbogen and the Luchtsingel, as described in the previous paragraph, the railway has to be covered. This cover forms the *plateau* that receives the flows from different directions. It forms and elevated public space that seamlessly merges with the surrounding.

The plateau is the public domain where the buildings are oriented at. Through the plinths that adjoin the plateau, circular activities can be made visible to the public. Transparency of the plinths, both literally and figuratively, will contribute to arouse curiosity and evoke functional reactions through psychological stimuli.

The process of collecting and exchanging materials must be manual and visible to the public, by actively using the open space between the buildings (the plateau). If the process of exchange is hidden behind an automated system, the pursue to demonstrate that waste-production can be significantly reduced through human interactions has been unsuccessful.

The circular initiatives and organizations in the plinth are already eager and willing to educate people in order to spread awareness. Therefore, every activity that takes place in the plinth should be aimed at proving that human interaction and cooperation is an effective solution to reduce waste.


BEHAVIOR
genetics
culture
religion
attitude
coercion
social norms and ethics of a society
influence by authority
education
experience
environment
education
experience
environment


EDUCATION
program
EXPERIENCE
perception
ENVIRONMENT
architecture
incentives
workshops
community platform
resource collection
coworking
lectures/exhibitions
convenience
pleasant
compensation
visibility/transparency
accessibility
part of a community
openness
plateau
no barriers
ramp
integrated collection bins
extended luchtsingel
kitchen garden

ix. **Responding to the human senses**

Behavior is an outward expression that is formed by many factor. Some (perhaps) influenceable by physical interventions and some not. Attitude is something that can be influenced but not controled or accurately predicted. Attitude, as elaborated earlier, is closely related to the mindset, experience and the perception of a person. It is formed by factors such as education, experience, and environment. Attitude is the mental tendency that largely determines our decisions, actions, and stimuli.
In order for the building to influence behavior and alter people's perspective, the building must anticipate on the factors that affect attitude: *education*, *experience*, and *environment*.

Education is the purpose of the building which forms the program. The environment are the architectural implementations that forms the structure. The program and the building creates a new environment together which leads to a certain experience which essentially affects the perception.

In a linear way of thinking you could leave to experience to chance, by only focussing on translating the program into a physical object. However, in order to influence behavior, we must address perception. Perception is not innocent because it is never neutral. It continually compares new information with informaton acquired from previous situations. Our memory influences our judgements.

Only changing the physical environment cannot cause behavioral change. But only a specific program cannot achieve this either. Experience and perception are key factors in forming our attitude. Our attitude is essentially a crucial factor that affects our behavior.


A NEW INITIATIVE
HAS EMERGED
MEET
CirculariTea
CirculariTea is a fresh new circular startup that uses tea leaves and tea bags to create beautiful accessories and decorations.
We would like to kindly ask you to collect and deposit them from now on.

x. **The (intended) user group**

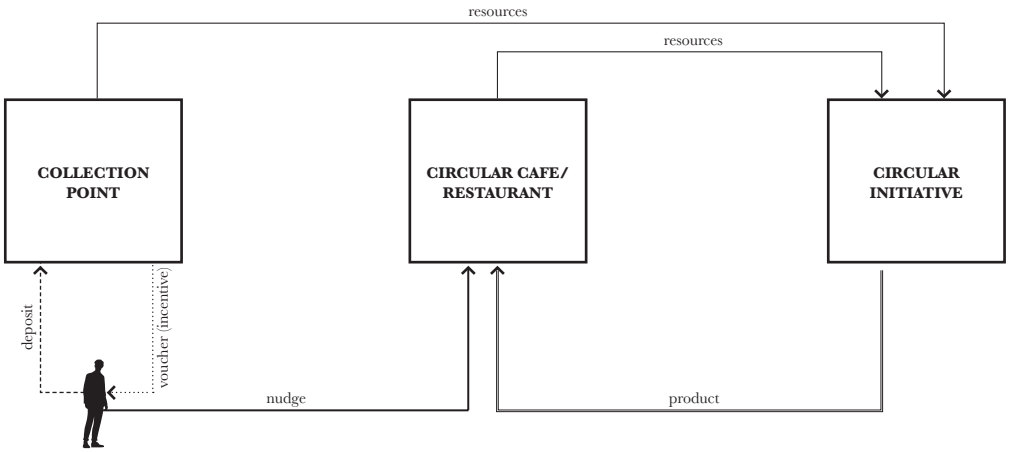
In order to be in line with the actual developments in Pompenburg, the project will also result in two towers housing apartments, workspaces and (short stay) hotelrooms. The project is about activating circular interaction between the programs and the surrounding, sharing materials, products and the premises with the actors, collecting and exchanging materials between initiatives, and preventing waste-production as much as possible.

The apartments will be equipped with an integrated collection bin in their kitchen and a 8-10 m2 vegetable garden on their terrace. The collection bins are to stimulate the separation of waste. They contain 8-12 hermetically sealed compartments. Integrating the collection bins is a nudge to make it easier for people to separate and collect waste. The residents will be notified through an online community application when a new initiative has emerged that collects a specific material. The residents can then collect specific materials and waste instead of separating and depositing everything.
The vegetable gardens are to stimulate local food production. The vegetable waste can be sent to the urban farming where a compost machine can turn it into compost. It can then return to the apartments, or other citizens in the area who have delivered resources. If supply is eventually more than the demand, the compost can be sold to local farmers.

Expectations and inclusiveness
There are many people who want to contribute to circularity but do not know exactly how, or how much impact their effort makes to the planet. Bringing these people together creates a community spirit whereby each individual feels that they are part of something bigger. This sense of unity is essential for the motives for participation.

Living in these apartments will naturally require acts from the residents that will contribute to the circular economy. However, it is also essential that the complex remains inclusive for everyone. People who are yet unfamiliar with circularity might not want to get involved with this building. They might feel alienated or unwelcome. Accepting them might gradually change their perception as their entire physical environment is focused on circularity. These are the people the House of Circularity wants to educate most in order to spread awareness and change their behavior in the long run.

In order to not only attract 'circular actors', 25% of the apartments are didicated to everyone. The remaining 75% is intended for people who want to contribute to the circular economy and be an active member of the community platform and the collection point.


resources
resources
COLLECTION POINT
CIRCULAR CAFE/ RESTAURANT
CIRCULAR INITIATIVE
deposit
voucher (incentive)
nudge
product

xi. **Incentives for mutual benefit**

Incentives encourage people to take specific actions. Deposit money we pay at the supermarket for bottled beverages for example. No one would bother bringing them back if we did not pay for it. Throwing them away is then much easier. In Germany and Scandinavian countries people also return cans. These are perhaps a bit self-evident examples that are embedded in our society for centuries. But they work well. That is evidence that the same principle can be applied to more materials. This naturally requires a well-founded system, but also requires support from regulations. If we want to retain valuable resources and reduce waste, we must encourage fundamental changes in our consumer behavior. This, however, is only possible if regulations support this and if financial compensations are developed for the consumer.

Local incentives in different forms can also be an effective tool to let people take certain actions. For circularity it can serve as a stimuli to actively participate.

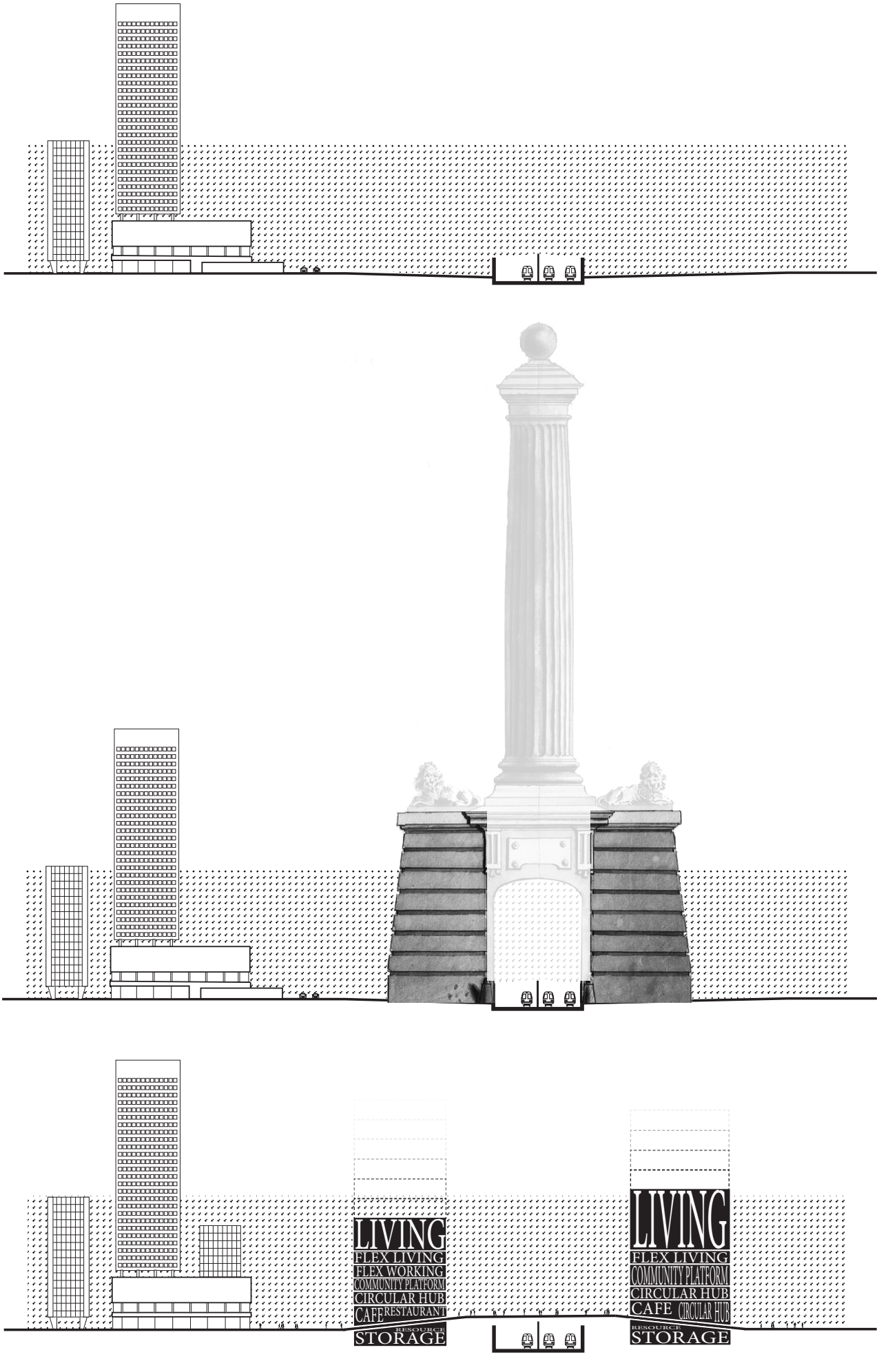
For example: all functions, apartments, offices, restaurant, etc. receive a registration number with a code that they can use to measure their circular contribution. A type of circular-model can be drawn up in which certain compensations are formulated, such as depositing 1 bag of plastic per month means that you have to pay €10,- less rent or energy costs. Or a stamp card can be introduced where people can collect for a free meal at the circular restaurant or a combi-deal at the circular cafe. This essentially enables resources to circulate longer inside the building.

See diagram: The person deposits the material he collected, he then receives a voucher for the restaurant or cafe. Meanwhile, the material he deposited has been stored or sent to the right initiative. The person goes to the restaurant or cafe and orders something that is served on a recycled product created by one of the initiatives. The waste created at the restaurant or cafe then goes to the right initiative again.

The incentive has created a circular-model that could benefit various parties. It enables materials to remain for a longer period in the loop and the amount of waste during the process can be significantly reduces.

5

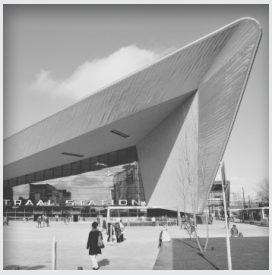
Pompenburg | An urban asset


LIVING
FLEX LIVING
FLEX WORKING
COMMUNITY PLATFORM
CIRCULAR HUB
CAFE
RESTAURANT
RESOURCE
STORAGE
LIVING
FLEX LIVING
COMMUNITY PLATFORM
CIRCULAR HUB
CAFE
CIRCULAR HUB
RESOURCE
STORAGE

i. **The new ‘Hofpoort’**

The Hofpoort has a significant importance for Pompenburg. It was one of the 10 city gates of Rotterdam. Hofplein got its name from this gate and the Shell tower is named after it. But both structures do not express the meaning and the function of the old city gate. Hofpoort was situated at the top angle of the Stadsdriehoek (city triangle). Park Pompenburg is almost at the exact location where the former city gate stood.

The building practically functions as a gate. It forms the connecting passage between the Central District and Rotterdam North. Therefore, the building could become the new ‘Hofpoort’ that marks this transition.



1. Rotterdam Central

2. Groothandelsgebouw

3. Schouwburg square

4. Boijmans van Beuningen

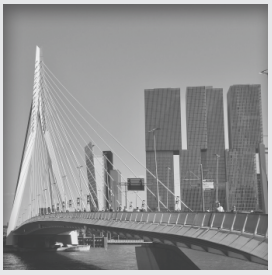
5. Het Nieuwe Instituut

6. Museumpark

7. Kunsthal

8. Euromast

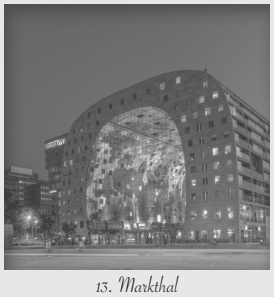
9. The Park



10. Erasmus bridge

11. The Rotterdam

12. Cube Houses



13. Markthal

14. Laurens church

15. Pompenburg

ii. **Becoming a destination**

Rotterdam has a number of sights and landmarks most national and international tourists like to visit. Usually starting from the Central Station, the next stop they visit is the Groothandelsgebouw. After visiting the famous Schouwburg square they head towards the 'Kunst-as' where they visit the museum Boijmans van Beuningen, Het Nieuwe Instituut, Museumpark and the Kunsthal. The next stop is usually the Euromast and the grand park. Along the quay they head towards the Erasmus bridge, admire The Rotterdam and head towards Rotterdam Blaak to see the Cube Houses and the Markthal. Before going back to the station, they walk past the Laurens church and head towards the Koopgoot and Lijnbaan.

In the future Pompenburg can become the next stop after the Laurens church to finish *The Cultural Circle*. Pompenburg will have its own landmark and a unique attraction that will draw visitors. The House of Circularity will become its most recognized object.


1. CENTRAL STATION
2. GROOTHANDELSGEBOUW
3. SCHOUWBURG SQUARE
4. MUSEUM BOIJMANS VAN BEUNINGEN
5. HET NIEUWE INSTITUUT
6. MUSEUMPARK
7. KUNSTHAL
8. EUROMAST
9. THE PARK
10. ERASMUS BRIDGE
11. THE ROTTERDAM
12. CUBE HOUSES
13. MARKTHAL
14. LAURENS CHURCH
15 POMPENBURG

6

Conclusion | The quest proceeds

i. **The challenge**

The design of the House of Circularity in Rotterdam, Pompenburg requires a new approach to circularity and hybrid architecture. In a world where resource depletion is at such speeds that our planet cannot regenerate itself, and where the climate crisis poses a threat to us and future generations, circularity must be prioritized at the top of the list of urgent issues. Circularity is a collective responsibility that should not solely depend on a small group of visionaries and activists. Everyone is equally responsible to preserve a livable planet for future generations.

Currently circularity is measured through individual performances or achievements. Usually using recycled materials or designing to make reuse possible. Ideally, the latter is much more effective, since recycling is a delayed process of downcycling. However, if we want to become circular as a city, we cannot let circularity limit by or depend on industrial developments. So far, research has shown that the climate goals are still unrealistic to achieve and that (almost) zero progress has been made in a whole year in the field of circularity.
However, circularity has gained more awareness in recent years. Rotterdam has developed itself as the frontrunner and stated its ambition to become a fully circular city by 2050. A bold statement, but Rotterdam has already proven its reputation as a courageous city.

ii. **The design**

The project focuses on the city of the future. It enables the designer to define a scenario and create a specific context for his project. The major cities in the Netherlands are coping with an exponential growth in population. By 2030, the population in Rotterdam will grow with 50.000 inhabitants. Unlimited expansion is impossible as most cities, especially in the Randstad, are bounded by surrounding cities. Hybrid buildings therefore pose a solution to densify and diversify the existing urban fabric. In terms of circularity, hybrids reveal unique possibilities. Sharing premises with others lead to less requirement for new space. Moreover, it leads to interaction between different actors and users which can foster new ideas and collaborations.

Within this project, circularity is considered as a necessary condition for future hybrids. As mentioned earlier, circularity is a collective responsibility. Which means that contributing to preserve resources and eliminate waste should happen on various scales. However, awareness is what is delaying or preventing circular developments. Many people are still unfamiliar with the Circular Economy or do not know in what ways they can contribute. The research pointed out that circularity has a certain polarity. This is defined as an attribute that is separated into hard and soft characteristics. Hard being measurable performances which are usually self-evident with circularity; reuse, reduce, recyle. Soft, however, are properties that have a long-term agenda; education, raising awareness, creating job opportunities, and sharing products.

Raising awareness is critical for circular organizations and companies. Currently Rotterdam count 60+ circular initiatives who are all equally relevant for the economy. But their input is contingent on or determined by the input of the people. This became a turning point that defined the meaning of the House of Circularity. In order for people to get actively involved in the circular economy, we must educate them, spread awareness, alter their perspective, and ultimately influence their behavior.
However, activating circularity depends on a number of aspects. Besides a change of behavior and attitude, the process of contribution should also be facilitated, i.e. people should be able to contribute easily without costing them too much time and effort.

Park Pompenburg is one of the underutilized areas in Rotterdam with a variety of opportunities and latent potential to become an node for circular interaction. The plateau brings various neighborhoods together and stimulates reciprocity in the surrounding. In the plinth, circular initiatives, startups, and the public share the same space. The open environment of the structure creates a cross-pollination

of knowledge and information, resulting in implicit spreading of awareness. The plinth is a shared space that oposes isolation by emphasizing continuity, openess, and accessibility. It also enables a cross-connection between the two districts to encourage the public to engage with the building. The House of Circularity is essentially bringing the public and the circular stakeholders together to interact and transfer knowledge.
The towers accommodate apartments, workspaces, and hotelrooms. The last two are separated from the apartments with an intermezzo layer. The intermezzo is a intermediate floor which houses a community platform, hydroponic farming, resource collection point, and storage displays for the materials. The intermezzo is a platform that brings residents and all other circular 'actors' together. It provides space to create a local marketplace where knowledge and materials are shared. The intermezzo is an interactive layer that is visible from the outside to demonstrate the circular activities inside the towers.
Arousing curiosity is critical to evoke certain functional effect. Nudging is a creative strategy to steer people in a desired direction without limiting other possible options. On the plateau different playful installations and art objects stimulate circular engagement. Specific paths and directions inside the plinths and on the plateau are highlighted with the color yellow which, according to psychological studies, arouse a meaning of happiness and competence. Moreover, it also creates a association with the Luchtsingel and its extension towards Rotterdam Blaak.

Ultimately, imagining a building with a specific program that aims to alter people's behavior and perspective on circularity is not necessarily a building of the future. It is a building of today.
The aim of the project was to propose a realistic strategy for a building with a specific program that makes circular activities visible to the public, teaches people about circularity and at the same time endeavors to influence their behavior to contribute to circularity. However, this quest proved that this might even move closer to a psychological approach than solely architectural. Understanding the way the cognitive capacity of the human mind functions may enable us to design environments that better anticipate on our behavior. Attitude appears to be a very decisive aspect for our behavior. Education, experience, and environment are the key factors that construct the attitude. The same three factors that distinguish successful architecture from poor architecture.

The city of the future, as imagined in this project, is a future where people are aware of circularity. A future where people feel equally responsible for our planet. A future where circular interaction and engagement is facilitated for the public. A future where buildings collect and send resources to the organizations that can use them. A future in which hybrid buildings symbolize circularity.

References |

Almeida, T. (2013, March 5). *Le Corbusier: How a utopic vision became pathological in practice.* Retrieved from: https://orangeticker.wordpress.com/2013/03/05/le-corbusier-how- a-utopic-vision-became-pathological-in-practic/

Alpert, D., (2010, April). *What is 'mixed use?*. Retrieved from: http://greatergreaterwashington.org/post/5478/what-is-mixed-use/>

BlueCity. (n.d.). *BlueCity: Surfing the new economy*. Retrieved from: http://www.bluecity.nl

BlueCity. (2019). *Bring Back Balance.* Retrieved from: https://www.bluecity.nl/bring-back-balance/

BNA. (2017). *Snelweg x stad – Highway x city.* Amsterdam: BNA Onderzoek.

BNA. (2018). *De stad van de toekomst: Stad maken in tijden van grote transities.* [Werkdocument]. Retrieved from: https://www.bna.nl/onderzoeks-project/stad-van-de-toekomst/ toekomst-2/

BNA Onderzoek. (2018, January 10). *De stad van de toekomst: Stad maken in tijden van grote transities.* Retrieved from: https://www.bna.nl/onderzoeks-project/stad-van-de-toekomst/

BNA. (2019). *"Hoge circulaire ambities vragen tijd en flexibiliteit"*. Retrieved from: https://www.bna.nl/bna-academie/alle-categorieen/klimaat-en-energie/circulair-ontwerpen-bouwen/hoge-circulaire-ambities-vragen-tijd-en-flexibiliteit/

Caso, O., & Cavallo, R. (2013). *Hybrid Buildings Celebrate the Collective Realm: Design Research at the TU Delft.* Retrieved from: https://www.researchgate.net/publication/320234579_ Hybrid_ Buildings_Celebrate_the_Collective_Realm_Design_Research_at_the_TU_ Delft

Cavallo, R., & Kuijper, J. (2018). *Design research on the city of the future.* Retrieved from: Surfdrive

Circle Economy. (2016, October). *Five ways the Circular Economy can help mitigate climate change*. Retrieved from: https://www.circle-economy.com/five-ways-the-circular-economy-can-help-mitigate-climate-change/#.XNnRgneiFZ2

Circle Economy. (2019). *The Circularity Gap Report*. Retrieved from: https://www.circularity-gap.world

Dantzig, G.B., & Saaty, T.L. (1973). *Compact City: Plan for a Liveable Urban Environment.* San Francisco: W. H. Freeman.

Didenko, L. (2016, March). *Nudging: onbewust gedrag bewust beïnvloeden.* Retrieved from: https://www.marketingfacts.nl/berichten/nudging-onbewust-gedrag-bewust-beinvloeden

Dif Connect. (2018). *Dif | blue economy is here | BlueCity.* [video file]. Retrieved from: https://www.youtube.com/watch?v=D8SjaOKUboM&list=WL&index=13&t=0s&frags=pl%2Cwn

Dura Vermeer, J.P. van Eesteren & Synchroon. (2018). *Pompenburg*. Unpublished document (Recieved from Synchroon).

Ellen MacArthur Foundation. (2017). *What is a circular economy? A framework for an economy that is restorative and regenerative by design.* Retrieved from: https://www.ellenmacarthurfoundation.org/circular-economy/concept

Fenton, J. (1985). *Hybrid Buildings, Pamphlet Architecture (no°11).* New York, San Francisco: Princeton Architectural Press.

Ferrandi, S.J. (2013, February 15). *A Brief History of Mixed-Use Developments.* Retrieved from: https://

www.cityofbowie.org/DocumentCenter/View/952/A-Brief-History-of-Mixed-Use-Developments---Stephen-Ferrandi-Presentation?bidId=

Floris, J., Komossa, S., Marzot, N., Cavallo, R., & Lengkeek, A. (2011). *Tekenboek Stadsgebouwen, Functiestapelingen, publieke binnenwerelden, in één blok.* Rotterdam: AIR, Centrum voor Architectuur.

Gehl, J., Kaefer, L.J., & Reigstad, S. (2016). *The City at Eye Level: Lessons for Street Plinths* (2nd extended version). Delft: Eburon Academic Publishers.

Gemeente Rotterdam. (2016). *Rotterdam Kaart van de Stad: Verkenning ontwikkelkansen lange termijn.* Retrieved from: https://www.rotterdam.nl/wonen-leven/

Hinton, A. (2015). *Understanding Context*. USA, Sebastopol: O'Reilly Media.

Holl, S. (2009). *Hybrid II (Hybrid series)*. Vitoria-Gasteiz: a+t architecture publishers.

Holl, S., Fernández Per, A., Mozas, J., & Arpa, J. (2011). *This is Hybrid: An analysis of mixed-use buildings.* Vitoria-Gasteiz: a+t architecture publishers.

Hutton, T.A. (2004). *The New Economy of the Inner City*. Cities, Volume 21(Issue 2).

Kahneman, D. (2011). *Thinking, Fast and Slow.* UK: Penguin Random House.

Kalundborg Symbiosis. (2019). *Kalundborg Symbiosis.* Retrieved from: http://www.symbiosis.dk/en/

Komossa, S., Marzot, N., & Cavallo, R. (2014, June 1). *Groundscrapers: Vitalizing the Tradition of the Urban Low Rise, Mixed Hybrid Building.* Delft: TU Delft.

Lynch, K. (1960). *The Image of The City*. USA: The MIT Press.

McMichael, A.J., Woodru , R.E. & Hales, S. (2006, March 17). *Climate change and human health: present and future risks.* Retrieved from: https://www.sciencedirect.com/science/article/ pii/S0140673606680793

Majekodunmi, D. (n.d.) *The Role of Architecture in Shaping Human Behaviour.* Retrieved from: http://eprints.covenantuniversity.edu.ng/10271/4/The%20Role%20of%20Architecture%20in%20Shaping%20Human%20Behaviour.pdf

Morose, R. (2007). *The Mind of Consciousness.* Australia: Ocean View Publications.

Nabielek, K. (2012, July 11). *The Compact City: Planning strategies, recent developments and future prospects in the Netherlands.* Ankara: AESOP 26th Annual Congress (PBL Netherlands Environmental Assessment Agency).

NOS. (2019, April). *Wonen boven het spoor moet stadsdrukte het hoofd bieden*. Retrieved from: https://nos.nl/artikel/2278884-wonen-boven-het-spoor-moet-stadsdrukte-het-hoofd-bieden.html

OECD iLibrary. (2016). *Megatrends affecting science, technology and innovation.* Retrieved from: https://www.oecd-ilibrary.org/sites/sti_in_outlook-2016-4-en/index.html?itemId=/content/component/sti_in_outlook-2016-4-en

Platform Wederopbouw Rotterdam (PWR). (n.d.). *Tijdlijn tot 1970.* Retrieved from: https://wederopbouwrotterdam.nl/tijdlijn

Porcelijn, B. (2017). *The Hidden Impact*. Amsterdam: Uitgeverij Q.

Ramkumar, S. (2016). *Making Sense of the Circular Economy: The 7 Key Elements.* Retrieved from: https://www.linkedin.com/pulse/making-sense-circular-economy-7-key-elements-shyaam-ramkumar?trk=portfolio_article-card_title

Rau, T., & Oberhuber, S. (2016). *Material Matters: Het alternatief voor onze roofbouwmaatschappij.* Haarlem: Bertram + de Leeuw Uitgevers.

Rotterdam Circulair. (2019). *Over Rotterdam Circulair.* Retrieved from: https://rotterdamcirculair.nl/over-ons/

Rotterdam Circulair. (2019). *Programma Rotterdam Circulair 2019 - 2023*. Retrieved from: https://rotterdamcirculair.nl

Surbhi, S. (2016, July). *Difference Between Attitude and Behavior.* Retrieved from: https://keydifferences.com/difference-between-attitude-and-behavior.html

Tilman, H. (2018, September). *Blog – Nudging voor architectuur.* Retrieved from: https://www.dearchitect.nl/architectuur/blog/2018/09/nudging-voor-architectuur-101199407?vakmedianet-approve-cookies=1&_ga=2.41802914.1852690836.1553176349-1984680631.1553176349

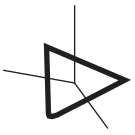
Thaler, R., & Sunstein, C. (2008). *Nudge*. USA: Yale University Press.

UNFCCC - United Nations Framework Convention on Climate Change. (2015, December 12). *Paris Agreement*. Retrieved from: https://unfccc.int/process-and-meetings/the- paris-agreement/the-paris-agreement

Van Duin, L., & Van Wegen, H. (1999). *Hybrides: Stedelijke architectuur tussen centrum en periferie*. Delft: Delft University Press.

Van Mastrigt, T. (2017, April). *Acht keer over het spoor: Het Maankwartier*. Retrieved from: http://www.heerlenvertelt.nl/2017/04/acht-keer-over-het-spoor-het-maankwartier/

Von Meiss, P. (1998). *Elements of Architecture: From form to place*. New York, NY: E & FN Spon.
World Economic Forum. (2017). *5 things we can learn from the world's greenest business district.* Retrieved from: https://www.weforum.org/agenda/2018/10/paris-world-greenest-business-district-deux-rives-circular-economy/



POMPENBURG

Fikri Yalvaç

xDomain | City of the Future