An exploration of circular operational processes in the context of coworking spaces in the Netherlands in 2020

Bachelor Thesis / Graduation Project

Qendresa Rexhepi

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Abbreviations

CE - Circular Economy
CWS- Coworking spaces
EMF- Ellen MacArthur Foundation
DGBC- Dutch Green Building Council
OP- Operational processes

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Executive Summary

Given that the Netherlands has established a program aiming for a circular economy (CE) by 2050, organizations need to inevitably change the way they operate. As the coworking industry is substantially growing, it presents the ability to make a significant contribution to realizing these circular visions. A closer look at literature, however, reveals a knowledge gap on what circularity means for specific industries, such as co-working spaces. Therefore, the research paper examines circular operational processes (OP) in coworking spaces (CWS) and offices among the areas of physical resource flow (Energy, Material, Water), social capital (Human Society and Culture, Health and Wellbeing) and natural capital (Biodiversity).

The findings of the research close the knowledge gap by outlining practices realized within these three-impact areas. Ultimately creating an overview of the circular OP that intend to help linear CWS in altering their OP in a circular manner.

1. Introduction

The world's population is growing and with it inevitably the need for natural resources. (Lacy, P., & Rutqvist, J., 2015) As a consequence, the earth's climate is changing, and impacts are being felt among many sectors that are vital to society. This will intensify in the future if no further action is taken. Sectors such as human health, agriculture, food security, water supply, transportation, energy, and ecosystems are expected to become progressively disordered in the coming decades. (Amnesty International, 2020) These impacts are due to the increasingly impractical use of the linear business model which is characterized by the ''take-make-waste' approach, prioritizing profits at the expense of the planet. Given that this model is reaching its physical limits and is not feasible for the future, the term of CE has gained a great deal of popularity among both businesses and the government.

The Ellen MacArthur Foundation (EMF) (2013), a global thought leader on CE, defines CE as a model that is restorative and regenerative by design. The CE aims to keep products, materials, and components in circulation by finding new purposes or preserving their value. In order to realize circular practices, Kerkhof et al. (2017) emphasize the importance of changing the way organizations operate and therefore is heavily reliant on operation management. Following these guidelines, the Dutch government has established a wide program that aims to realize a CE in the Netherlands by 2050. Among several goals, it accentuates the realization of the CE within the construction industry, including the design, operation, and management of a building, coordinated with respect to circular principles. (A Circular Economy in the Netherlands by 2050, 2016)

Within these settings, the coworking industry presents an opportunity for the implementation of circular principles. According to the 'Global Coworking Growth's study (2019), the number of Coworking spaces worldwide is presumed to soon cross 20,000 and reach 25,968 by 2022. Therefore, it not only represents a business that continues to grow at a strong pace but also a concept that in itself features sustainable components of an urban ecosystem.

While many models such as the 'ReSOLVE' framework developed by the EMF (2015) outline circular business opportunities, little attention has been devoted to the end state of circularity. (E. Gladek, 2017) The framework 'The seven pillars of CE' designed by Metabolic, a sustainability consulting agency, in contrast, aims to illustrate the outcome once circularity has been achieved. The most significant limitation, however, is seen in the lack of actionable advice, which is applicable to a specific industry, such as the coworking industry. The connection between circular OP and CWS remains mostly unexplored. Therefore, this research aims to close this knowledge gap by examining OP within circular coworking spaces and outlines practices realized within the seven pillars. Ultimately, creating an

overview of circular operational practices that intend to help linear CWS in altering their OP in a circular manner.

Insights drawn from the research will support the consulting practices of Evert-Jan Velzing,

the client cooperating on this thesis. He aims to assist the Werkspoorkwatier, an emerging hub in Utrecht, in what actions need to be taken to operate in a circular manner.

This research is of relevance as according to the client, 'Many analyses on the CE are still rather abstract and there is a lack of understanding of what circularity would mean for specific industries. (Velzing,2019).

2. Current Knowledge

According to the World Business Council for Sustainable Development Thelen et al. (2018), the transition to a CE requires innovation in the way organizations operate. In order to realize circular innovations, Kerkhof et al. (2017) illustrate that organizations are heavily reliant on operation management and therefore ask for priority as it presents the foundation of any institution, such as CWS. Although several CE principles are currently being realized (Geng and Doberstein, 2008), more actionable advice is needed among different layers of implementation.

(McDowall et al., 2017).

2.1. Definition of Operational Processes

In order to accomplish circularity among these layers, a deeper understanding of the holistic processes within a CWS is needed. According to the Cambridge dictionary, a process displays 'a series of actions that you take to achieve a result'. The underlying concept of operational processes is therefore defined as 'the essential process of how the device works.' (Vincenti, 1990) Ultimately leading to the need of looking at a building as a whole.

2.2. Definition of Circular Buildings

The Dutch Green Building Council (DGBC) (2018) provides the following definition for circular buildings: *"A circular building is one that is developed, used and reused without unnecessary resource depletion, environmental pollution, and ecosystem degradation. It is constructed in an economically responsible way and contributes to the wellbeing of people and other inhabitants of this earth. […] Technical elements are demountable and reusable, and biological elements can also be brought back into the biological cycle."(Kubbinga et al., 2018)* The definition adheres to the vision of 'A Circular Economy in the Netherlands by 2050' agenda that asks for the use of renewable material, the optimal use of materials through recycling, reduction in CO2 emission and, innovation tailored to changes in society and private sectors.

In line with these ambitions, thought leaders of the CE have jointly examined circular strategies in 'A framework for circular buildings.' While the paper builds on existing knowledge and demonstrates impact areas for a sustainable world, Metabolic's 'Seven pillars of the CE' approach, offers an actionable and practical framework that forms the foundation of this research (Kubbinga et al., 2018). It further accommodates one with an explicit set of objectives, presenting the end state of circularity. Which makes the framework especially helpful when examining the coworking spaces, as it allows one to look critically at each category and see if the objective is achieved. By only stating the end goal, it leaves room for interpretation, therefore, establishing different performance characteristics shaping a diverse set of roadmaps. The framework pays equal attention to seven areas, which have been clustered by the researcher as follows: Firstly, physical resource flow, which accounts for material, energy, and water usage. Secondly social capital presented through the preservation of health and wellbeing and the human culture and society. Followed by natural capital (Biodiversity) and lastly, value beyond financial. Although according to Korhonen et al. (2018) the seventh pillar 'value beyond financial' presents new business, market and employment opportunities it will not be taken into account as a separate dimension. This is due to the fact that it emerges as a result of each aforementioned impact area.

Figure 1 The performance characteristics of a circular economy

2.3. The 7 pillars of the Circular Economy

'Materials are cycled at a continuous high value.'

A number of authors have recognized that materials can be distinguished in two different cycles, namely the biological and technical cycle. (Ellen MacArthur Foundation (EMF),2015) Biological materials refer to the use of materials that don't harm the environment. The lifecycle can be extended through cascading (Hoekstra et al.,2015). The technical cycles instead focus on reuse through recycling, refurbishment, and maintenance principles. (Hoekstra et al.,2015)

'All energy is based on renewable energy.'

This can be achieved by focusing on two major aspects: energy production and energy usage. (Korhonen et al., 2004) Energy production is illustrated by the procedure of shifting from carbon-based energy to renewable energy. Energy usage instead is driven by the reduction of general energy consumption by providing energy-efficient technologies. (Korhonen et al., 2004) The Paris agreement reinforces the approach by asking for a mix of renewable energy and energy efficiency. (United Nations,2015)

'Water is managed in a 100% circular fashion.'

According to EMF, water can be distinguished into two water cycles, the nature managed and the human-managed system. The opportunity of the circular economy in respect of water is to better align to these two cycles (Arup et al. 2018). Therefore, the strategies of recycling within internal operations as well as reducing main water consumption are addressed. (Ellen MacArthur Foundation,2015)

'Biodiversity is structurally supported and enhanced.'

Research has outlined the importance of keeping resources at their highest value by cascading biomaterials, always with the goal to preserve natural capital. (European Environment Agency, 2018) More specific research has investigated that biodiversity can be enhanced by encouraging sustainable land use, habitat protection, and creation. (Kubbinga et al., 2018)

'The health and wellbeing of humans and other species are structurally supported.'

This is achieved by prioritizing nontoxic material and placing economic activities that don't harm humans. (Metabolic, 2017) Furthermore, good air quality and thermal comfort is stimulated, while ensuring pleasant lighting, acoustics, and thermal comfort. (Kubbinga et al., 2018)

'Human society and culture are preserved.'

The pillar aims to capture and maintain the diverse culture of an organization through activities and events. Furthermore, it enables cooperation through public and shared spaces. (Metabolic, 2017)

Although the framework attempts to crystalize clear indicators for the physical resource flow, it lacks on indicators for the social and natural capital. Ultimately, representing a knowledge gap with the potential for further research based on the example of coworking spaces.

Based on the framework the following research question emerged:

RQ: How can coworking spaces in the Netherlands contribute to a circular economy through changes in their operation processes in 2020?

SQ1: What practices emerge from the physical resource flow that is associated with material, water, and energy at a circular coworking space in the Netherlands in 2020?

SQ2: What operational practices are effectively supporting social and natural capital in circular coworking space in the Netherlands in 2020?

3. Research Procedure

3.1 Research Design

For the scope of the research, a qualitative exploratory research study has been carried out. This included data collection on the basis of semi-structured surveys and interaction with participants through expert- and epistolary interviews. The qualitative approach according to Kumar is used to holistically describe a phenomenon where yet little is known. (Kumar, 2014) The objective of the study, how coworking spaces can alter their operational processes and translate their circular economy aspiration into actions is yet still unexplored and therefore suitable for the qualitative approach.
For this research, the mixed methods approach has been applied, namely expert interviews, epistolary, and semi-structured surveys.

3.1.1. Expert Interview

Expert Sampling

Expert interviews with a semi-structured approach have been conducted with a predetermined number of experts among occupations such as operational manager, architect, and sustainable development manager providing in-depth knowledge from several angles. The selected interviewees were not only considerably knowledgeable but also hands-on professionals in implementing circular practices. Therefore, expert sampling is used to draw assessments in the field and help to understand the topic circularity in practice. As some of the interviewee wished to remain anonymous, interviewees are cited with I1-I6. According to Bryman, literature review and expert interviews are repetitive by nature.

(Bryman, 2012) Through the snowball effect, interviews served as a means to be connected to other contacts and sources. Within these diverse settings, a holistic understanding of circularity in the built environment is gained.

3.1.2. Epistolary Interview

Expert Sampling

Given the circumstances of COVID, significant limitations became apparent. Therefore, the method of epistolary interviews is utilized. It allows for a knowledge exchange mediated by technology. (Debenham, 2001) However, even though it proofed to be limited in terms of quantity of insights, the answers given were more considerable and precise.

Methodology	Expert Interview, Epistolary Interview		
Experts	Occupation	Chosen because:	Referred in the paper as:
	Architect with a focus on circularity	Gives perspective on how circularity is achieved in a building	I1
	Sustainable development manager	It outlines the performance criteria to reach circularity	I2
	Operational Manager	It maps out operational processes within a circular operating institution	I3
	Founder and Parametric Designer	It presents design strategies to realize circular principles	I4
	Founder	Can give insights on how operations have been altered from linear to circular	I5

Table 1 Expert selection

3.1.3. Survey

Judgmental Sampling

To gain a deeper understanding, how circular practices are currently being implemented in coworking spaces and the specific operational processes, a survey was designed. A survey is particular helpful for gathering data and determining the diversity of the given topic. (Groves et. Al., 2004, p.4) The insights gained from the expert interviews shaped the framework of the survey and categorized five impact areas: Water, Energy, Material, Natural Capital (Biodiversity), Social Capital (Health & Wellbeing, Human Society and Culture) The selection of participants is based on a set of criteria that will allow for

cross case comparability and transparency. Given the fact that coworking spaces where struggling in the COVID crisis the scope of the research has been enlarged to buildings that function as offices. The following participants have been selected based on the criteria:

Location: All participants are located in the Netherland, to adhere to clients need and ensure same legislation.

Status: All participants have realized circular principles in their operations.

Building function: Among the participants the building should function as either an office, a coworking space or a meeting & event space. Furthermore, as the client aims to assist the Werksporkwartier, an emerging business hub, Park 20/20 representing a business park will be incorporated as well.

Building function	Office	Coworking / Meeting & Event space	Coworking space	Business park	Office	Hotel (Including event & meeting space)
Referred in the paper as:	R1	R2	R3	R4	R5	R6

Table 2 Survey respondent selection

3.2. Analysis

Interviews have been transcribed and analyzed with Atlas.ti. Specific codes help to systemically structure the data and create an overview of interviewees perspectives and recommendations. (See appx. 7.2.3).

4. Results

4.1. Physical Resource Flow

4.1.1. Energy

Survey participants have proven that realizing circularity in the sector of energy includes two methods. Firstly, the use or generation of renewable energy and secondly the reduction of general energy consumption, hence energy efficiency. (See table 3.) Generating renewable energy is accomplished largely through the use of solar energy in the form of solar thermal or photovoltaic panels placed either on the rooftop, the façade or parking structure. Furthermore, if not self-generated, energy is locally sourced from Dutch wind energy.

In order to reduce general energy consumption, special heating and cooling system are set in place. For instance, through thermal energy produced by geothermal energy and solar water heaters.

Lastly, energy has been reused, by recovering the heat from the parking garage, and utilized for heating.

Third parties implementing circular solution can be found in appx. 7.5.2.

Renewable Energy	Photovoltaic cells	R1, R4
	Solar Panels	R3, R5
	Locally sourced Dutch wind energy	R6
Reduction of Energy consumption	Optimized Design of the Building	R5, R4
	Heating & Cooling System (Fasolar façade, Geothermal heat exchanger, On-site heat & cold thermal storage)	R2, R5, R4
	Energy saving office equipment	R3

Table 3 Methods to realize circularity in the sector of energy

4.1.2. Water

Survey respondents have widely implemented the predetermined strategies of recycling internal water operation and the reduction of main water consumption. The first was realized by enabling self-closing water supply for sanitary. There, water is collected in a biological system. Special filters such as the horizontally or the vertical flowed helophyte filter are installed to recycle the water by purifying and extracting nutrients from grey water. The recycled grey water is ultimately used to flush toilets. Furthermore, rainwater harvesting systems, mostly located on the roof, enabled a separate sewer system that is used to water the plants and simultaneously flush the toilets. By the use of these two practices, the water streams of grey and rainwater have been recycled. General water consumption is reduced, by

adapting the offering of drinking quality water by the amount that is needed. Despite that, special sanitary equipment such as low flow taps and sensors were installed that will stop the flow when it is no longer needed. Third parties implementing circular solution can be found in appx 7.5.2.

4.1.3. Material

Experts outline four fundamental aspects that need to be taken into account when realizing circularity with materials.

1. Design for disassembly	'The building needs to be prepared for easy disassembly in the future so future reuse is facilitated.'(I1,2020) Furthermore the design for modularity is proposed so modules can be easily upgraded or extended. (I5, 2020) While design plays an important role, I5 emphasizes on knowledge sharing through the implementation of a material passport, including information from a material level to the entire construction system.
2. Reducing the use of new materials	'It is suggested to use materials in new development that are already in the loop. For example, by reusing the structure of the building and only add new facades and finishing. Or by assembling new buildings with materials that are harvested from other buildings or structures.' (R1, 2020) Therefore, byproducts from surrounding processes and their associated value chains are used as raw materials.
3. Maximize of renewable materials through biological and technical material loops	Biological material loops haven been achieved through the use of composite or waste wood, resilient flooring and zero voc paint. Technical material loops were achieved through maintaining existing building structures and recycle materials such as jeans and company clothing, for insulation purpose. Bricks and buildings block from construction waste and fishing nets as modular carpets. While keeping the main focus on C2C certified materials. While both approaches are perceived as favorable, R1 and R5 (2020) believe the use of biological material is most promising. As recycling materials if often more energy efficient than the production of materials based on natural resources.
4. Pay-per-use systems	Lastly, R2, R3 and R4 (2020 have maximized material sharing by establishing pay-per-use systems, through leasing of office furniture, lightning, office carpet floor, coffee machine, Solar panel.

Table 4 Methods to support circularity in material use

Third parties implementing circular solution can be found in appx. 7.5.2.

4.2. Social Capital

4.2.1. Human society and culture

As noted in the previous section, clear indicators for social and natural capital are missing. To fill this knowledge gap, I2 (2020) argues that a building needs to adopt its design to enable and stimulate human diversity and complexity. Therefore, the construction should allow for functional shared space and encourage promotion and transparency of the institutions culture. R2 and R4 (2020) translate their vison of circularity through activities and events. Among these activities guided tours to showcase circular practices as well as circular think tanks were most prominent. Further to workshops that motivate practical behaviour change. I1 (2020) reinforces the promotion of circularity through events and workshops as: 'It is an important part of successfully maintaining what has been set in place. But also boost the community and encourage other companies to adopt similar practices.' Followed by I2 (2020) 'Their way of perceiving and therefore reacting on it will ultimately close the picture of circularity.

4.2.2. Health and Wellbeing

All respondents address the aspect of health and wellbeing through good air quality rates, and thermal comfort which often resulted from implementing greenery (See Table 5.). I2 (2020) stresses that these aspects are often not taken very seriously even though they result in lowering medical costs and reduction in sick days.

Air rate	Green Façade and a moisture management have been implemented to enhance air rates	R1, R2, R4, R5
	Indoor Plants	R1, R2, R3, R4, R5, R6
	Greenhouse purifies outdoor air before it enters the building.	R1, R2
Thermal Comfort	On-site heat & cold thermal storage	R6, R1
	Solar Chimney that will heat up by the sun and allows for natural air flow.	R1

Table 5 Methods to ensure Health & Wellbeing

4.3. Natural Capital

4.3.1. Biodiversity

Sustainable land use was encouraged by vertical gardening, green roofs and indoor plants and green walls (See Table 6.) Furthermore, all respondents have implemented helophyte filter providing living

space for flora and fauna. Ultimately attracting a diversity of insects and water birds. It is noted that the incorporation of greenery, not only enabled shared and functional space but also resulted in better air quality and thermal comfort and should therefore be prioritized.

Vertical gardening	R1, R2, R4, R5
Green roofs	R1, R2, R6
Indoor plants	R1, R2, R3, R4, R4, R5, R6
Green Walls	R1, R2, R3, R4, R4, R5, R6
Helophyte Filter	R1, R2, R3, R4, R4, R5, R6

Table 6 Overview of implementation to support natural capital

4.4. Transition towards circularity

I1 (2020) states: 'It is fair to say that I know of no building so far that achieves that goal. The market for reused materials is still embryonic. The wear and tear that comes with the long usage of materials in buildings makes reuse difficult. Developments in building laws and technical innovations make old buildings materials obsolete and unattractive.' In the light of the argument, I6 (2020) suggest 'that a transition is best achieved through a number of projects and activities that are used as a pedestal towards the end goal of circularity.' However, it remains difficult to find circular third parties for collaboration. 'You don't always start out with circular operating ambitions. If you want to transition it would be helpful to have an overview who to reach out to and where to start.' (I3)

5. Conclusion

The research reveals that the transition towards circularity is a step by-step process and does not have to realize circular principles in every impact area all at once. Instead, focusing on selected key areas that will pave the way to the end goal of circularity is recommended. (RQ)

By exploring practices at circular co working spaces and offices, this paper was able to outline strategies among the impact areas of physical resource flow. (SQ1) Lastly, the research closes the knowledge gap of clear indicator for social and natural capital in the context of CWS.

Social capital can be preserved by enabling shared and functional space and translating the circular vision into activities and events. Natural capital can be persevered by implementing helophyte filter and incorporating greenery among green roofs, walls and indoor plants. (SQ2) The prioritization of natural capital is recommended as it presents a relatively easy implementation with benefits among all areas.

Lastly, conducted interviews have recognized the complexity of transitioning towards circularity due to a lack of knowledge about circular suppliers and installers. A key theme is that third parties that implement circular principles are not collected and outline at one place. If a transition is intended, linear operating co working spaces don't know where to start and whom to reach out to.
In the light of these arguments, the gathered insights have been translated into a mock-up website aiming to establish an overview of practices, while enabling collaborations to third parties.

5.1. Mid-term strategies

While a mock-up provides a medium-fidelity representation, the mid-term strategy is to develop the functioning website. Taking into account that the CE is growing substantially in terms of technologies and circular suppliers, the website needs to be continuously updated.

5.2. Long-term strategies

In respect of future expansion, the website can be designed to offer a more tailored approach adhering to an organization need. Therefore, not only offering access to an overview of third parties implementing circular solution, but also a greater collaboration among customer-made network and an exchange of knowledge. Envisioned scenario would look as following:
Coworking space x indicates the areas they want to alter, in order to support circular principles, for example the impact area energy. The matchmaking platform will then access and make a precise evaluation lastly offering third parties matches that satisfy the CWS needs. The platform can be utilised to facilitate consulting practices of the client Evert-Jan Velzing while additionally offering promotional and networking space to possible stakeholders.

The mock-up website can be found here:
https://appelmalou.wixsite.com/circulartransitions/circular-matchmaking

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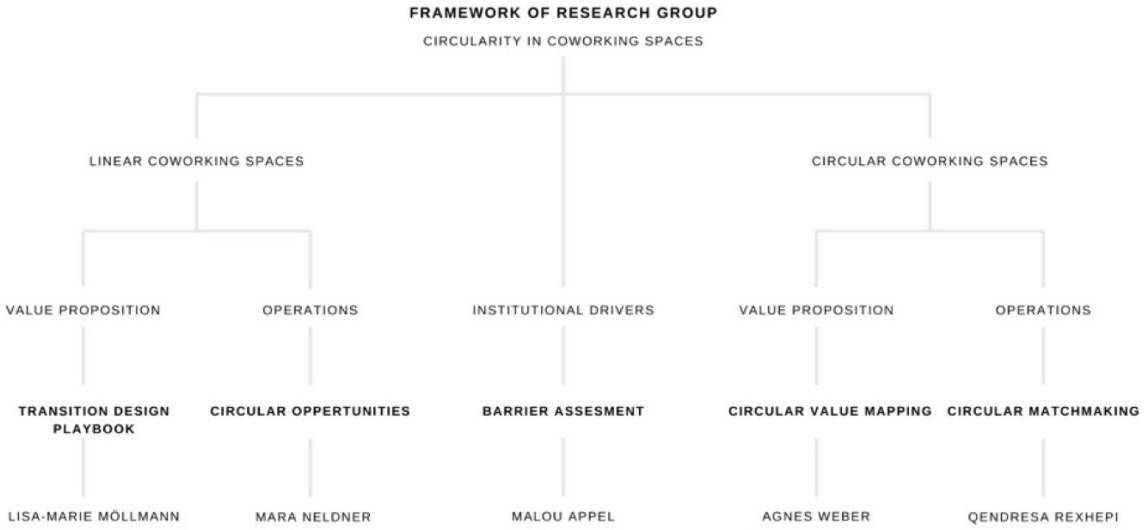
7. Appendix

As discussed with the client, part of the appendix is in a separate google docs.
Here you will find access to the over whole folder:
https://drive.google.com/drive/u/0/folders/1kN6-kHfuYHbPIzDgwK608blvjOOcXJHL

7.1. Group Framework

The framework was utilized by the research group that resulted in five modular protypes. The joint use resulted in a circular transition toolkit for coworking spaces that can be found here:
https://appelmalou.wixsite.com/circulartransitions



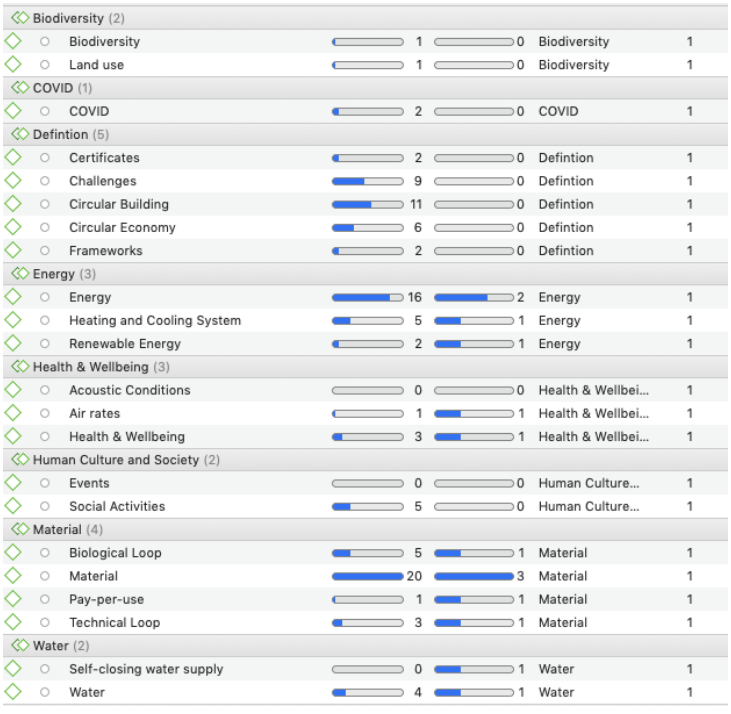
FIVE MODULAR PROTOTYPES COMBINED INTO A CIRCULAR TRANSITION TOOLKIT FOR COWORKING SPACES

7.2. Atlas Visualization

7.2.1. Atlas Code First Version

COVID (1)				
COVID	2	0	COVID	
Defintion (3)				
Circular Building	11	0	Defintion	
Circular Economy	6	0	Defintion	
Frameworks	2	0	Defintion	
Operational Processes (6)				
Energy	16	2	Operational Pro...	
Health & Wellbeing	3	1	Operational Pro...	
Management	6	1	Operational Pro...	
Material	20	3	Operational Pro...	
Social Activities	5	0	Operational Pro...	
Water	4	1	Operational Pro...	
No code group				
Acoustic Conditions	0	0		
Air rates	1	1		
Biological Loop	5	1		
Certificates	2	0		
Challenges	9	0		
Control of the Building	0	0		
Heating and Cooling System	5	1		
Operation & Maintainance manuals	0	0		
Operation Manuals	0	1		
Pay-per-use	1	1		
Renewable Energy	2	1		
Self-closing water supply	0	1		
Technical Loop	3	1		
Transportation	0	0		
Waste	0	0		

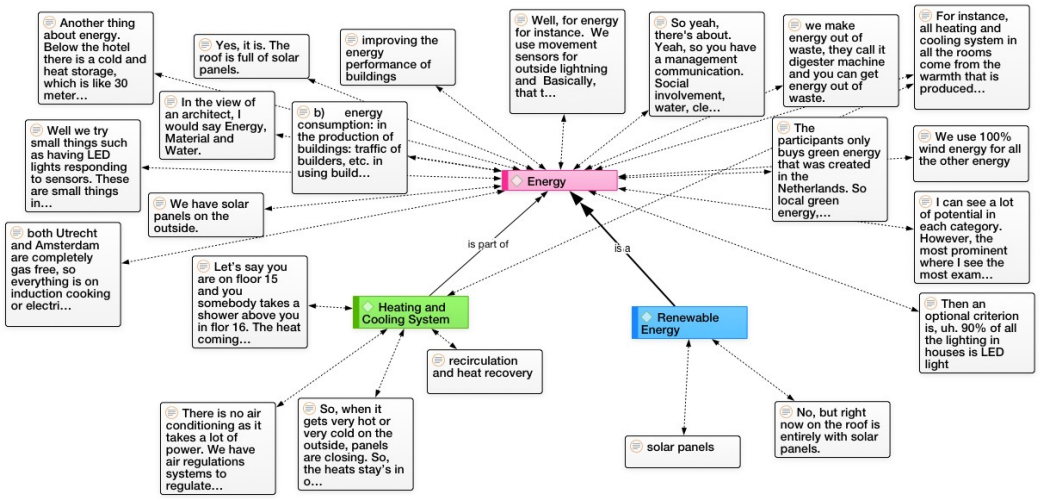
7.2.2. Second Version 2



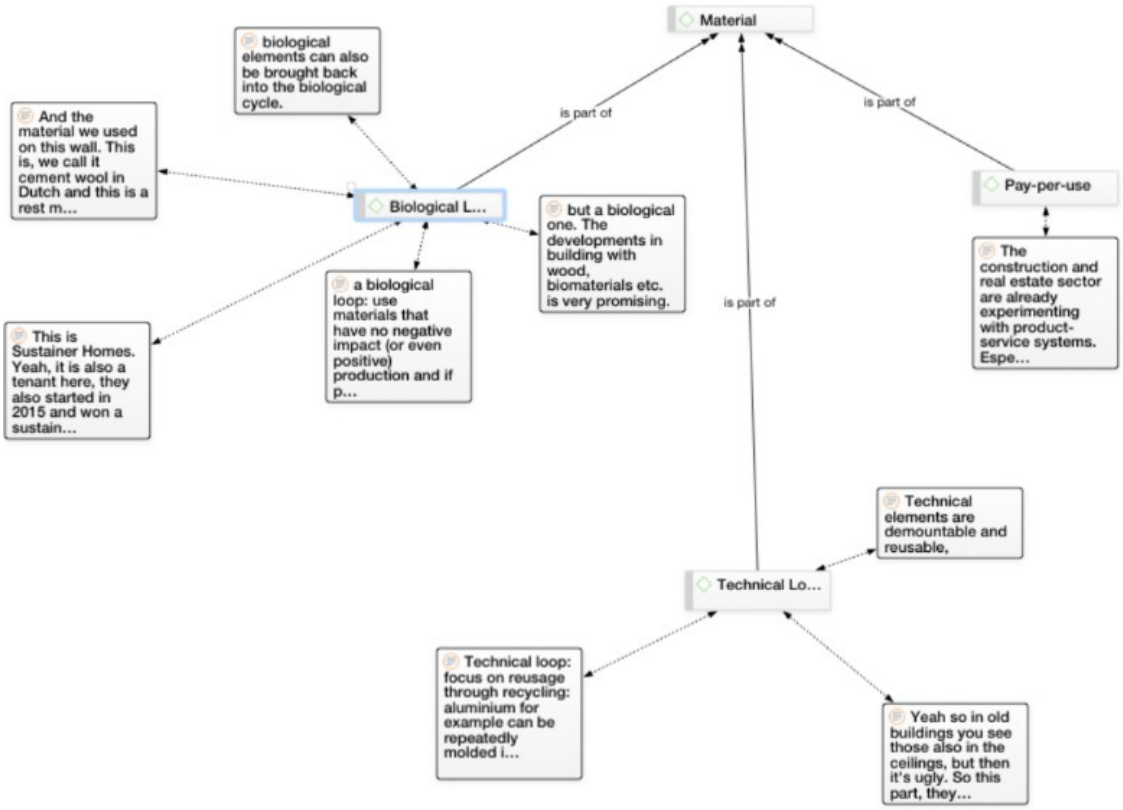
Biodiversity (2)				
Biodiversity	1	0	Biodiversity	1
Land use	1	0	Biodiversity	1
COVID (1)				
COVID	2	0	COVID	1
Defintion (5)				
Certificates	2	0	Defintion	1
Challenges	9	0	Defintion	1
Circular Building	11	0	Defintion	1
Circular Economy	6	0	Defintion	1
Frameworks	2	0	Defintion	1
Energy (3)				
Energy	16	2	Energy	1
Heating and Cooling System	5	1	Energy	1
Renewable Energy	2	1	Energy	1
Health & Wellbeing (3)				
Acoustic Conditions	0	0	Health & Wellbei...	1
Air rates	1	1	Health & Wellbei...	1
Health & Wellbeing	3	1	Health & Wellbei...	1
Human Culture and Society (2)				
Events	0	0	Human Culture...	1
Social Activities	5	0	Human Culture...	1
Material (4)				
Biological Loop	5	1	Material	1
Material	20	3	Material	1
Pay-per-use	1	1	Material	1
Technical Loop	3	1	Material	1
Water (2)				
Self-closing water supply	0	1	Water	1
Water	4	1	Water	1

7.2.3. Atlas Network based on Interviews

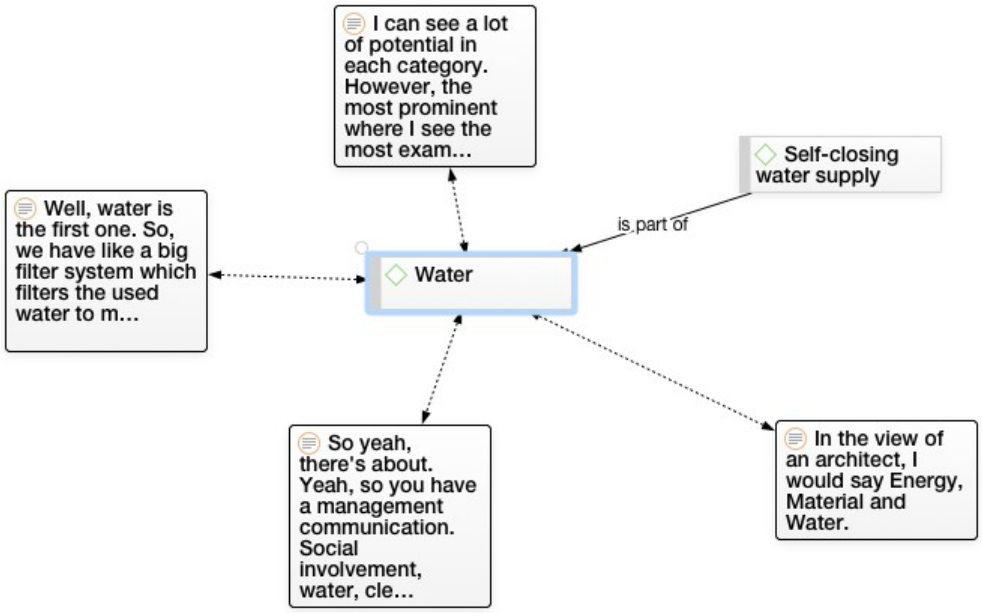
Impact Area: Energy



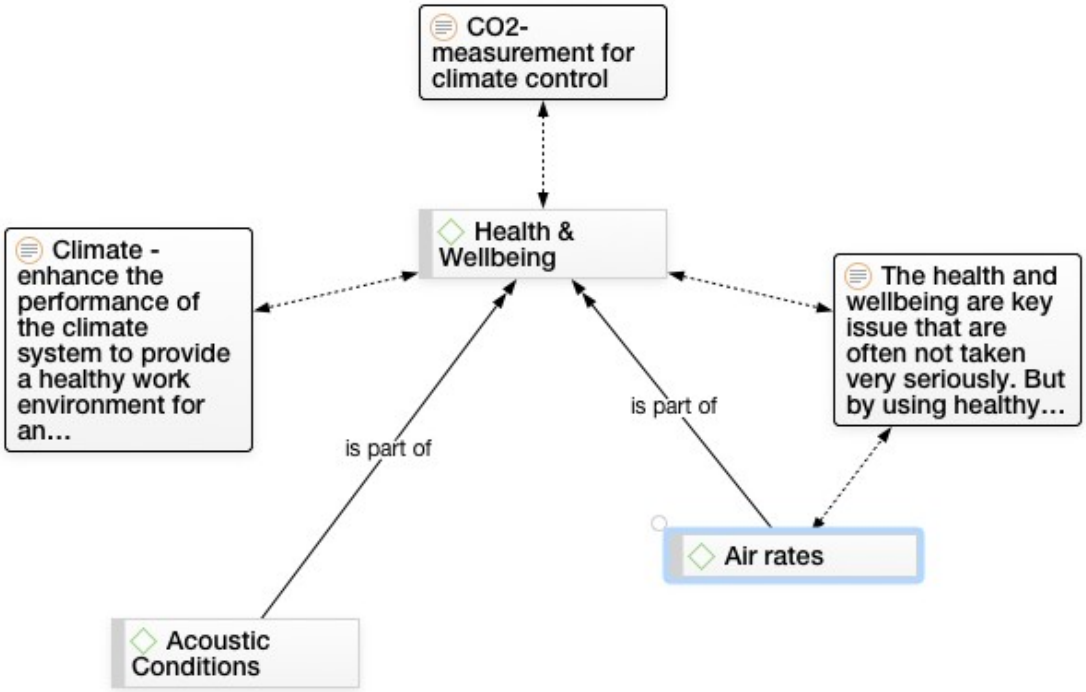
Impact Area: Material



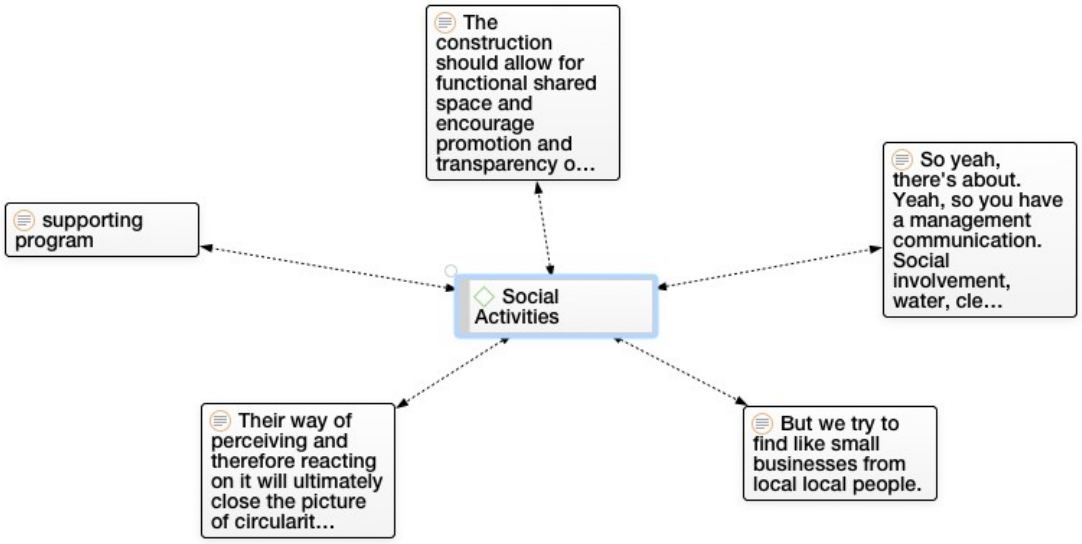
Impact Area: Water



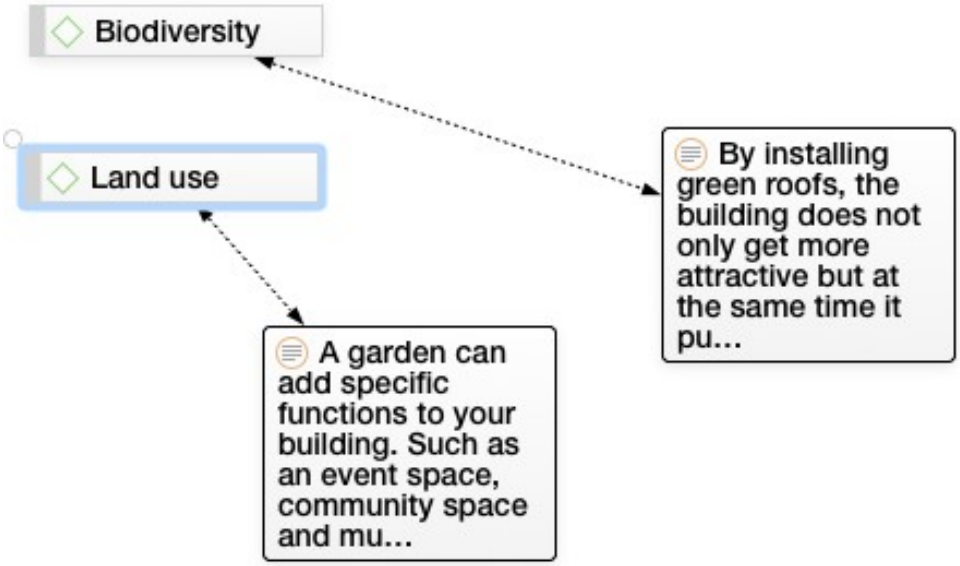
Impact Area: Health & Wellbeing



Impact Area: Human Culture and Society

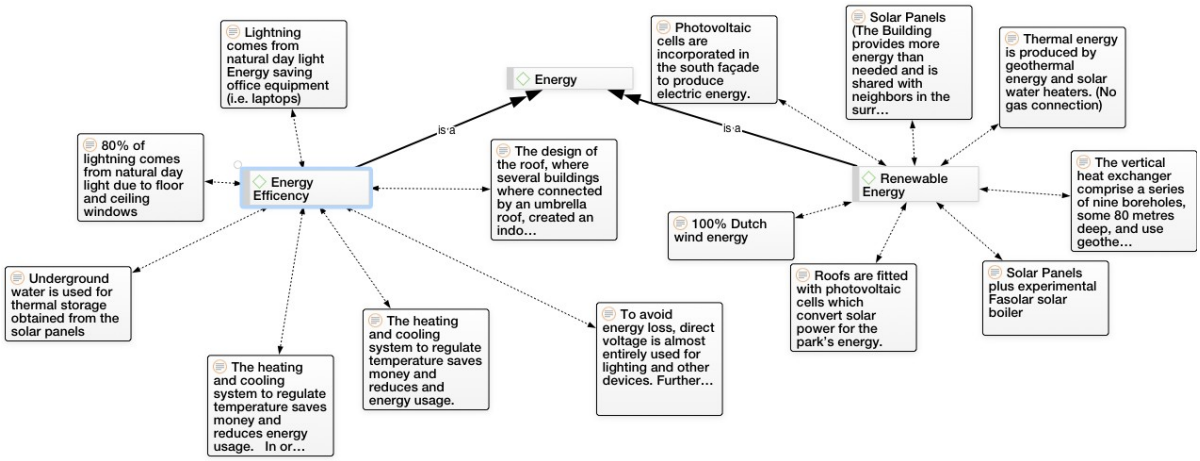


Impact Area: Biodiversity

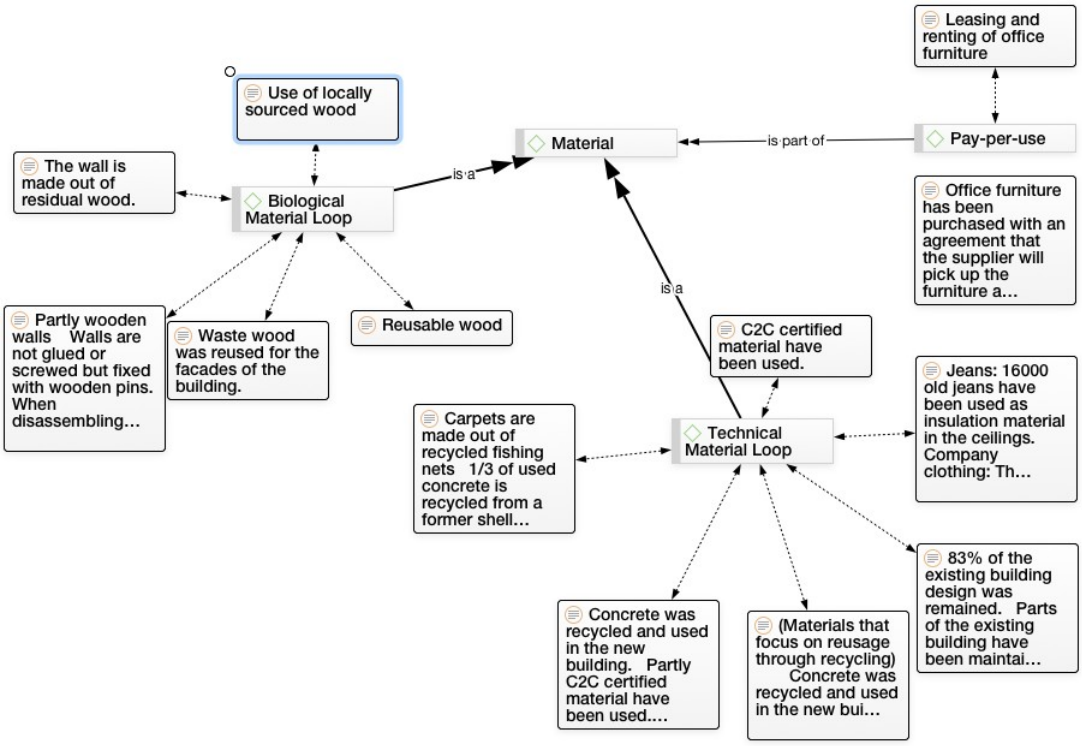


7.2.4. Atlas Network based on Survey

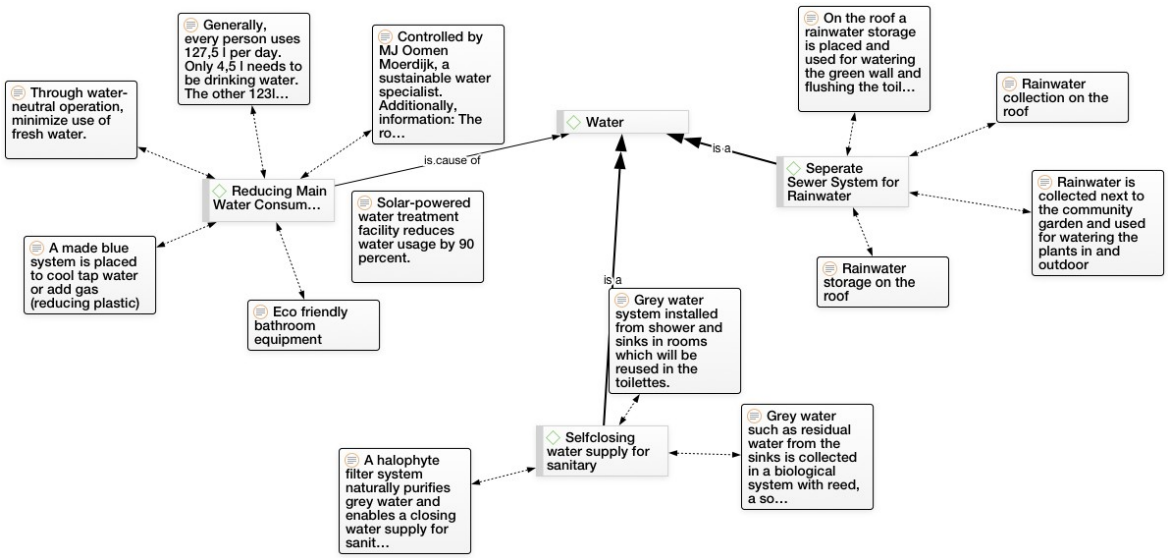
Impact Area: Energy



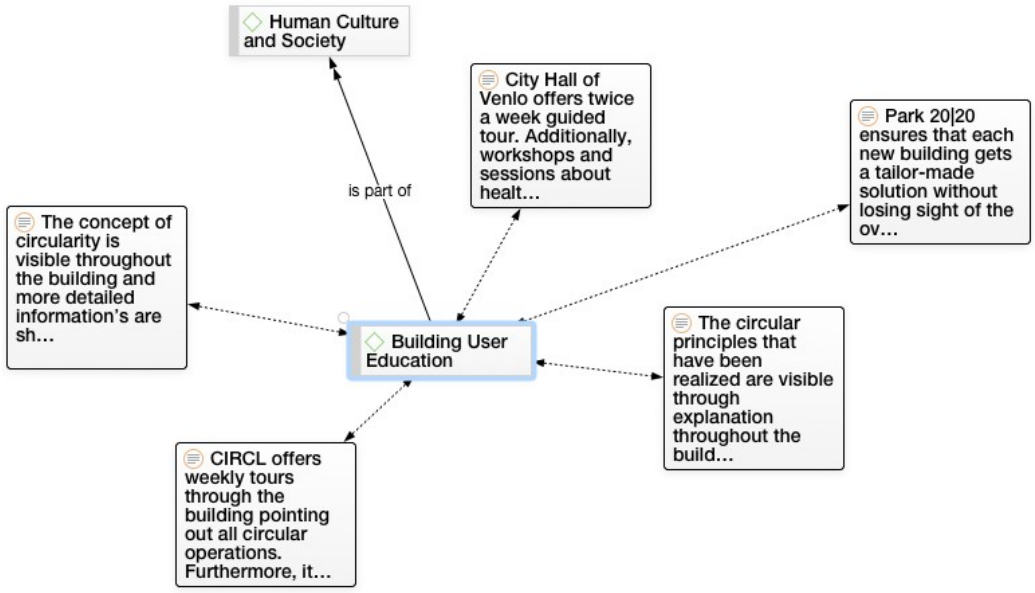
Impact Area: Material



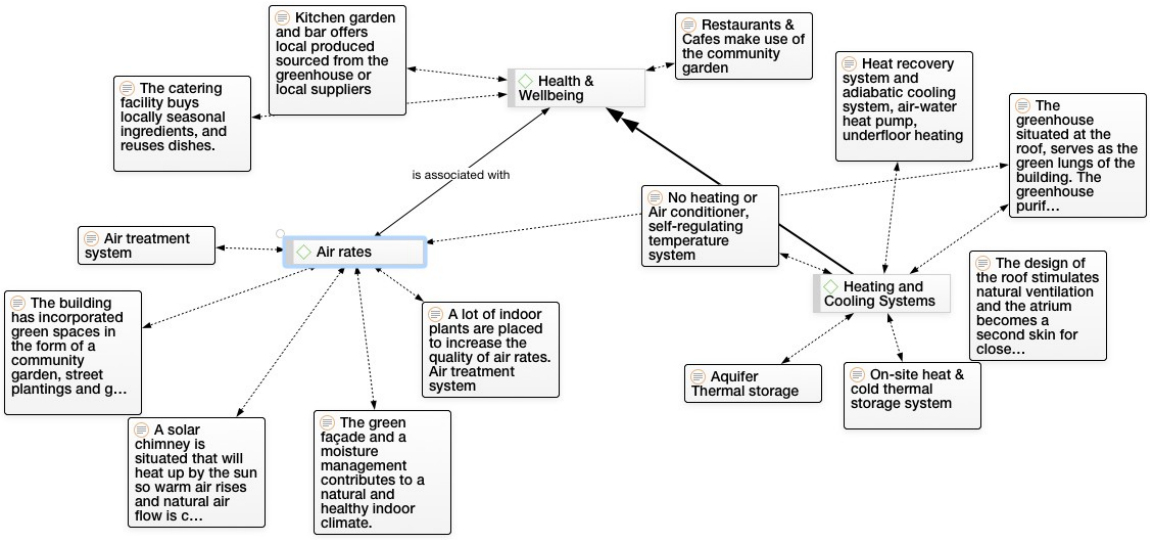
Impact Area: Water



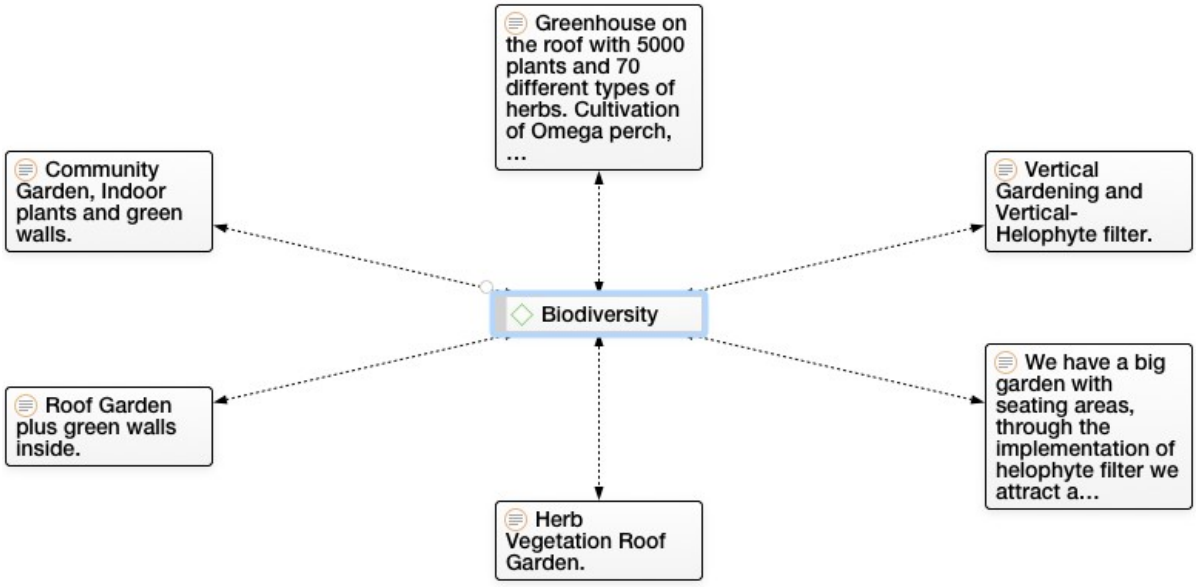
Impact Area: Human Society and Culture



Impact Area: Health and Wellbeing



Impact Area: Biodiversity



7.3. Code Report for Interviews can be found here:

https://drive.google.com/drive/u/0/folders/1lVmXr9JNrDlS9l0DXnbtPorSRkXv-JDA

7.4. Code Report for Survey can be found here:

https://drive.google.com/drive/u/0/folders/1lVmXr9JNrDlS9l0DXnbtPorSRkXv-JDA

7.5. Results

7.5.1. Survey Results can be found here:

https://drive.google.com/drive/u/0/folders/1YxxnwUnfLicnrAtzcQzslBvALdJCs7bC

7.5.2. Summary of survey results of third parties implementing circular solutions

!. Physical resource flow

Operational Process: **Energy**		
Renewable Energy	Solar Panels	https://exasun.com/ https://energiedak.nl https://www.zonnefabriek.nl/ https://www.q-cells.nl/
	Photovoltaic Cells	https://www.zonnepaneelprijzen.nl/
Reducing of general energy consumption (Energy Efficiency)	Energy Monitoring	https://www.in2-ecobuildings.nl https://green-men.nl/
	Lightning	https://www.fagerhult.com/
	Heating and Cooling	https://www.nathan.nl/ https://www.dago.nu https://www.warp-systems.nl/

Operational Process: **Material Use**	
Pay-per-Use	**Coffee machine, Washing machine, Dryer** https://bundles.nl/ **Lightning** https://www.lighting.philips.com/main/services/lighting-capital **Office Carpet floor** https://professionals.tarkett.com/en_EU/ **Office Furniture** https://www.re-place.nl/
Biological Material loop	Residual Wood https://studiorap.nl/#/ Wood Office Module https://www.sustainerhomes.nl https://www.buurman.in/ Wall system Bamboo https://www.bamcore.com
Technical Material loop	Marketplace for leftover building materials https://www.enviromate.co.uk C2C Materials http://www.c2c-centre.com/products Bricks and Building material https://www.byfusion.com/about/ Panels for furniture and decorative surfaces https://ecorglobal.com/# Flooring https://professionals.tarkett.com/en_EU/ Insulation Material Old company clothes

	https://www.denimtex.nl Old jeans https://www.vrk-isolatie.nl Recycled Cotton http://www.inno-therm.com Green pipe – environmental stormwater and drainage system https://www.thegreenpipe.com.au/products/index.html Environmentalfriendly paint https://www.solventfreepaint.com

Operational Process: **Water**	
Wastewater treatment	https://wmec.co.uk https://www.wetlantec.com/nl/ https://www.wateco.nl/
Water harvesting systems	https://www.regenwater.com/
Reducing main water consumption	https://www.armitageshanks-mena.com/homepage.html
Operational Process: **Health & Wellbeing**	
Air Rate	https://www.modernalchemyair.com/ https://www.verticalgardens.nl/green-walls/
Thermal comfort	https://www.clage.nl/nl/ https://www.geze.com/en/products-solutions/building_automation/smart_facades/c_36835 https://www.webeasy.nl/

Operational Process: **Biodiversity**	
	https://www.wetlantec.com/nl/ https://www.groenebouwhekken.nl https://donkergroep.com/nl http://greenbusinessclub.nl/utrechtcentraal/projecten/ https://www.verticalgardens.nl/green-walls/

7.6. Interview guide, transcript, recordings

7.6.1. Semi-structured Expert Interview guide

Introduction
The goal of this research is to advocate regular co working spaces to a faster and more mindful transition to the Circular Economy. This is why I am investigating best circular operational processes in the context of coworking spaces. Therefore, todays interview is all about exploring the status quo of CWS X and what ambitions are for the future in terms of circularity.

Defintion of Circular Economy (CE)
How would you define the CE?
When did you start thinking in circular manners?
Why do you think that is important?

Definition of a Circular Building
How would you define a circular building?

Operational Processes
What operational parts of the organizations have been adapted to the CE? (Ranging from water management, sanitation, energy systems,material use)
How does the adaption look like? What circular principles are being supported?
Which operational area has the highest potential for circularity?
What circular services do you offer?
Do you make use of a pay-per-use system?
Who's involved in implementing circular installation?
Are there any external parties responsible for implementing/ maintaining it?
What are the challenges you face turning circular?
How can one create a pleasant and healthy working environment while bringing circular principles to life?

7.6.2. Interview transcript can be found here:
https://drive.google.com/drive/u/0/folders/12qc02NoEj-Ble_Ooz43nqJwtLkRz6Og0

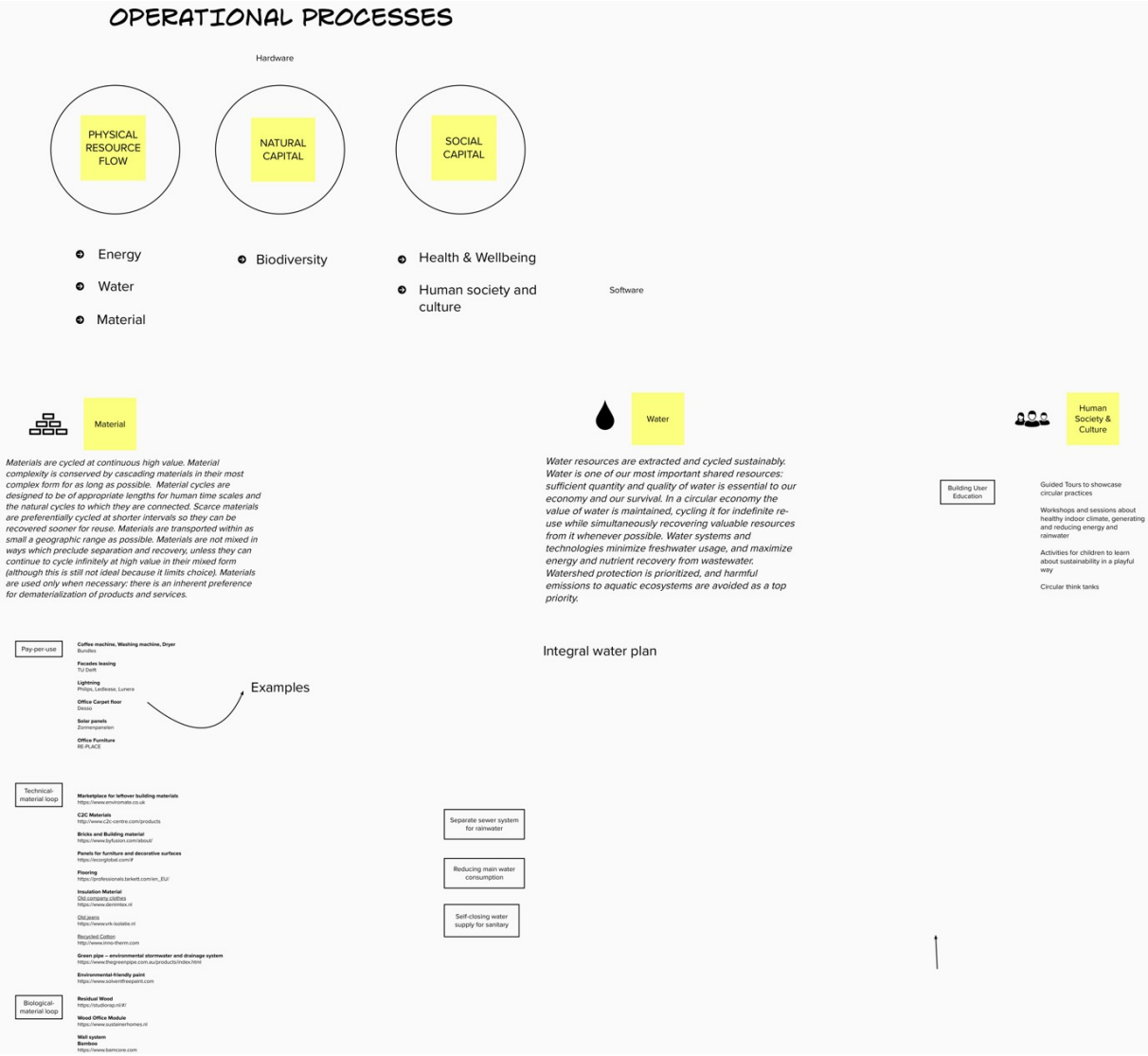
7.6.3. Interview recordings can be found here:
https://drive.google.com/drive/u/0/folders/1j8iMQa6ePKYoqnrJaniGniKgvPb72pY9

7.7. Survey Guide

Survey Guide can be found here:
https://drive.google.com/drive/u/0/folders/1lxdyrEO8t2G38M560I5oLce70bntd8xl

7.8. Prototype

First Version



The iteration can be found here:
https://appelmalou.wixsite.com/circulartransitions/circular-matchmaking