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CULTURAL HERITAGE BUILDINGS IN THE CIRCULAR TRANSITION

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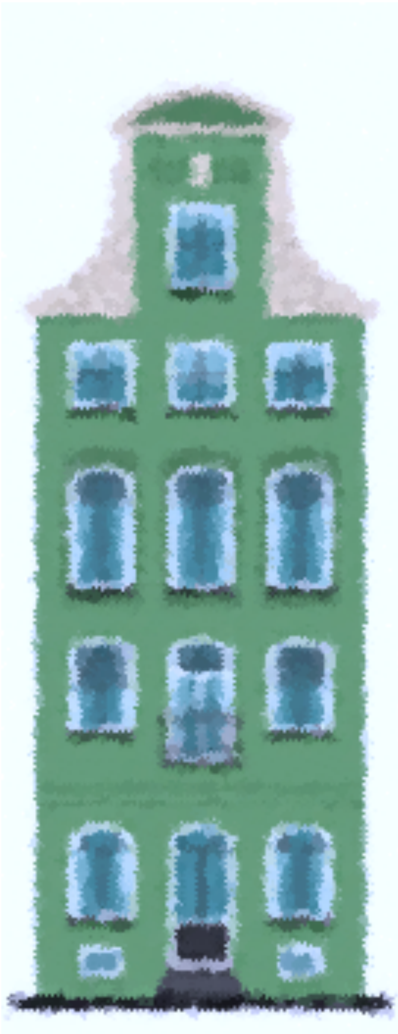
In the end, our society will be defined not only by what we create, but also what we refuse to destroy

John Sawhill



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Abstract

In 2050, 75%-90% of the existing building stock will still be standing in the Northern Hemisphere. To comply with the goals of becoming fully circular by 2050 in the Netherlands, the existing building stock needs to be considered in this process. The circular economy is currently known for lacking a social and cultural dimension, which makes its application challenging for the existing cultural heritage building stock. The transformation of CH is challenging because it has to find a synergy between cultural and social values, economic growth and environmental sustainability. Therefore, this research aims to answer *how the implementation of circularity can be stimulated within the cultural heritage built environment*. To answer this research question, this thesis mobilizes the literature on cultural heritage, conservation theory and the circular economy and carried out a systemic analysis of the existing circular implementation processes within cultural heritage buildings in the Netherlands. The research is performed by analysing 13 semi-structured interviews and 252 documents to assure data triangulation. The results allowed to map the CE implementation process, with the current status quo, including the main challenges for stakeholders. Next, the findings offer practical implications on how the circular transition can be stimulated within the CH built environment. The main findings suggest that the five main target areas identified to stimulate the CE implementation within CH buildings are *policy support, knowledge development, stakeholder engagement and collaboration, maximum cultural value retention and the creation of new financial opportunities*. The findings hold the promise of advancing theory regarding how to incorporate social and cultural dimension in the assessment of CE implementation performances. Suggestions for further research include a circular component and material level analysis of CH, a life cycle assessment of the sustainable performances of a circular CH building and the exploration of the neighbourhood approach potential.

Keywords: circular economy; cultural heritage buildings; circular implementation process; stakeholder analysis

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Abbreviations

CE = Circular economy
CH = Cultural heritage
POM = Professional Organizations for Monumental conservation
RCE = Rijksdienst voor Cultureel Erfgoed

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1: Introduction

In 2021, almost 92% of Europe's materials were processed linearly (Kostakis & Tsagarakis, 2021). In the Netherlands, the goal is to become fully circular by 2050 (Government of the Netherlands, 2016). This implies that in less than 30 years, a systemic change is needed, as we are currently at risk of triggering environmental changes that would be fatal for all living organisms (Röckstrom et al., 2009; Steffen et al., 2015). The current linear system based on 'take-make-dispose' puts stress on the environment. The world requires a system that does not compromise, and in the best case, can improve the Earth's system functioning (Desing et al., 2020; Elia et al., 2017). The circular economy (CE) provides a promising alternative as the waste concept is eliminated whereby end-of-life materials and products are seen as resources. This aims at closing the loops of materials and reducing the need for raw materials, as inspired by ecosystems (Desing et al., 2020; Elia et al., 2017). CE is therefore a promising tool for achieving a sustainable transition (Pomponi and Moncaster, 2017). Especially in the built environment CE is relevant, as the industry is the largest consumer of natural resources compared to other industries, and represents more than a third of the total energy consumed in the world (Munaro et al., 2020; Zimermann et al., 2016; International Energy Agency (IEA), 2013).

At the moment, research focuses on developing CE strategies for building design and construction but has not yet resulted in an acknowledged or established CE strategy across the built environment (Eberhardt, 2020). Buildings have a lot of components and materials with different life cycles of their own, which makes the applicability of CE strategies highly complex (Pomponi and Moncaster, 2017). Moreover, in 2014, the IEA published a report which stated that 75%-90% of the existing building stock in 2014 would still be standing in 2050 in the Northern Hemisphere (IEA, 2014). This suggests that not only future new building stock is important to take into account for CE strategies, but also the existing built environment.

In the European Green Deal of the European Commission, targets have been set to renovate existing buildings to achieve carbon neutrality by 2050 through the circular economy (among others) (European Commission, 2021). Existing cultural heritage (CH) buildings are also part of these targets. CH buildings can be architectural works, historical buildings, a building with a value of the art of science, or an outstanding building or site with great significance for the city itself (Worthing, 2008). CH has an instrumental value with touristic, cultural, and commercial purposes. But more importantly, according to Hosagrahar et al. (2016) is the intrinsic value of CH '*serving as identity, the embodiment of accumulated knowledge, that bonds community to space, determining the spirit of place and source of pride that is of interest for future generations as a non-renewable cultural source we have been handed down by previous generations*' (Hosagrahar et al., 2016, p. 40).

There is a debate on how to integrate sustainability in CH. For example, UNESCO started the 'Culture for Sustainable Urban Development Initiative' in 2015, and in one of the Sustainable Development Goals (SDGs), there is a clause included about protecting and safeguarding the world's CH (Foster, 2019). This suggests a trend in which the importance of the preservation of CH is highlighted in the context of a more sustainable future, as CH buildings are interconnected to climate change, health, poverty reduction, energy challenges and urbanisation, (Guzmán et al., 2017). Therefore, CE as a tool can be applied to achieve sustainability within CH. However, CH poses a new challenge as the CE is known for lacking the social/cultural dimension. According to Lazell et al. (2018), CE implementation so far ignores social and cultural dynamics such as how waste streams are created and how CE measures implicate people's lives. Furthermore, within society, sustainability and circularity are mostly seen as obligations to save the environment rather than measures that can benefit themselves as well (Gonzales-Arcos et al., 2021). Within CH, the cultural instrumental and intrinsic value form the identity of the building, which forces a CE implementation to take them into account (Girard, 2019). CH buildings require a high amount of criteria for renovation and preservation, to keep their intrinsic value intact. When applying CE to the renovation and preservation of CE, there might be constraints between what is socially and culturally desirable, and what is needed for an environmental-friendly approach.

To assure that the value of CH remains in a future where the entire society needs to become fully circular, strategies need to be developed for integrating circularity. CH buildings pose a new challenge as their transformation has to find a synergy between cultural and social values, economic growth and environmental sustainability. Therefore, this research aims to identify strategies to overcome CE challenges when renovating and preserving CH buildings. This results in the following research question:

'How can the implementation of circularity be stimulated within the cultural heritage built environment?'

To answer the main research question, the following sub-questions are formulated:

1. *'How are circular strategies currently implemented within cultural heritage buildings?'*
2. *'Which challenges arise when trying to implement circularity within cultural heritage buildings and why?'*
3. *'How can these challenges be overcome when trying to implement circularity within cultural heritage buildings?'*

The outcome of this research is based on a systemic analysis of the existing circular implementation processes within cultural heritage buildings in the Netherlands. The analysis builds on a theoretical foundation of CE implementation within the existing built environment and CH studies. The goal was to map the process and understand the challenges and solutions per process step. This was done in two successive steps. First, a document analysis was performed to create insights into the current CE implementations within CH buildings. Secondly, the main research input came from a sector analysis whereby experts gave insights into sector dynamics, its performances and the potential. A national focus was chosen as the scope of the study to gain an overview of trends in the sector, as a high variability exists among municipalities.

By doing this research, new insights are created for scholars working on a holistic approach (*i.e. integrating social, cultural, economic, environmental, institutional and technical elements*) toward CE implementation. It further fills a gap within the circular built environment literature, where little to no attention has been paid to the various circularity implementation process steps within CH buildings, and the challenges and solutions that arise in each step of the process. Therefore, the aim is to construct explanations that uncover a successful CE implementation process. By finding a way on how the CE implementation can be stimulated within CH buildings, their role as cultural and economic assets can be maintained in a future sustainable society. More concretely, this thesis will help to identify target areas where improvement is possible within the circular preservation process, so that the CH buildings are compatible with social, cultural, economic and environmental needs of the future. This will be of interest to policy makers, conservation specialists and other CH stakeholders.

This thesis is structured as follows. The theoretical framework is presented in chapter two, including a schematic overview of how the different theories used are being combined into one comprehensive model. Then, chapter three shows the research design with the associated justification of the methods and the operationalization of the research. Next, the final results are presented in chapter four, supported by the conducted interviews and document analysis. Chapter five will then provide a discussion of the results. The final chapter forms a conclusion about the research done and answers the research questions.

2: Theory

This chapter reflects on the existing theories and concepts known surrounding the implementation of CE within the built cultural heritage. The first section starts with the notion of CH whereby built cultural heritage, its stakeholders and its connection with sustainability are highlighted. In the next section, CE is addressed in the context of the built (CH) environment with potential implementation challenges and strategies.

2.1 Cultural heritage

The concept of CH encompasses all intangible and tangible artefacts of human expression that are inherited from previous generations. These artefacts can be of value for communities, groups or society at large and therefore preserved in the present and passed on to future generations for their favour (Roders and Van Oers, 2011). Tangible CH can be seen as monuments, buildings and sites. CH also has an 'intangible' meaning, namely the knowledge capital that arises from the development and experience of human practices, and from spatial, social and cultural constructions related to our common 'memory' (Di Turo and Medeghini. 2021).

CH as a whole represents both *memory* and *identity*. In the case of *memory*, cultural heritage resembles the presence of a community at a certain time in history, thereby connecting the past to the present, as evidence of cultural reality. As Bleibleh and Awad (2020) mentioned: '*The particular heritage and collective memory of each locality or community is irreplaceable and an important foundation for development, both now and into the future*' (p. 197). Heritage as a construct of *identity* is typically seen as a 'shared symbolic estate'. Although identity is a fluid concept, it has the power to bring people together within a distinctive culture and place in the world. A critical note needs to be made, as CH as identity is not uncontested, because some members of a community do not have a recollection of the physical artefact or traditions (Tweed and Sutherland, 2007).

To identify cultural heritage by its worth, Farelly et al. (2019) did a literature research into what classifies as CH. In this case, they developed three core attributes that define CH: *physical form*, *links* to what is culturally and historically significant, and *vitality* to transmit meaning actively. In the case of *physical form*, the physical properties of the cultural heritage object are listed. *Cultural and historical links* refers to relevant contextual information of CH linked to its history and culture. These links are very diverse and range from people, gods, communities, values, beliefs, knowledge, skills, traditions, rituals, meanings, associations, art, science, literature and important events in culture and history. Lastly, *vitality* becomes clear when the historic and cultural significance of the CH object is put into perspective, creating a high value of the object.

As cultural heritage is a very broad concept, this research will be narrowed down to tangible cultural heritage, and then specifically the built cultural heritage.

2.1.1 Built cultural heritage

In general, the built CH covers any individual or group of buildings, structures, monuments, or installations of remains that are associated with either architectural, cultural, social, political, economic or military history (Tweed and Sutherland, 2007). The UNESCO World Heritage lists a set of CH buildings based on their value. These values can be divided into the cultural identity values (as mentioned before with physical form, links and vitality), scarcity values (what makes the building unique concerning recently built ones) and economic values (Bosone et al., 2021). Resulting out of these values, the main categories are architectural works, archaeological remains, buildings of art, historic buildings and buildings with an outstanding universal value from the point of science (Ramos et al., 2018).

2.1.2 Conservation of built cultural heritage

The aforementioned meaning and values of cultural heritage merit special protection of CH buildings so both current and future generations can enjoy the benefits (Al-Sakkaf et al., 2020; Di Turo and Medeghine; 2021). The ability to conserve CH is paired with maintaining cultural values, contributing to social cohesion, and fostering economic productivity (e.g. tourism). Therefore, the social-cultural aspect plays a key role in CH conservation and preservation (Nocca, 2017).

Conservation theory is described by Chorola (2008) as '*a cultural activity that uses technical methods to preserve the building by reducing its deterioration rate (..) the intervention must respect the historical, documental and aesthetic value of the building*' (Chorola, 2008, p.2). Within the current conservation theory, there is a debate about preserving from an *authentic* perspective or a *values-based* perspective. From the *authentic* perspective, the physical materials of the heritage buildings carry the memories and values associable with them (Huuhka and Vestergaard, 2019). So, the preservation on a material level as great as possible has the main focus. Here, it is debated when to choose for the conservation of the material or the form and aesthetic of a building when both are not possible. It should be kept in mind that conserving the original state of the building is usually not desirable, as ICOMOS states that the appearance of buildings should portray their 'true' inner nature (Huuhka and Vestergaard, 2019). This includes all-time layers, including previously done conservation activities and crafting techniques, to avoid 'falsification' of CH.

The other side of the debate, the *values-based* perspective, gives attention to the complex nature of CH whereby the values are considered multidimensional and subject to interpretation. It adds an extra layer of multiple stakeholders who attribute values to objects. So, the material level focus is a prevalent value rather than the main focus (Poulios, 2010).

The authentic and values-based nature of CH buildings is partially based on qualitative argumentation. Approaching conservation solely from a material science perspective will result in a lack of understanding of the values embedded in the building. Because of the qualitative nature, the decisions based on what to conserve and what not have a subjective note and are therefore prone to debate. Thus, conservation is a process of negotiation, which makes considering all stakeholders' interests a crucial aspect (Al-Sakkaf et al., 2020).

2.1.3 Stakeholders within built cultural heritage

The aforementioned complex nature of CH is interconnected with a large group of stakeholders that are affected by and affect the CH buildings. Hajialikhani (2008, p.2) investigated the stakeholder management for CH sites and created a list of the stakeholders involved, which are:

- Client, government authorities, final users
- Sponsors, internal and external owners and investors
- ICOMOS
- Environmental preservation organizations
- Researching institutes, universities, specialists
- Consultants, contractors, suppliers, workers
- Local people in the site and around the site
- Tourists and tourism agencies
- Site manager, performing organization, management team
- Society

From this list of stakeholders, the main groups having the biggest impact on CH are the government, the market and the civil society, and therefore must be considered to determine the success of CH management (Linnér and Wibeck, 2019; Fischer and Newig, 2016). To accept and enable change, citizens hold an important position together with the market (i.e. consultants, contractors etc) and the government to help shape a 'landscape' where CH preservation can take place (Fischer and Newig, 2016). Expertise in maintaining CH is found within the market and governmental actors. Section 2.2.1 will dive deeper into the role of the stakeholders concerning CE implementation in CH.

2.1.4 The role of sustainability within a built cultural heritage conservation

Besides the authentic and values-based perspective on CH conservation, there is also an increase in interest from the environmental perspective. The principle of sustainability and of CH share commonalities, whereby in both cases the goal is to maintain something for the current and future generations. In the scientific literature, attention is paid both to the influences of the environment (like natural disasters by climate change) on CH and the role of CH in a sustainable future. The latter involves strategies for conserving and renovating CH as it allows to preserve the identity and memory of communities (cultural benefit), increase of economic productivity (economic benefit), reducing raw material use (environmental benefit), and increasing social benefits like employment (Nocco, 2017). However, no single guideline exists on how cultural heritage can operate fully sustainably. According to Turo and Medeghini

(2021), this is mainly due to two factors: the interdisciplinary nature of a material of cultural interest and the still early developments of sustainability within the built environment. Circularity can be seen as a tool to increase the sustainable nature of CH.

2.2 Circular economy

The CE concept has gained increasing attention from governments, scholars, companies, and citizens as a crucial step within the sustainability transition (Corona et al., 2019)[1]. According to the Europeans Commission's CE program, the CE serves as a suitable replacement for the current linear take-make-dispose economy, and can limit the material flow to a level that nature tolerates and utilizes ecosystem cycles within economic cycles that respect the natural reproduction rates (Korhonen et al., 2019; Desing et al., 2020; Kirchherr et al., 2017). According to Geissdoerfer et al. (2017), the biggest theoretical influences for CE are cradle-to-cradle, laws of ecology, looped and performance economy, regenerative design, industrial ecology, biomimicry and the blue economy. In the scientific literature, multiple studies have investigated the CE, but the concept is still in its infancy and many different approaches exist (Geissdoerfer et al., 2017; Korhonen et al., 2018; Millios., 2021). By bringing 114 different definitions together, Kirchherr et al., (2017) created an all-encompassing definition that will be used in this research, namely: *'an economic system that replaces the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes. It operates at the micro-level (products, companies, consumers), meso level (eco-industrial parks) and macro-level (city, region, nation and beyond), to accomplish sustainable development, thus simultaneously creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations.'* (Kirchherr et al., 2017, p.229).

2.2.1 Circular Economy analysis for built cultural heritage

The built CH can be analysed based on different 'CE scales'. Ghisellini et al. (2015) have developed a framework that shows how these different scales operate, as shown in figure 1. According to Ghisellini et al. (2015, p.6) the built environment, where built cultural heritage is a part of, can be divided into three different scales: (1) micro-, (2) meso- and (3) macro-scale. In the built environment the micro scale is seen as the building component, the meso as individual buildings where all the components are assembled, and the macro scale as cities (i.e. urban metabolism). Pomponi and Moncaster (2016) argue that within the scientific field, usually one scale is analysed when mapping CE processes for buildings. However, because of the complex nature of CH with its core values of memory and identity for communities, a multi-scale analysis is necessary to understand (i.e.) how replacing components, changing the buildings' appearance, or the buildings' function on a city level influences the identity and memory of the CH building (Pintossi et al., 2021).

[1] CE does not equal sustainability, it is a tool to achieve sustainability.

According to Frantzeskaki et al., (2017), the three main stakeholders as mentioned in paragraph 2.1.3 (government, market and civil society) have a threefold role within the CE transition of the built environment. The first role is that they act as a driver of transformation to sustainability, as the actors involved have the knowledge, flexibility and capacity to bring direct contributions. The second role is that they are a safeguard of social and cultural needs. Lastly, the third role is the disconnected innovator, wherein an independent and creative way new innovative initiatives arise. So, when implementing CE in CH buildings, the government, market and civil society need to be included in the decision process.

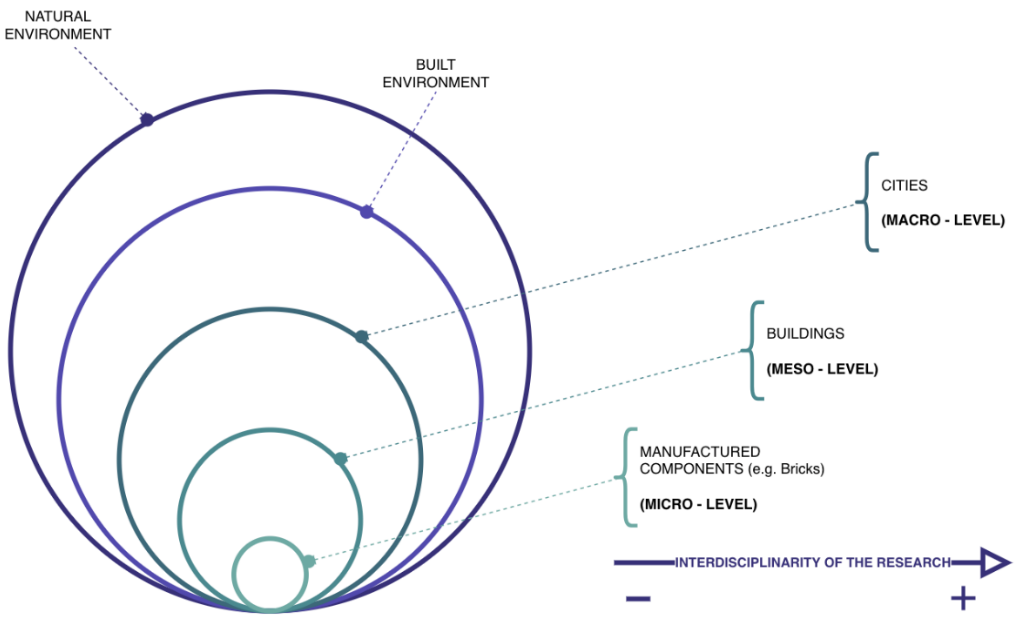

Figure 1: Different CE scales in the built environment by Ghissellini et al. (2016).

2.2.2 Implementation strategies for circular economy in the built cultural heritage

To implement CE in CH, the micro-, meso- and macro-level all need to be considered. As specific strategies in the literature for CE implementation in CH do not exist yet, Huuhka and Vestergaard (2019) made their interpretation by combining two different tools that are currently leading in CE implementation. They combined the butterfly diagram by the Ellen McArthur Foundation and the material hierarchy (see appendix A), better known as the R-Framework, using multiple R strategies.

The idea of the R-framework is a 10-step hierarchy of strategies that contribute to the realization of a CE (Potting et al., 2017). From R9 to R0, an increase in value retention is noticeable, whereby R9 = Recover , R8 = Recycle , R7 = Repurpose , R6 = Remanufacture , R5 = Refurbish, R4 = Repair , R3 = Reuse, R2 = Reduce , R1 = Rethink, and R0 = Refuse (See appendix B for an elaborate explanation). The first three R's (0,1,2) aim at smarter product use and manufacture, the next set of R's (3,4,5,6,7) at extending the lifespan of the product and its parts and the last R's (8,9) aim for a useful application of materials. The R-framework represents the idea that products are designed and optimized to eliminate waste by reducing consumption, enabling efficient reuse, disassembly and refurbishment (Singh and Ordoñez, 2016). Waste that still ends up being incinerated or sent to landfills, can be recovered or recycled (Polzer and Persson, 2015).

The butterfly diagram by the Ellen Mc Arthur Foundation (2019) illustrates the continuous flow of materials in the economy, and proposes two cycles – the technical and biological cycle – that show strategies for keeping the loops as small as possible to prevent the extraction of natural resources. The technical cycle being most relevant to the built environment, proposes loops of sharing, maintaining, reusing, refurbishing and recycling.

As the R-framework incorporates R's that are most applicable to the design of new building stock (like Refuse and Rethink for product design) and the butterfly diagram of the Ellen McArthur foundation does not include different micro-, meso- and macro-levels, Huuhka and Vestergaard (2019) combined both frameworks into the following for existing buildings:

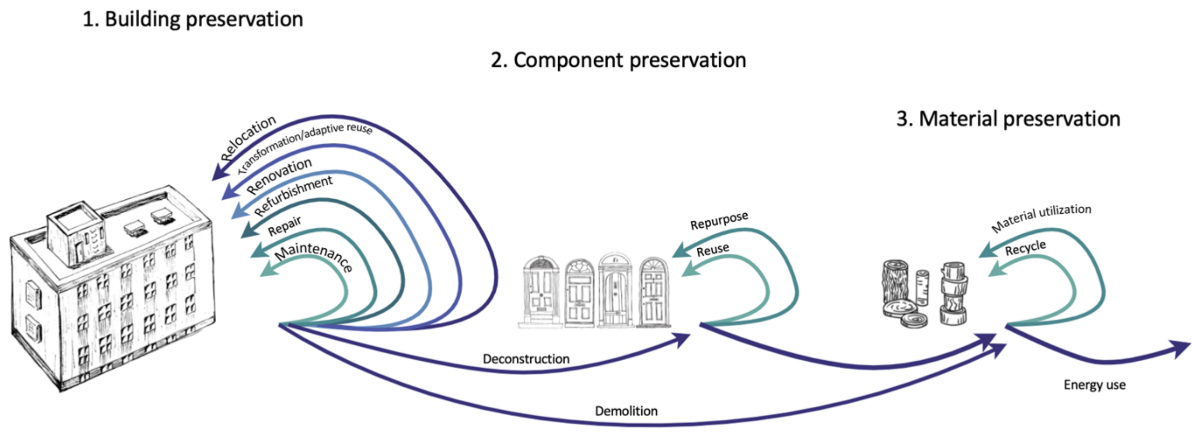

Figure 2: CE in the context of buildings (Huuhka and Vestergaard, 2019).

Huuhka and Vestergaard (2019) divided the CE strategies for the existing building stock into three levels, namely building preservation (meso-level), component preservation (micro-level) and material preservation (micro-level). Here, the lifecycle extension of the currently existing stocks of buildings is seen as the main priority, even though reparability or adaptability might not always be ideal. After extending the buildings' lifetime to its maximum, the buildings can act as 'material banks' for other construction projects. It should be noted that premature demolition of buildings to access raw materials should always be prevented till there is no other option. The choice of a circularity (R) strategy should always move from the inner circles to the outer circles in figure 2, only when the smaller circles are no longer feasible. The lifecycle extension has a primary goal of avoiding material extraction and resource depletion, but also the avoidance of related energy use which can result in greenhouse gas emissions.

The model of Huuhka and Vestergaard (2019) does not include the macro-level analysis. Within the CE transition of CH buildings, this resembles an urban metabolism perspective (Pomponi and Moncaster, 2016). This would require information about how the implementation process is designed through cultural, social, governmental, economic and environmental forces. However, the scientific literature, so far, has not elaborated on these points for CH buildings specifically.

It should be noted that the strategies mentioned in figure 2 are not mutually exclusive, they can interact with each other and can be applied at the same time (Morseletto, 2020). This can result in challenges, namely (1) circularity in one product chain may lead to less circularity in another, (2) making a product chain more circular could require more natural resources, in the form of fossil fuels and (3) intensifying product use by facilitating access can lead to an unintended increase in product use (Potting et al., 2017). Therefore, circularity does not equal sustainability, as ambiguity and discrepancies exist.

2.2.3 Implementation challenges and enablers of the circular economy

Multiple organizations and sectors have started to try to implement CE (i.e. textile industry, packaging industry etc). But, practice shows that this implementation process meets obstacles (De Jesus and Mendonça, 2018; Kirchher et al., 2017; Geissdoerfer et al., 2017; Corona et al., 2019; Droege et al., 2021). However, in the scientific literature, little to no attention has been paid to circularity implementation in practice within cultural heritage. This means that the literature available on associated challenges within CE implementation does not specify CH, but remains on a broader sector level, like the built environment as a whole. In the literature, four main categories are listed, namely social/cultural, institutional/governmental, financial/economic and technical challenges. To facilitate a better CE implementation process, the previously mentioned challenges need to be overcome. In the scientific literature, enablers are mentioned that have the potential to solve challenges. Table 1 shows an overview of the most prominent challenges and enablers named in the literature. The challenges and enablers listed, serve as an example of what challenges and enablers might look like, but do not represent the actual challenges and enablers for the CH sector.

Table 1: Implementation challenges and enablers of CE in the built environment

Category	Challenges	Enablers
Social/cultural	Time consuming efforts to implement CE, lack in specialized human resources, lack of CE awareness, failure of adoption	Leadership, creating awareness, value chain engagement, systems thinking.

Institutional/ Structural	Missing leadership commitments, lack of stakeholders support, geographic dispersion of the value chain, lack of regulatory and public support, path dependency, obstructing laws and regulations	Green public procurement, legislation on CE, regulatory reform, leadership.
Financial/ economic	High upfront investment cost, decoupling revenues from material input, lack of a clear business case for CE, lack of collaboration between organizations	Clear business case, viable take-back schemes, financial incentives to use secondary materials.
Technical	Interaction of different material loops in a system (complexity), technology gaps, long product life cycles	Development of enabling technologies to recover materials.

Sources: Droege et al., 2021; Ghisselini et al., 2016; Geissdoerfer et al., 2017; Lewandowski, 2016; Corona et al., 2019; Planing, 2014; Bourguignon, 2016; Korhonen et al., 2018; Hart et al., 2019; Singh et al., 2021; Kirchher et al., 2017; De Jesus and Mendoça et al., 2018; Adams et al., 2017.

2.3 Theoretical framework

Combining the current insights on CE and CH, the conclusion can be drawn that there is still a lack of information on how CE can be implemented on individual CH buildings. Especially the transformation of existing building stock requires attention, as these need to comply with circular requirements as well in the near future. CH buildings have to undergo the same transition, but with the additional challenge of preserving social and cultural values, the CE transition remains in its infancy. The initial scientific research of CE has been applied in practice in the form of strategies, but social, institutional, economic and technical challenges arise when applying these strategies to CH. Therefore, this research tried to identify the possibilities for integrating CE within CH buildings with the previous theories in mind. Hereby, the CE strategies on a micro- and meso-level are assessed in practice (the current CE performances within CH buildings), and which macro-level forces challenge and enable the CE implementation process. Figure 3 combines all concepts mentioned, and is used to structure he data collection. It is investigated how the different levels operate in the CE implementation process of CH buildings.

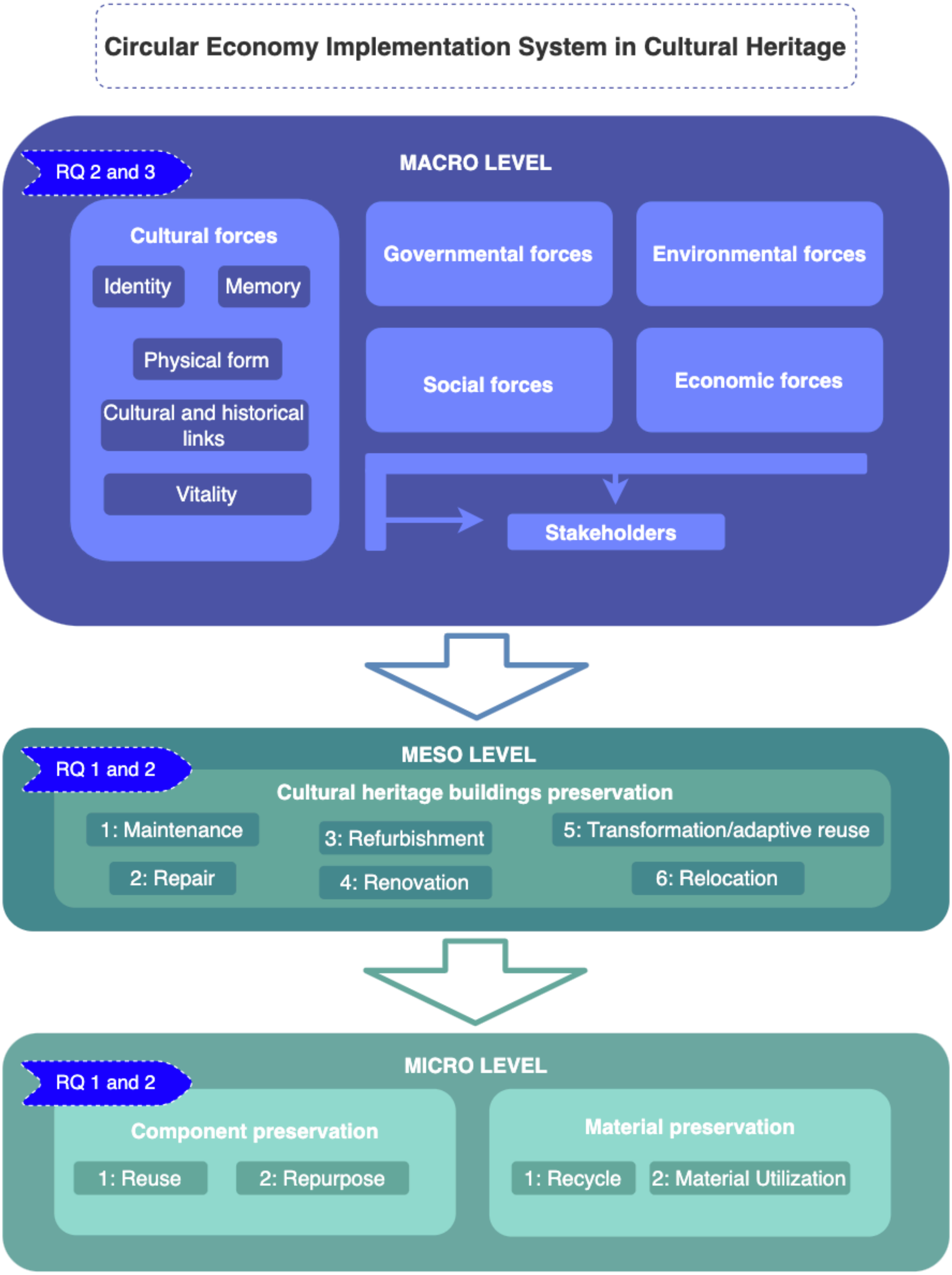

Figure 3: Conceptual framework

3: Methods

In this chapter, the methodological approach of this research, including the research design, data collection and data analysis is presented. It involves

3.1 Research design

The objective of the study is to understand the system (on a micro-, meso- and macro-level) of the CE implementation process within CH buildings with its corresponding challenges and enablers in the Netherlands. Therefore, a combined deductive and inductive qualitative research was chosen which allows for the exploration and identification of emerging phenomena and underlying relationships. Hereby, new insights and possibilities are created rather than just testing a specific theory (Bryman, 2012). This allows to explore the landscape of CE implementation in CH. The unit of analysis for this research was the complete process of preservation and conservation within CH. The scope if focussed on the Netherlands. The broad scope was needed to get an overview of the current climate (i.e. which ingredients ensure a successful implementation and the other way around), and to ensure representativeness because all processes can vary from municipality to municipality (not to mention the differences per building). To understand the CE implementation on micro-, meso- and macro-level, this research applied a sector analysis, whereby the trends within the sector were explored. To accomplish the research aim, this research is exploratory. Since specific literature supporting the research question is scarce, exploratory research helps to understand the important elements and questions in the field of circularity in CH buildings in the Netherlands (Bryman, 2012). This research was done based on expert interviews and a document analysis. A qualitative sector analysis with expert interviews has the goal of gaining process and technical knowledge (Döringer, 2021). In this case, experts are considered knowledgeable based on their in-depth knowledge resulting from their position, experience and responsibility (Bogner et al., 2009). The document analysis is performed to assure data triangulation, and to identify CE practices currently proposed in the built CH and why these are possible.

3.2 Data collection

3.2.1 Document analysis

A document analysis provides a systematic procedure for reviewing or evaluating documents, both printed and electronic material. The overall goal of document analysis is to uncover meaning, develop understanding, and discover insights into the research subject (Bowen, 2009). The documents collected gave insights into implementation developments of CE within CH buildings and how the corresponding processes were involved, to find the main challenges and enablers. LexisNexis, an online platform providing a database of publications, has been used to filter publications on sustainability and CE developments within CH. Table 2 provides an overview of the parameters entered in the database. Searches were both done in Dutch and English. Moreover, after the interviews, experts also provided additional documents that were found relevant to the research topic. These were included in the data analysis. In total, 252 documents were collected. Appendix C shows an overview of all documents collected, including the extra documents provided by the experts. The choice has been made to include the publication types of news, company profiles and industry analyst reports. News gave insights into how the current CE implementation process is viewed from different types of stakeholders' perspectives, and give a snapshot of CE developments within CH. The company profiles and industry analyst reports showed new circular approaches in the conservation and preservation industry.

Table 2: LexisNexis input for document analysis

Specific search terms	Publication Type	Period	Number of hits
"Circular" AND "Cultural heritage" AND "Implementation" AND "Netherlands"	News	2018-2022	219
	Company profiles		26
	Industry analyst reports		7

3.2.2 Semi-structured interviews

The main data collection instrument used is semi-structured interviews. Semi-structured interviews benefit this research by discovering the why and the underlying rationale of the problem to identify challenges and potential strategies to overcome them (Fylan, 2005). A semi-structured interview allows for deviation from the predetermined interview structure to cover topics in more detail (Barkley, 2019). To collect the interviews, purposive sampling was used (Bryman, 2012). More specifically, a theoretical sampling method was used, as it allows for collecting and analysing data and generating theory iteratively, to develop the theory as it emerges (Glaser & Strauss, 1967). Therefore, the goal of the sampling strategy was to find experts based on their affiliation with sustainability implementation within the conservation and preservation industry and their expertise in maintaining the values of CH in the Netherlands (market and governmental stakeholders). Choosing expert interviews allowed to make the distinction between common findings and those unique to particular cases, which enhanced generalizability and external validity.

The semi-structured expert interviews were held with 7 sustainability experts and 6 CH experts. Table 3 provides an overview of the expert interviewees. Each interviewee is given a code to allow referencing throughout the thesis. A total of 26 people were contacted, whereby 13 were eventually interviewed, as others either did not respond or refused to participate. An interview guide was made to structure the interviews. Both a separate interview guide was made for the sustainability experts and the CH experts (Appendix D). The interview guides were operationalized based on aiming to obtain information on the key concepts mentioned in the theory section. After the first interviews, the effectiveness of the interview guide was evaluated and adjusted if necessary. After 13 interviews, data saturation was achieved in the sense that similar statements were made among experts and no new findings arose. The interviews were both conducted online through Microsoft Teams and in-person between February 2022 and May 2022. The duration of the interviews varied from 50 minutes to 80 minutes in the interviewee's native language (either Dutch or English). For each interview, informed consent[2] was obtained. If no oral permission was granted for the recording of the interviews, extensive notes were made. The names of the respondents have been left out due to privacy reasons.

Table 3: Overview expert interviewees

	Identifier	Type expert interviewee	Function interviewee
1	S1	Sustainability expert	Advisor, architect
2	S2	Sustainability expert	Contractor project management
3	S3	CE expert	Circular project leader
4	S4	Sustainability expert	Advisor and project leader CH projects
5	S5	Sustainable CH expert	Advisor
6	S6	CE expert	Project leader
7	S7	Sustainable CH expert	Advisor
8	C1	CH expert	Specialist CH and sustainability government
9	C2	CH expert	Cultural heritage advisor government
10	C3	CH expert	Cultural heritage advisor government
11	C4	CH expert	Municipality
12	C5	CH expert	Monument owner
13	C6	CH expert	Government agencies

[2] For informed consent, the informed consent form template provided by Utrecht University was used.

3.3 Data analysis

Both the documents and interviews were analysed in a similar way, whereby Excel was used for the documents and NVIVO for the interviews. To answer sub-question 1, a deductive approach was pursued whereby the CE performance of CH buildings based on figure 2 was tested. To gain insights into how these CE strategies were implemented, all related information to the status-quo of the implementation process was coded under *the beginning of the implementation process* and *during the implementation process*. The outcome of the deductive approach is showed in paragraph 4.1. The second part of the data analysis relied on inductive techniques, which focused on identifying patterns, identifying interactions between stakeholders and changes among these patterns and interactions (Strauss and Corbin, 1998). So, the research tries to go from specifics, to more common concepts for generalization (Elo and Kyngäs, 2008). The analysis of the data occurred in three successive phases, namely open coding, axial coding and selective coding (Bryman, 2012). In the phase of open coding, all transcripts and documents were analysed, and all statements related to the CE implementation process were coded, whereby concepts and themes were identified. Then, differing views from experts were compared for an all-encompassing overview of the CE implementation process. This involved highlighting the main challenges, enablers and the main CE implementation process. When new concepts emerged, these were checked by going back and forth between different transcripts to ensure all relevant data was included. A small part of this process is shown in appendix E , illustrating the mind map and connecting different concepts in the data. During the axial coding phase, the codes were analysed more in-depth, creating an overview of (e.g.) different incentives for the owners to start with the sustainability implementation process. This phase allowed for developing categories and sub-categories. For example, the quote of interviewee C2: '*We determine (among others) whether a change can go ahead by looking at the visibility of the historical layers on a monument.*' was coded as '*amenity value*' in the category '*monumental value*', which is part of the 2nd order theme '*Intangible identity*'. In the third phase, selective coding, the coding scheme was refined and completed, resulting in the scheme presented in figure 4, showed below. This involved the systemic integration of all categories, whereby the final 2nd order themes were identified and how they relate to the aggregated dimensions. Eventually, 214 codes were linked to 32 concepts, 10 themes and 2 dimensions.

It should be noted that during the interviews, specific questions were asked on how the mentioned challenges could be overcome. This resulted in a correlation between challenges and enablers. Therefore, each challenge mentioned has a matching enabler that can help overcome the issue. An enabler does not always equal a solution, but is seen as a step in the right direction of overcoming the challenge.

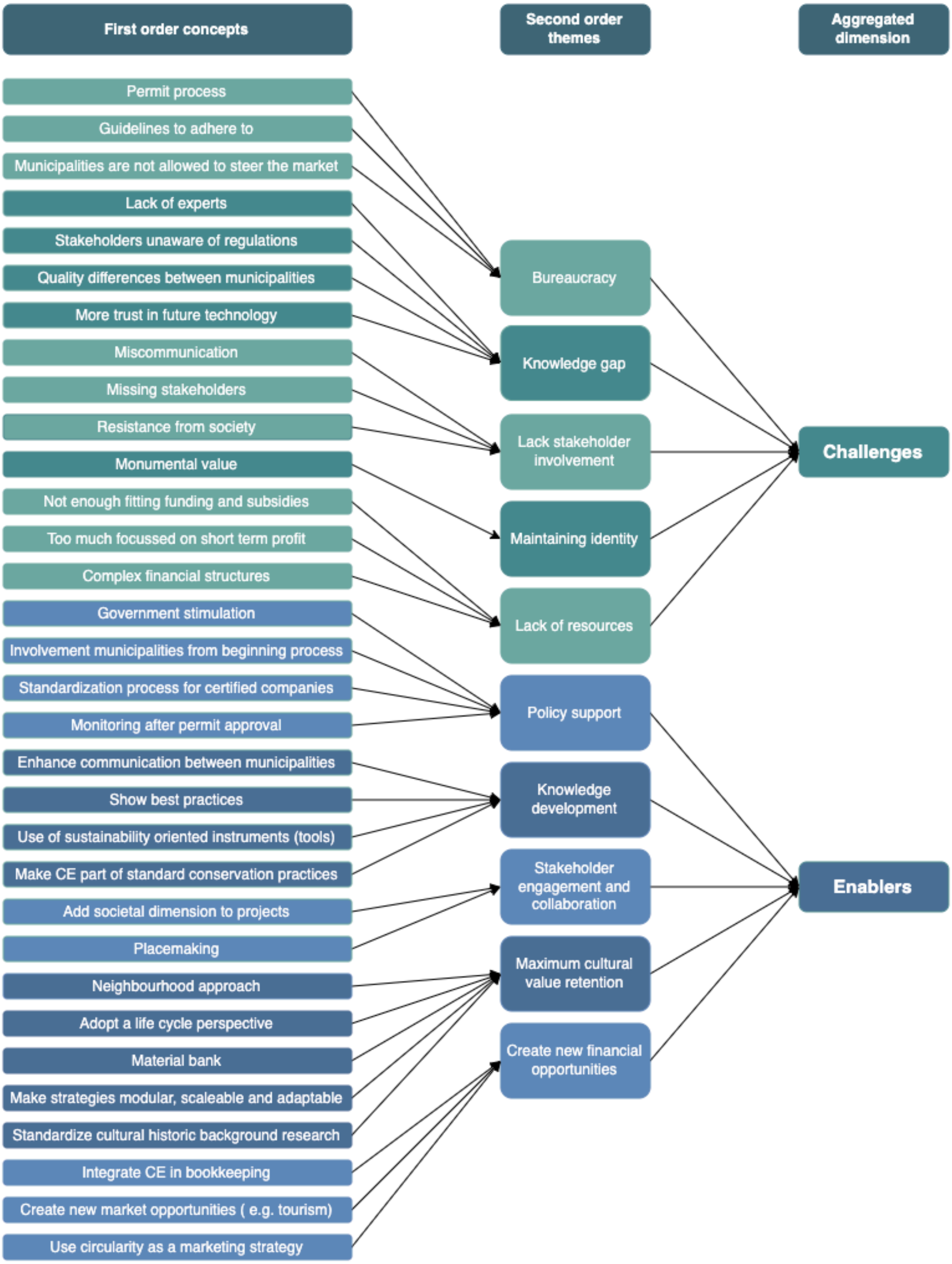

Figure 4: Data structuration and analysis process.

3.4 Quality criteria used in this research

The main criteria proposed by Bryman (2016) to assess qualitative studies is *trustworthiness*. Trustworthiness consists of four criteria, namely credibility, transferability, dependability and confirmability. Credibility was assured through the use of method triangulation, using both a document analysis and interviews as a source of data. The transferability of the research was achieved by doing a sector analysis with a wide diversity of interviewees and as many as possible within the given amount of time. In this way, the main trends in the sector could be identified rather than only context specific information. This also related to ensuring external validity by setting a clear sectoral and geographical focus. Through an audit trail, it was assured that dependability was possible. This entailed keeping track of every step made in the research process, and documenting everything, like fieldwork notes, transcripts, analysis decisions etc. This is closely related to the reliability of this research, whereby documenting all steps in the data collection and analysis ensures the repeatability of this research. For the confirmability of the research, it is necessary to prevent theoretical or personal inclination. Confirmability is achieved by presenting the thinking process behind the codes grouping and corresponding interview guide and quotes of the transcripts. This makes the research process transparent and allows readers to make their own interpretation of data.

4: Results

In this chapter, the findings are presented based on a document analysis and 13 semi-structured expert interviews. The first section dives into the current process of implementing circularity within cultural heritage buildings, which represents the macro-level operations. Then, the most prominent CE strategies implemented are assessed, showing the meso- and micro-level strategies. Lastly, the challenges and corresponding enablers are explained, which again, are part of the macro-level.

4.1 Status quo of CE implementation in CH buildings

4.1.1 The beginning of the implementation process

In the Netherlands, multiple owners of CH buildings exist. Private, public, and collective ownership are all present. Examples of owners can be Professional Organizations for Monumental conservation (POM), individuals, organizations, or municipalities. The owners decide whether they are interested in making their property more sustainable or not, which makes it the first step in the CE implementation process. During the interviews, it was revealed that several reasons exist for considering an interest in sustainability (which is the end goal when implementing circularity). A total of five incentives were identified during the interviews, namely (1) **technical or environmental targets they need to adhere to** (mentioned 2 times), (2) **reputation** (mentioned 7 times), (3) **coupled with regular maintenance** (mentioned 2 times), (4) **comfort** (mentioned 13 times), or (5) **a high energy bill** (mentioned 13 times). These are rarely solely from a sustainability perspective. The incentives mentioned the most by the interviewees were reputation, comfort and a high energy bill. Interviewee C2 stated about reputation: '*Owners sometimes see sustainability implementation as a status symbol. (..) Having a Tesla on the driveway, solar panels on the roof, to show that you are sustainably oriented and innovative.*' The importance of comfort was best illustrated by interviewee C1: '*A monumental building is quite aesthetically pleasing for private owners, but when your feet are chilly every evening while sitting on a couch next to a cold window, yes.. at some point that will become very annoying. We must keep monuments habitable and other functions pleasant to use* '. Therefore, in recent decades, comfort was often seen as a reason to renovate monumental buildings. With (among others) the recent price increases as a result of the war between Russia and Ukraine, high energy bills are becoming an important incentive for owners to look into the sustainability transition, simply because it will save money. Interviewee S7 explains: '*We must keep living in monumental buildings affordable, because otherwise in 50 years the buildings will become vacant as it is no longer feasible for the homeowners to bring up the costs [due to poor insulation].*' Interviewee C1 complements these statements by addressing the financial incentive: '*People are now looking at, where are my biggest energy leaks, where can I gain the most profit? They often hear that solar panels pay for themselves quickly, so that from a financial point of view it is profitable* *and strategic to go along with the energy transition.*' These incentives suggest that a circular implementation needs to have a 'personal' benefit for the owners themselves.

When a circular implementation is considered, the owners have to gather knowledge that enables the implementation. This usually involves independent stakeholders with expertise in sustainable conservation. Examples of stakeholders are consultancies, or municipalities. Although the collaboration with experts is advised during the interviews, this does not always happen, as it was mentioned that owners often try to implement strategies themselves by going to do-it-yourself stores (Praxis, Gamma etc) without proper knowledge. When chosen for a specialized consultancy, interviewee S4, who works at such a consultancy, said: *'We schedule an introductory meeting at the monumental building and we prefer to walk through the building with the owner and/or concierge and cultural historian to take it all in. Sometimes at museums and castles, we also ask an installation technician. Then, We would like to receive information about the building's historical characteristics, construction drawings, etc. It is also important to discuss the expectations with the customer in advance, so what is their sustainability goal for example. When we received everything, we will start drawing up a plan, but that is of course custom made for each building.'*

This involves the third step in the implementation process, namely developing a strategic plan for CE implementation, custom made for the CH building.

4.1.2 During the implementation process

When a plan has been drawn up, it usually involves a change or renovation of the building. This cannot be carried out without the permission of the municipality, because they act as patrons of monuments against, for example, damage or demolition. Therefore, the owners have to apply for a permit, which is the fourth step in the CE implementation process. For municipal monuments, a regular permit period of eight weeks applies (with the option of an extension of six weeks) and for national monuments, an extensive permit procedure of 26 weeks (with the option of extending for 6 weeks). In the event of partial demolition, a major change, adaptive reuse or reconstitution, the National Cultural Heritage Agency of the Netherlands (RCE) must be contacted in the case of national monuments. So, the municipality always remains the first point of contact and assesses together with a local monument committee whether the initiator should be forwarded to the RCE. Monuments within a municipally or nationally protected townscape (*beschermde dorps- en stadsgezichten),* must apply for an all-in-one permit for physical aspects in case of, for example, adapting facades and/or roofs. For applying to those permits, costs are charged (dependent on the activities). So, different procedures apply for different types of classifications of CH buildings. It should be kept in mind that the above-mentioned role of the municipality and the RCE is not the only one that is being carried out. They can be involved in different stages of the process: in the beginning phase in which an initial idea can be discussed openly; after a formal permit application (as mentioned above) and during implementation in case additional advice is required.

When the municipality or the RCE is involved, they will decide based on a set of criteria whether the change/renovation will affect the cultural-historical values. How this is assessed differs per municipality, but the RCE has published a manual with some criteria. In the rapport '*Uitgangspunten en overwegingen advisering gebouwde en groene rijksmonumenten*'[3], translated: '*Starting points and considerations for advice built and green national* monuments', the RCE has established a framework in which a decision can be made. The RCE collects information provided by the municipality and the owners themselves on four aspects, namely the monumental value, the intended intervention, the consequences of this intervention and the circumstances that play a role. The four aspects will be further explained in the table 4 below:

Table 4: RCE Criteria

Aspect	Elaboration
Monumental value	The monumental value is assessed based on five criteria, which are the cultural historical value, the architecture and art historical value, the situational- and ensemble value, integrality and recognizability and the rarity.
Intended intervention	For the intervention, the RCE needs information about the assignment, the program requirements, the vision behind the intervention, the eventual design and the intended execution.
Consequences intervention	For the consequences of the intervention, it will be examined whether the intervention will affect the monumental value as described in the first aspect. Then, the sustainability wins will be assessed and what kind of societal impact the intervention will have.
Circumstances	For the circumstances, there will be looked at the future perspective, the history of the monument, the stakeholders and whether there is social and administrative support.

When the request for an all-in-one permit for physical aspects is accepted, the owners can execute their plan. Some owners can bear the costs themselves, but in general the costs for monument renovations are high. That is why several subsidy schemes are currently available. Appendix F shows an overview of some subsidy schemes available. Furthermore, the RCE has launched a special monument loan (DML) for national monument owners to receive a budget through a low-interest loan to make their monuments more sustainable. At the same time, there is a subsidy scheme that facilitates sustainability research. The RCE together with the Restauratiefonds (Restauration fund) published the statistics on the use of these financial resources in 2019 and 2020, which can be found in appendix F.

[3] https://www.cultureelerfgoed.nl/publicaties/publicaties/2019/01/01/uitgangspunten-en-overwegingen-advisering-gebouwde-en-groene-rijksmonumenten

To conclude, in total five steps were identified during the CE implementation process: (1) *decision making process of the owner to start the CE implementation*, (2) *combining relevant stakeholders to start the implementation process*, which are, concluded from the interviews (together with the owners and society), sustainability experts (e.g. architects, consultancies) and CH experts (municipality, RCE or local monument committee), appendix G elaborates on the role, tasks and objectives of the stakeholders; (3) *developing a strategic plan*, (4) *the permit application* and (5) *the execution of the strategic plan*. Step 1 to 3 were identified during the beginning of the CE implementation and 4 to 5 during the implementation process.

4.1.3 Main circular strategies currently implemented

During the execution of the strategic plan, several CE strategies have been observed. The interviews indicated that monuments are unique and therefore require a customized approach. So, no uniform CE strategies exist. Thus, the following strategies will only be a simplification of reality, and different strategies can happen at the same time as well. Table 5 shows a summary of the findings per circular strategy for both the expert interviews and the document analysis. The colour in the third column indicates how often the strategy was mentioned during the data collection as a strategy that was actively used in practice (**Red** = 0 times, **orange** = 1-5 times, **yellow** = 6 – 10 times, **light green** = 11 – 15 times, **dark green** = >20 times). In the description column, information is given about the examples of the CE strategies given during the data collection, to provide contextual information.

Table 5: Overview of the CE strategies in CH preservation mentioned in the data collection

Phase	CE strategy	x	Description
Building preservation (Meso-level)	**Maintenance**		Maintenance belongs to the standard practices within conservation of CH. The target areas are humidity and temperature. Usually, this consumes a lot of energy (e.g. Heating a church). Therefore, more sustainable options need to be used. For temperature and humid controlling measures (for example), air heating systems, heat pump, heat sensors under panels on the roof, solar panels, smart insulation strategies, smart windows options, closing draft spots, and air purification systems are currently applied as sustainable alternatives. However, although developments for sustainable alternatives are frequently applied, normal conservation does not always include sustainable options, as mentioned by the interviewees.

	Repair	Same as maintenance, repair strategies are commonly applied within conservation. The ERM (Acknowledge Restauration Monument Care) foundation listed seven target areas for the standard repair and restauration practices, found in Appendix H
	Refurbishment	Refurbishment strategies are used in building preservation, but not that often. In Appendix H, when new or other (reused) materials have been added to maintain quality, this can be seen as refurbishment strategies.
	Renovation	During the data collection, renovation activities were mostly found within maintenance, repair and refurbishment.
	Adaptive reuse	Adaptive reuse was often mentioned during the data collection. The new functions that were mentioned the most were business premises, multitenant buildings, library, event locations, hotel and catering industry, restaurant, office spaces, museum, multifunctional uses, cultural functions and residential functions.
	Relocation	No examples were mentioned of relocation of CH buildings.
Component Preservation (micro-level)	**Reuse**	Some reuse strategies were mentioned during the interviews, but it is not a common practice. Reuse can happen within the boundaries of a building itself, or exchanged between different (similar) buildings.
	Repurpose	Repurpose strategies were mentioned, but mostly as an exception. For example, pews in a church can be used for covering pantries or as partition walls.
Material preservation (micro-level)	**Recycle**	Only one initiative was identified of the recycling strategy. It concerns a collaboration between Brokkenmákers and New Horizon whereby a circular brick is produced with the rubble that becomes available during the restoration of the Utrecht Dom Tower. The bricks are manufactured and used in sustainable construction projects in Utrecht, such as the Merwedekanaalzone and the Cartesisusdriehoek. Residual material is recycled and then used as a new building material. The initiative states: 'Dutch river clay is used as the basic raw material for the stone: a sustainable material that is infinitely and locally available. The rest material of the Dom is added to the brick as raw material. This composition guarantees a long life, with all the functional and aesthetic properties of a brick.'

			At the end of the lifespan, the circular bricks can be selectively demolished, processed and reused as a material
	Material utilization		No examples were mentioned of material utilization.

Based on table 5, it can be concluded that the CE performances are most present in the building preservation, and lack development in component and material preservation. This is due to the extending lifetime principle within conservation practices. Maintenance, repair and refurbishment strategies are commonly applied, also without the environmental consideration. The highest R strategies for building preservation therefore hold a cultural and social incentive to preserve the cultural value of the building as long as possible. As interviewee C3 mentioned: '*Within the preservation or renovation of CH buildings, CE is not actively pursued, rather the protection of the monumental value is what drives these processes.*'

4.2 Challenges and corresponding enablers for CE implementation with CH buildings

Having outlined the overall sustainability implementation process with its corresponding CE strategies, this section will dive into the challenges associated with this implementation process, and potential solutions and enablers to overcome them. This part focusses on the macro-level. The challenges and enablers can apply to multiple or all CE strategies at the same time, and will not be linked to specific CE strategies on their own as the challenges and enablers apply to the implementation process of CE strategies rather than the CE strategies on its own. Also, the challenges and enablers themselves are interconnected. For analytical purposes, the challenges and enablers will be reported separately and linked to the CE implementation phases mentioned in 4.1, namely the beginning of the implementation process and during the implementation, based on the phase where they occur most often as found in the data analysis. However, it should be kept in mind that these challenges can span phases, dependent on how the implementation process is executed. Appendix I shows the supporting quotes which form the basis of the findings.

4.2.1 The beginning of the implementation process

As discussed, owners of monumental buildings decide whether they want to start the sustainability implementation process. For owners to decide upon which renovations they want to pursue, relevant knowledge, stakeholders and understanding of their monument are required. This poses the first challenge within the implementation process.

4.2.1.1 Knowledge

Challenge: knowledge gap. First, during the decision making process of the owners to start a sustainability transition, it was found that **owners can be unaware of**

sustainability and law. The unawareness of sustainability expresses itself in the lack of understanding of the sustainability concept. It was found that owners do not know what it specifically entails, and why it is needed. During the interviews, it was mentioned that this is a societal issue whereby the dispersion of general sustainable knowledge is limited (access to knowledge). When unaware of the concept of sustainability, this can result in the wrong application of implementation measures, as interviewee C2 mentioned: '*Sometimes people want to generate renewable energy, but their biggest problem finds itself in insulation issues'*. Moreover, the unawareness of law expresses itself in owners not knowing their responsibilities that come with owning a monument. This can be caused by lack of knowledge transfer at the notary. According to the Dutch law, monuments are protected in the Heritage act, which requires owners to inform the municipality when doing renovations. In a lot of cases, interviewee C4 pointed out that this does not happen. When owners are unaware of their responsibilities, owners may inadvertently cause damage by applying (for example) insulation from do-it-yourself stores.

Secondly, when different experts are gathered (second process step), a challenge of **lack of expertise exists among contractors and consultancies**. This is caused by a lack of experts and lack of fitting knowledge, which can be a result of lack of education. Interviewee C1 explains: '*When making monuments more sustainable, you need expertise on both the cultural heritage site as sustainability wise. However, what often happens is that people with restoration knowledge are advising owners, but they do not yet know about (for example) insulation and installations. They are not educated on that part*'. This can result in misinformation towards the owners, whereby they set up a plan that involves incorrect sustainability and CE strategies that are both a mismatch in CH and sustainability requirements.

Third, **lack of knowledge occurs amongst municipalities**. Sometimes, a big difference is observed in quality between different municipalities. The decentralisation resulted in full responsibility of municipalities over CH within their boundaries. With responsibility, the right knowledge and expertise must by available. However, smaller municipalities have different capabilities due to less FTE available, and are therefore unable to hire the right experts. Hence, the employees are often insecure because of a lack of expertise and withhold permits to avoid possible errors.

Enabler: Knowledge development. To overcome a knowledge gap, knowledge development is needed. During the data collection, several examples were given of potential approaches. First, when **best practice cases** of sustainability implementation within monuments are shown within the monument community, people are more aware of the possibilities and potential of their monuments. Interviewee S2 explained: '*When an iconic monument is fully sustainably renovated, it can function for spreading the right knowledge regarding sustainable implementations. By clearly communicating the successful approach, one can reach a huge number of visitors*'. A second approach is **enhancing educational resources**. Owners, as well as architects and policy staff, need to be educated with the right knowledge. Examples mentioned include a knowledge bank (for example online), where all the right knowledge is collected in one place and knowledge sessions to be organized on a neighbourhood level to offer information locally. In this way, knowledge is easier accessible. Third, by **integrating CE practices in standard conservation practices**, sustainability is not an extra step that needs to be pursued which requires knowledge on the owners side. A fourth approach mentioned was the development of useful **tools to guide the implementation process**. In the early stages, many owners are still unsure about who is needed in the process, what can and cannot be changed and how something should be done. Therefore, currently, three different tools are developed to guide this process. Table 6 gives a short elaboration on the tools. In appendix J, screenshots are provided of the online version of the tools, for visualization purposes. To guide specialists in their sustainability assessment (so misunderstandings of the hotspots are prevented), a **lifecycle approach** was recommended. In this way, all inefficiencies across the lifecycle of the building and its components can be recognized. This includes all raw material flows that move in and out of the building, the manufacturing stage of new material input, the use stage, demolition of components and the materials and components that are disposed of.

Table 6: Comparison of the three different tools available

	DuMo prestatiekaart	Groene menukaart	Erfgoedkompas
Function	A mathematical model in which both the monumental value as the sustainability performance of a monument are scored. It creates insights into what the possibilities are in terms of sustainability. If the monumental value scores high, less sustainability implementation are usually possible and visa-versa.	The Groene Menukaart provides insights into technology, regulations, financing and energy saving opportunities for owners of a diverse palette of monuments.	A digital tool that supports the sustainability process with a questionnaire on cultural-historic-, social-, functional-, economic-, ecological-, material-, climate- and well-being values.
Goal	To find an optimum between the monumental and sustainability value of a building, to see what happens to the overall score when interventions take place. The higher the total score, the better.	Insights into the follow-up steps for each sustainability implementation measure per type of monument.	Create an integral approach in which the status-quo of a monument is determined, and an improvement process is recommended for low-scoring components.
Initiative	NIBE	Groene Grachten	NRP

4.2.1.2 Stakeholder involvement

Challenge: Lack of Stakeholder Involvement. Overall, lack of stakeholder involvement happens at every step in the implementation process, but during the collaboration amongst stakeholders and development of the strategic plan, lack of stakeholder involvement poses the biggest challenge. Lack of stakeholder involvement is expressed by the **lack of communication**. It was found that during the decision-making process, so developing the strategies for implementation, inefficient communication occurs between experts and stakeholders. From a societal perspective, this expresses itself in resistance from society (e.g. locals), due to lack of ownership in the project. As CH is seen as a public good, citizens feel connected with CH, and feel passed when they are not taken into consideration. Moreover, it might result in risk adverse behaviour from owners as they do not want to risk their social relations in the neighbourhood. From a market perspective, lack of communication results in higher costs, wrong execution of activities, time overrun and a lot of rework. An illustrative example was given by interviewee S4: '*We had a project at 8 monumental schools in Hilversum. The school was managed by a foundation in Rotterdam. Together with us, they decided to install solar panels. When I asked the caretaker what they had delivered, he said nothing. They weren't connected. The foundation hadn't informed the school board that they had to arrange the connection themselves. Then an installer was called, but they're extremely busy, so it took months before it had any effect at all. We have not seen this at one school, but at six.*'

Lack of stakeholder involvement can also occur due to the **complete absence of stakeholders**. This results in an incomplete assessment both on the sustainability and the CH side. In the document analysis, an example was given of demolish companies. Demolition companies can make an assessment when analysing a building of which materials can be reused and how best to dismantle them. Currently, they are only brought in when the building is being demolished, whereby choices made impact the quality of potentially reusable materials and components.

Enabler: stakeholder engagement and collaboration. To increase the social dimension of a circular project, stakeholder engagement and collaboration is required. Multiple enablers were mentioned. First, **the implementation process has to start with all relevant stakeholders present**, which contributes to a solid strategy from the start, and enhances the joint development of a plan where all stakes have been taken into account. However, an increase in collaboration is also paired with more issues as more people need to be considered, as mentioned during the interviews. Therefore, one interviewee mentioned that one stakeholder, preferably the contractor, can serve as a **connecting factor that acts as a chairman** between different stakeholders.

Moreover, as the Faro Convention has emphasized, CH is intertwined with human rights and democracy, and objects and places are not, in themselves, what is important about CH but the meanings and uses that people attach to them and the values they represent. In light of this perspective, it is crucial to **give a voice to society** (e.g. locals) when considering changes in monuments. Participation by stakeholders leads to empowerment and to joint ownership of the monument. Examples that were given to increase communication with society were a local Q&A booth (or online) for enhancing the participation rate of civil society, which aims at reducing the risk of protest by knowledge sharing, and sharing ownership of plans. A concept that was mentioned as a solution is placemaking[4].

4.2.1.3 Maintaining Intangible identity

Challenge: Maintaining Intangible Identity. During the development of the strategic plan stage, the biggest challenge is incorporating the cultural dimension. The strategy developed must enhance the environmental and economic values without limiting the cultural values. Therefore, a challenge lies in complying with the **monumental value** of a building. Taking an amenity-, authenticity-, contextual- (historic events (different layers), location building), and the ensemble value into account were mentioned as the biggest challenges, which are explained more in depth in table 7.

Table 7: Monumental value description

Value	Description
Amenity value	Is the value that enhances people's appreciation of a building, so they are derived from the pleasantness, the aesthetic coherence and cultural attributes of a building. Something that attracts people to the building.
Authenticity value	The characteristics that more truthfully reflect and embody the cultural heritage values.
Contextual value	Contextual values are based on where the CH building is located, what is the meaning in its geographical context. Moreover, it represent the historic events that took place and in what way this is seen on the building, like different building structures, materials.
Ensemble value	In what way is the CH building still intact, do all elements of the building still act as a whole.

Source: Own compilation based on interviews and document analysis.

This is caused by a dependency on place, history, the significance to society, material use etc. A lot of **different influences** need to be considered, which results in a different value for each CH building. Moreover, many people might have different preferences, so the intangible identity of a building is fluid. The question, then, is how to take all factors into account without losing the true identity of a building.

Enabler: Maximum cultural value retention. In the conservation industry, maximum value retention is seen as the solution to maintaining the intangible identity.

[4] The art of making places [CH buildings] for people, broadening the scope of community involvement. It includes the way places work and matters such as community safety, as well as how they look. It concerns the connections between people and places, movement and urban form, nature and the built fabric (Sepe, 2015)

Often, this is seen as a mismatch with sustainability, but with the idea of circularity, it holds similarities. To operationalize maximum value retention which suits both sustainability and cultural approaches, the following enablers were discussed. First, the **essence of CH must be determined**. This can be done through built historic background research. Interviewee S4: '*It is incredibly important to have good built historic background research so you can make solid choices based on knowledge of the core values.*'. In most cases, this is also a requirement for the permit application process, but according to the interviewees, this should be a standard practice. Then, a phased plan can be created. This has the advantage of being able to evaluate step by step what the consequences are of a certain change. Should a change be undesirable, it can be reversed more easily. This relates to a technical solution, whereby sustainable solutions have to be designed in a **modular, scalable and adaptable way**, which enables reversibility and invisibility of the solution. Moreover, the BouwhulpGroep has developed the concept of Inside-the-Box. Inside-the-Box is a modular product solution that preserves the monumental character of a building. The existing gas heating is exchanged for a high-temperature air and water heat pump. An innovative feature is the underground mounting of outdoor units instead of on the façade or roof. The ventilation ducts are incorporated into elements that blend in with the surroundings. Interviewee S1 added to this: *'We can combine the sustainable installations with something that is already needed in the public space, like benches or flowerpots for example, in this way, we can integrate functions without hampering the monumental value'*. Thus, a strategy that is both in line with the monumental values as the environmental requirements.

Another approach is the **neighbourhood approach**. Achieving circularity is not done in isolation, but within a system. During the interviews, it was proposed that fully applying circularity and sustainability on CH within the boundaries of a building, is not feasible as the monumental value will lose at some point. Therefore, by applying strategies on a neighbourhood level, the CH building can benefit from its surroundings without harming the monumental value. This was showed by interviewee C3: '*Monuments often do not offer optimal space for solar panels, for example, because of skewed roofs, limited space and suboptimal roof strength. Therefore, in the municipality of Gouda, we collaborated with a nearby industrial park, which made their roofs available for solar panels so that the entire neighbourhood could benefit. The generated energy was not delivered back to the grid but consumed within the neighbourhood. This meant that the value of the monument did not have to be affected.*' Although the neighbourhood approach is seen as promising, interviewee C1 gave a critical note by stating that it is a very complex issue, as you have to make sure that everyone in the neighbourhood agrees with the decisions made, as they all experience the effects and consequences of (for example) the construction of a district heating network or geothermal energy.

To ensure values on a material level, it was suggested to make use of **a mapping system of materials and a material bank**. A material bank can act as an interactive environment where materials can be exchanged. Demolition companies (for example), can store and categorize all valuable materials, so they can be used with monuments with similar material properties.

Even though maximum value retention is primarily seen as a solution, the debate also touched upon a change in perspective. Currently, one of the viewpoints is to conserve the current state of a monument (i.e., including all historical layers). This is seen as the story behind a monument. Several interviewees, therefore, mentioned that a new discourse must be adopted in which sustainable additions to a monument (new wiring, solar panels), as a new layer of the history of the monument.

4.2.2. During the implementation process

When at the beginning of the implementation process, the right stakeholders and knowledge have been gathered and monumental values have been identified, the CE strategies can be implemented. This involves applying for an all-in-one permit at the municipality and finally sorting out the financials once the final plan is determined. The next sections will dive into the main challenges that arise during this process.

4.2.2.1 Regulation

Challenge: bureaucratic regulation. When a or multiple CE strategies are determined, owners have to apply for an all-in-one permit for physical aspects when they want to do more than regular conservation activities. Multiple challenges exist related to the application process. Interviewee S4 said: '*The process has* **no dynamic character**. *You submit a plan and it takes about 12 weeks before you get a response. If it is rejected, the whole process has to be started again from the beginning.*' Interviewee C4 agrees and added: '*The decision does not always have to be definitively negative. Sometimes, an additional build historic research is requested. However, because the* **communication is in legal language**, *the people do not understand the content and think their plan has been rejected.*' Interviewee S1 also concluded that '*The* **response time sometimes scares owners off**'. Interviewee C2 explained: '*The process can take so long because you first have to make a request on omgevingsloket.nl, after which the request is sent back and forth between different parties as the advice requires customization.*' The biggest cause of the long process is that each application must be studied in detail, as each building requires **a custom-made approach**. Because the municipality has seen many different successful approaches, it would have been helpful if they could recommend to owners which consultancies they could best engage. However, due to the law regarding free market operations, government agencies are not allowed to steer consumers in the 'right' direction.

Enabler: Policy support. Owners, and also some specialists, have a hard time getting through the application of the permit. Therefore, a multitude of solutions was proposed by the interviewees. By **simplifying the permit process**, the sustainability transition for monuments can become more easily accessible. This can be done by making policies more concrete for the owners. Because of the legal language, it is hard to find which rules you have to adhere to. For example, **by providing pre-determined criteria for permits for different types** of CH buildings, it becomes easier to build a plan around that. This can be supported by **tips and tricks** on how to obtain a permit more easily (i.e. have a clear vision). Moreover, by making the **permit process more iterative** (with feedback rounds), it prevents owners to go into a new application process when some details were missing. But, policymakers at the municipality are still resistant to simplifying the permit process, as they always want a way out to protect CH. A second approach is a **standard involvement of the municipality before the permit application**. If the municipality contributes to the plan before applying for the permit, many ambiguities can be addressed in advance. An example was given by interviewee C1: *'A contact at the municipality told me that they are working on a system whereby owners can send in a plan, whereby the municipality can then make changes to it in advance so that it fits the law's requirements.'*

In light of knowledge sharing, municipalities can **make standardized processes for certified companies** (architects, consultancies etc) that proved themselves to have an integrated approach to sustainability implementation within CH buildings.

4.2.2.2 Financial resources

Challenge: Lack availability financial resources. When a permit has been granted, the strategies can be implemented, but this is paired with high costs. In general, a monument requires more investment than a standard building, which often makes it unaffordable for the regular owner. Interviewee S4 pointed out that: '*The investment is often too expensive for them [owners], it's just too often about money*'. **Complex financial structures** were indicated as explanatory factors. As indicated earlier in section 4.1, various financing possibilities are available, but demand is still higher than the actual supply. Interviewee C6 said about supply: '*Part of the funding opportunities come from the government. The RCE itself does not have great financial possibilities, so funding is often obtained from the culture budget instead of other ministries with, for example, budgets for the built environment*'. Then, the subsidies themselves are **not available for every type of owner** and to qualify for the subsidies, you often have to meet a set of criteria that a lot of owners are not capable of. Lastly, from the private owners' perspective, the long term financial benefits are often not compatible with their wallets. Therefore, private owners are most **interested in short-term profit** which is not always guaranteed.

Enabler: creating financial opportunities. Besides the obvious enablers like more subsidies and funding, other financial opportunities can be created according to the interviewees. One of the examples given was the **integration of CE into bookkeeping**. By not depreciating material, but rather seeing it as a resource, it creates new financial possibilities. Usually, demolition is made up as a loss item in bookkeeping, but by including a harvest map of materials, it can provide structural value retention. Moreover, by **creating memberships of CH** (for example paired with new activities related to adaptive reuse), more income can be generated. This also relates to the **creation of new market opportunities** by for example tourism purposes. Lastly, some interviewees highlighted that a shift is needed in the mindset of thinking that sustainability equals expensiveness. In time, sustainability will reduce material input and energy consumption resulting in lower costs.

4.3 Stimulation of the CE implementation process within CH buildings

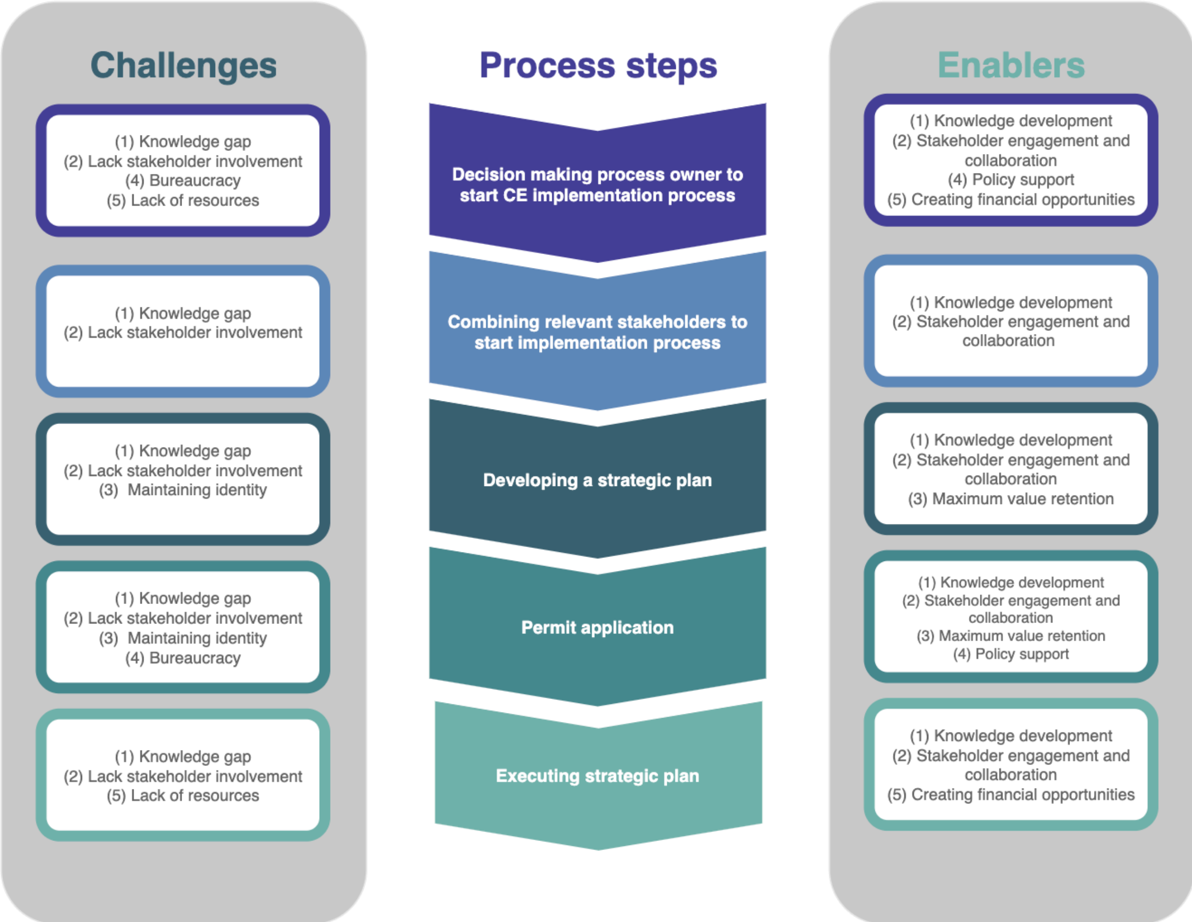

Figure 5: CE implementation process model of CH buildings with corresponding challenges and enablers

The key take-aways of the findings are that in total five main process steps occur during the CE implementation within CH buildings and five corresponding challenges and enablers. The previous sections provided a chronological order of occurrence of the challenges and enablers during the process steps of CE implementation. However, as mentioned before, the challenges and enablers can occur at multiple times during the CE implementation process. Therefore, figure 5 is developed to show when the main challenges occur linked to the process steps, whereby one challenge can occur multiple times. On the left side, the challenges are showed and on the right side the corresponding enablers. The colour coding indicates which challenges and enablers occur at which process step (e.g. purple = decision making process), and the number between brackets links a challenge to its enabler (e.g. 1 is knowledge gap and knowledge development).

Figure 5 shows at what point in the implementation process challenges occur, and how they can be overcome. The fact that the CE implementation within CH is tailor-made means that each process proceeds differently for different buildings. This makes it difficult to formulate an unequivocal approach that can be applied across the sector. Therefore, the implementation process has been scrutinized, and the biggest challenges per process step have been identified, so that the biggest obstacles for each

CH building can be found. In other words, it is not specifically about which CE strategies can best be applied, but how the process around it can be facilitated to achieve the best results. For example, at Building X in Beilen, Drenthe, the process might fail during the gathering of stakeholders, and at Building Y in Utrecht during the permit application step. The corresponding enablers indicate what improvements can be made by various stakeholders (e.g. owners, architects, municipality) to better facilitate the implementation process. Therefore, figure 5 acts as a guide for all stakeholders involved to improve their own process. A key take-away is that the absence of knowledge and the lack of stakeholders occur at every process step, and therefore should have the main priority within the agendas of policy makers for stimulating the CE implementation within CH buildings.

5: Discussion

This thesis was motivated by the absence of literature on the implementation of circularity within the CH built environment. By trying to add relevant insights, this research has focussed on mapping an all-encompassing CE implementation process, whereby is investigated why the implementation of circular strategies poses challenges for stakeholders involved. With the goal to identify key issues in the process with corresponding enablers on how to overcome them, the findings offer practical implications on how the circular transition can be stimulated within the CH built environment.

5.1 Theoretical contributions

This study makes three key contributions, namely (1) extending the theory on current CE implementation practices within CH buildings, (2) providing a multi-level analysis instead of either micro-, meso- or macro-levels, and (3) the integration of social and cultural dimensions within CE implementation.

(1) The first CE model applicable to the CH built environment was developed by Huuhka and Vestergaard (2019). This research has added to the CE implementation by assessing the status-quo within the Netherlands. This research confirms that the strategies mentioned at the building level, component level and material level do receive (to some extent) attention in practice. This suggests that developments are currently in place, but have not fulfilled its potential yet. As the model by Huuhka and Vestergaard (2019) proposed, building preservation has the first priority over demolishing and transforming it to components or materials. The applied CE strategies in practice for CH buildings were mostly found in the building preservation level, which suggests the correct order of CE implementation. The current studies (e.g. Foster, 2020) have only focussed on the adaptive reuse strategy within the building level, whereby the all-encompassing CE approach of this research allowed for identifying the status quo of all CE strategies. Therefore, this research adds a detailed account that shows that maintenance, repair and refurbish strategies have been interconnected with conservation strategies through the centuries. An important insight therefore is that CE and cultural conservation strategies are compatible, and do not constrain each other, as the ultimate goal of the building level strategies are extending the lifetime of the building as long as possible, in its true form. CE does not need to harm social and cultural values. Thus, the high focus on maintenance, repair and refurbishment strategies suggest a high circularity rate on a building level, as the building as a whole is prevented to be demolished. However, as mentioned in the theory, circularity is a tool for sustainability, and does not equal sustainability (Potting et al., 2017). This statement was confirmed as maintenance, repair and refurbish strategies within normal conservation require high amounts of energy and primary resources. Whereby in theory, high circularity has been achieved, relatively low sustainability levels are shown as the extension of the building lifetime has a high environmental burden. For example, when all materials on a building level are

preserved (i.e. extending lifetime), the use phase of the building still requires high amounts of energy to keep the temperature and humidity levels on a decent level, which equals a high environmental burden. Therefore, the findings suggests that for CH buildings, a dual focus is necessary, both on the energy transition (reducing the environmental impact of energy use) as circularity measures (extending the lifetime of CH buildings, components and materials). Moreover, on a component level, the CE strategies were less evident. Although strategies were mentioned, it became clear that a circular approach towards component reuse and repurpose was less integrated into common conservation practices than CE on a building level. The material level received even less attention than components on its own. Therefore, more attention can be paid to the operationalization of component and material level CE implementation within the CH built environment.

(2) As discussed in the theory section, previous research on CE implementation has focused on either a micro, meso or macro level, also in the built environment research as a whole (Pomponi and Moncaster, 2016). As circularity requires systemic changes (Pintossi et al., 2021), this research has taken a multi-level analysis, thereby creating novel insights into the whole implementation process. Whereby a single level approach only focusses on the level itself, without context, this research has shown the interconnectedness between, e.g., how renovation strategies are developed through economic, governmental and social forces and how it impacts the performances of the building on a micro level and has influence on social and cultural values. The findings have identified which stakeholders and experts are necessary in this process and which processes can enable (or hamper) the implementation process. These processes were previously identified in the context of the built environment, but never specifically for CH. Therefore, the findings on challenges and enablers in the CE implementation process go beyond the generic challenges and enabler categories mentioned in the theory section. Importing these findings to the literature on CE implementation, offers a way to describe and explain which challenges occur at which process step and at which level. This allows for targeted research into improving the CE implementation within CH buildings, but also the existing building stock as a whole. Due to the multi-level CE implementation process focus, additional findings occurred by identifying incentives for owners to start the CE implementation process. Existing literature (e.g. Droege et al., 2021), described challenges and enablers based on an already starting implementation process. However, in the case of CE implementation in CH, it was rather the question whether owners want to start a CE implementation. The findings suggest that owners are in need of personal direct benefits that they can measure. This insight adds to the CE implementation literature, by highlighting the importance of including personal benefits for owners when offering CE implementation measures. For the greater good of preventing environmental burdens is usually not enough. In the case of CH buildings, the owners need to have a personal benefit.

(3) The findings help to advance theory how to incorporate social and cultural dimension in the assessment of CE implementation. As CH is a societal property, and as cultural values are the basis of its existence, CE implementation processes are forced to take them into account (Nocco, 2017). This also distinguishes CH buildings from the 'normal' existing building stock, which is why more challenges are mentioned in the literature as in comparison less may be renovated for the sake of sustainability purposes. Where social and cultural sustainability and CE were until now mostly considered as two separate literature streams, they are combined into one approach in this study. Where normally the academic setting ignores social and cultural dynamics within CE implementation (Lazell et al, 2018), this research offers insights into how CE can be deployed so that the social and cultural values are not diminished (thinking of monumental value, stakeholder engagement, knowledge development and even policy support). The vast majority of the identified 2nd order themes have a social or cultural background, whereby can be concluded that CE implementation processes are highly intertwined with social and cultural processes, and can therefore not be ignored in future research (in order for the CE implementation to become successful).

5.2 Practical implications

Thus far, literature has recommended businesses, sectors and organisations to implement circularity through the R strategies (Kirchher et al., 2017). Yet, in practice, the R strategies as a tool is hard to implement without supporting context information that can enable the strategies (De Jesus and Mendoça, 2018). Because of the complex system in which the strategies need to be applied, no hands-on implementation guides are available on how to implement these CE strategies. Therefore, by the identification of challenges covering the whole implementation process, and opportunities on how to overcome them, the CE implementation has become more uncluttered for stakeholders. The value for all stakeholders finds itself in a implementation process guide, whereby during each process step, solutions and enablers are offered to overcome the challenges that are most present at that specific moment. A step in the direction of making CE a concrete concept rather than a vague one, gives clarity for businesses and organisations to actively pursue the CE implementation.

Moreover, this research identified the two implementation process steps where currently the biggest challenges lie, namely the decision making step by owners and the permit application step. By identifying the main incentives for owners to be interested in sustainability measures, this research gives a list of ways on how to make the CE transition more attractive for the owners themselves. This information can be used by municipalities, but also consultancies to attract clients and stimulate the CE transition. For instance, to comply with the goal of the Netherlands of becoming fully circular by 2050 (Government of the Netherlands, 2016). Another implication from this research is the need to simplify and smoothen the permit application process, as currently all stakeholders involved experience either communication, knowledge or regulatory issues. One of the main challenges identified was bureaucracy, which suggested resistance to change within CH regulation, but the enablers mentioned provide the basis of an accessible permit application process for all stakeholders involved. The practical enablers and opportunities offer suggest valuable insights to enable a circular change, namely with knowledge development, stakeholder engagement and collaboration, maximum value retention, policy support and creating financial opportunities.

Lastly, the general tendency in society is that sustainability and circularity are seen as obligations that must be made to limit the impact of climate change. The necessity for an integrative approach by each sector is often overlooked, which results in resistance to change (Gonzalez-Arcos., 2021). Especially in the CH built environment, the CE implementation is not immediately fully embraced because of the expected harm to the monumental values, as mentioned within the first key finding. This study, however, shows that the concept of CE does not harm social and cultural values, and is able to enhance social, cultural, environmental, economic and institutional values at the same time if the implementation process is followed according to a set of requirements and needed process steps. This is a dynamic that might not be limited to the CH built environment, but also applicable to other sectors where similar concerns are expressed, such as the fashion industry (Kirsch, 2020), construction sector (Atwi-Afari et al., 2021), cosmetics industry (Morea et al., 2021) and the food sector (Tseng et al., 2019).

5.3 Limitations of this research

The aim of this study was to create an overview of the main implementation process steps with corresponding challenges and enablers to stimulate the circular transition within CH buildings. However, a one-size-fits all strategy for all CH building does not exist, as each buildings is unique in its monumental values, meaning to society and even built physical properties. It is a matter of customization, whereby a focus on a specific CH type (e.g. mills) could provide more in-depth information. However, it was chosen to focus on all types of CH buildings as no literature was available on an integrative CE approach to CH buildings. Therefore, by focusing on all CH building types, a larger knowledge base on development within CH could be tapped. This involves the identification of a general implementation process to identify the biggest hotspots and trends where improvement is needed. Such generic information on the implementation process can form the basis for the actual implementation for each CH building, thereby contributing to knowledge development about CE implementation within the CH built environment.

A second limitation of this study is the coverage of stakeholders involved. As the exploration of the topic was in its infancy, the easiest and most effective way was to incorporate experts involved in the implementation process, as they hold the best overview of different process steps and requirements. However, due to the large societal dimension interlinked with CH, society is necessary to incorporate in the research process. Due to time limitations and lack of focus on a specific CH building type, society could not be taken into account directly. This was tackled by including the voice of society through the experts that encounter them the most. For example, the governmental and municipality experts are in close contact with owners and society, and through these expert interviews, societal views were incorporated in this research. But it is important to recognize that this information relies on second hand information, and should therefore be taken into account when interpreting the findings.

5.4 Suggestions for further research

For future research, this research stresses three main points. First, it is important to generate further theoretical insights into the possibilities of specific CE strategies into the component and material level of CH buildings. It seems promising to focus on these strategies more, as in practice the sector is struggling to deal with a material focus on a component and material level, as found within the data collection. Whereas this study focussed on potential examples of these CE strategies, future research can build on these findings and explore the possibilities in a bigger context, aiming at developing widely applicable CE strategies for CH.

Second, further work that investigates the actual sustainability performances of CE strategies on a building level would be highly valuable. After all, the CE as a tool has the goal to achieve sustainability. It could be interesting to perform multiple Life Cycle Assessments to test the actual performances of the building or investigated how a joint approach with CE and the energy transition can provide solutions for CH buildings.

Third, although the CE is not necessarily contradictory to social and cultural values of CH buildings, some buildings are very prone to change (based on building physics) and cannot be effectively renovated. Therefore, one of the enablers mentioned was the neighbourhood approach. The neighbourhood approach focusses on CE implementations on a neighbourhood level, whereby monumental buildings can benefit from sustainable or circular implementations of neighbouring buildings (e.g. use of green energy of solar panels placed on industrial roof, exchange of materials among different buildings). This would be a third suggestion for further research concerning the feasibility, potentials and challenges of the use of a neighbourhood approach for CH buildings, and whether it benefits the cultural and environmental challenges.

6: Conclusion

The aim of this research was to map out the processes involved within the CE implementation process within CH buildings and how this implementation could be stimulated. Many different macro-level influences (cultural, governmental, economic, social and environmental) determine how stakeholders operate and how the CE implementation strategies are pursued on a building, component and material level. By analysing qualitative data from a document analysis and semi-structured expert interviews, the main research question '*How can the implementation of circularity be stimulated within the cultural heritage built environment?*' could be answered as follows:

To stimulate the CE implementation, three elements must be known. First, how current CE strategies are currently implemented within CH buildings. This is done through a five step process, namely the *decision making process of the owner to start a CE transition, the combining of relevant stakeholders, the development of a strategic plan, the permit application* and lastly the *execution of a strategic plan*. Within these process steps, possibilities are shown to implement circularity on a building level, component and material level. Here, the possibilities are most abundant on a buildings level. To increase the actual implementation of circularity within the building, component and material level; challenges must be identified to see where change is needed, which forms the second element. Overall, during the process steps, five main challenges were identified that can occur at multiple times during the CE implementation process. These consist out of a *knowledge gap, lack of stakeholder involvement, maintaining the identity, bureaucracy and lack of resources*. Here, knowledge gap and lack of stakeholder involvement require the greatest attention as they occur during the entire process. To overcome these challenges, five corresponding enablers were identified that can help stimulate the CE implementation within CH buildings. These are *knowledge development, stakeholder engagement and collaboration, maximum value retention, policy support and creating financial opportunities*. These enablers indicate what improvements can be made by a variety of stakeholders (e.g. owners, architects, municipality) to better facilitate the implementation process, and can therefore stimulate the CE transition of CH buildings.

To conclude, by having identified the key issues in the CE implementation process and its corresponding enablers, this study tried to make a contribution to the further development of CE strategies for CH buildings in a holistic way, whereby the wishes of all stakeholders involved are taken into account. Because only together, we can act, innovate, adapt and move forwards.

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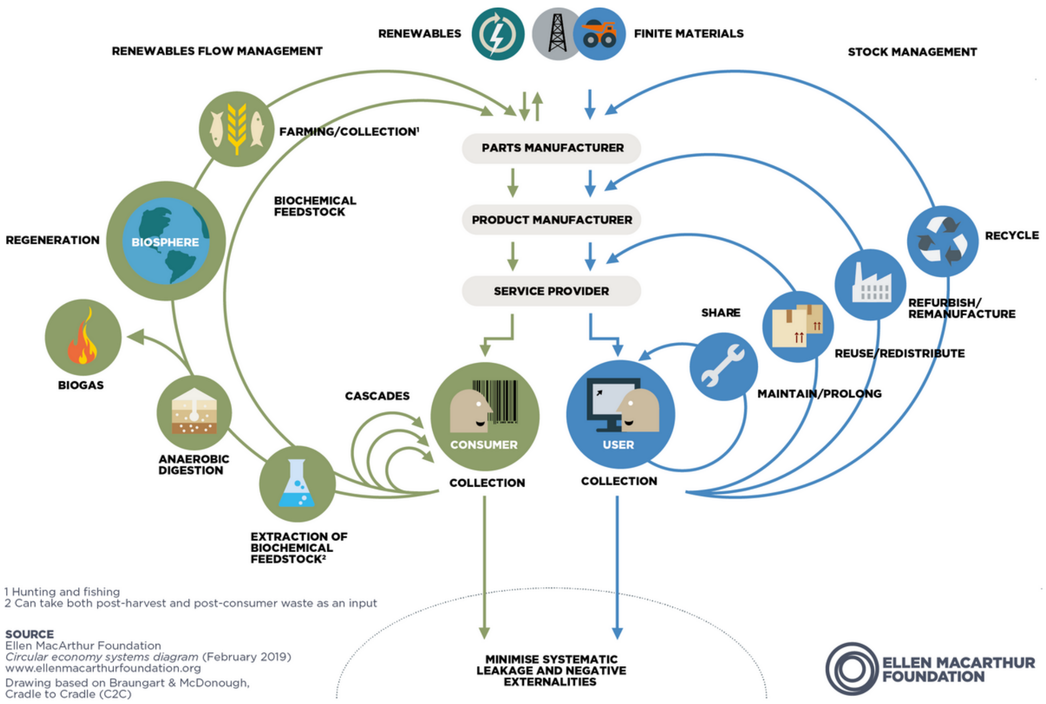
Appendices

Appendix A: Butterfly Diagram Ellen Mc Arthur Foundation



Appendix B: R-strategies

Circular Economy ↑ Increasing circularity — Linear Economy

Smarter product use and manufacture	R0 Refuse	Make product redundant by abandoning its function or by offering the same function with a radically different product
	R1 Rethink	Make product use more intensive (e.g. by sharing product)
	R2 Reduce	Increase efficiency in product manufacture or use by consuming fewer natural resources and materials
Extend lifespan of product and its parts	R3 Reuse	Reuse by another consumer of discarded product which is still in good condition and fulfills its original function
	R4 Repair	Repair and maintenance of defective product so it can be used with its original function
	R5 Refurbish	Restore an old product and bring it up to date
	R6 Remanufacture	Use parts of discarded product in a new product with the same function
	R7 Repurpose	Use discarded product or its parts in a new product with a different function
Useful application of materials	R8 Recycle	Process materials to obtain the same (high grade) or lower (low grade) quality
	R9 Recover	Incineration of material with energy recovery

R Framework, by Kirchherr et al. (2017).

Appendix C: Overview of all documents collected

Type	Content	Number
Newspapers	• New circular projects CH • Process description CE implementation CH • Examples success stories CE implementation CH • Challenges CE implementation • Societal influence on CE implementation	182
Newswires and press releases	• Summary content conferences on future of monument care • Summary presentations and workshops Monumenten Beurs 2022	16
Magazines	• Sustainable conservation and preservation strategies: opportunities	21
Institutional reports	• CH guidelines • Sustainability implementation regulations • Permit legislation reports	6
Public records	• Statistical data • Government financial records (subsidies etc)	6
Company profile reports	• Information about companies operating in sustainable monument care	26
Industry analyst reports	• Biggest trends • Industry performances • Main services offered • Operating conditions • Manuals	7
Books	• Handboek Duurzame Monumentenzorg (Manual sustainable monument care)	1

Appendix D: Interview guides

(Interview guide CE/sustainability experts)

Interview questions
Description of own role within the industry
▪ What is your role within the CH built environment? ▪ What is your current understanding of CE? 　○ What do you consider to be its core components? ▪ How familiar are you with CH buildings?
Current situation with CE / Sustainability in CH

- To your knowledge, in which phase is the development of CE implementation in the existing CH built environment?
    - If CE is present, which characteristics are CE oriented?
    - If CE is not present, is sustainability implemented?
    - If not at all, is there an ambition of implementing CE?

Current practices that are prominent within the sustainability transition

- To your understanding of CE, what are current CE practices implemented in the industry?
- (Explain best practices) To your understanding, too what extent are these 'best' practices?
- Have the implemented strategies promising results?
- With respect to the current practices, are there specific challenges paired with the CE practices?

Challenges within CE implementation of CH

(Ask for a specific project, situation that they've experienced before with implementing sustainability/ CE)

- Which challenges have you faced/do you foresee when implementing CE/sustainability
    - (keep in mind social, institutional, structural, financial, technical challenges)

Strategies for enabling CE transition within existing built environment / CH

- In your opinion, who should play a role in the implementation of CE in CH?
- What would be the first step towards CE implementation?
- What are the current best practices, of your understanding, with CE implementation?
- Which R strategies do you think are most feasible within the context of CH in the built environment?
    - If multiple, in which order?
- What are important stakeholders to include in a CE transition for CH?

Future expectations

- What are your predictions on CE implementation process within CH?
- What is the feasibility of the CE implementation process within CH?
- Which components of CH buildings can become circular?
- Are there components of CH buildings that cannot become circular?

Closing

- Is there still anything you would like to add regarding circularity in the building?
- Do you have any last questions in general?

- Can I contact you if I need some kind of clarification on the interview later on?
- If yes, how can I best contact you?
- Can you suggest a stakeholder that might be interested in having an interview with me about the topic that is indispensable for my research?

Thank you for your time and participation in our research?

(Interview guide CH experts)

Interview questions
Description of own role within the industry
▪ What is your role within the CH built environment? ▪ How familiar are you with CE and sustainability implementation within CH buildings?
Policy
• What is the current attitude towards sustainability and circularity within the policy of CH?   o Positive, negative, impeding, looking for possibilities
CE implementation process within CH Buildings

▪ When is there demand for making monuments more sustainable?
▪ When sustainability has not yet been included in the preservation of monuments, what can be potential reasons?
▪ To what extent is it desirable to increase sustainability?
 	
Starting from an initial CE implementation process:
▪ From a cultural-historical perspective: what are the core requirements that preservation must fulfill?
  o For the appearance of a monument?
  o For the interior of a monument?
  o The monumental value of the CH building
    ▪ History
    ▪ Unique
    ▪ Meaning to society
▪ Every building is unique, of course, but in general: how do you determine the monumental value of a building, determining what is untouchable and where the opportunities for change are?
▪ In order to best preserve the cultural value:
  o Whom do you need (stakeholders?)
  o What do you need (instruments etc?)
  o How do you use these assets?
  o When can this be done the best?

Challenges within CE implementation of CH

(Ask for a specific project, situation that they've experienced before with implementing sustainability/ CE)

- Which challenges have you faced/do you foresee when implementing CE/sustainability
    - (keep in mind social, institutional, structural, financial, technical challenges)

Strategies for enabling CE transition within existing built environment / CH

- In your opinion, who should play a role in the implementation of CE in CH?
- What would be the first step towards CE implementation?
- What are the current best practices, of your understanding, with CE implementation?
- To what extent would you advice to integrate CE within CH? Is it a priority?

Future expectations

- What are your predictions on CE implementation process within CH?
- What is the feasibility of the CE implementation process within CH?
- Which components of CH buildings can become circular?
- Are there components of CH buildings that cannot become circular?

Closing

- Is there still anything you would like to add regarding circularity in the building?
- Do you have any last questions in general?
- Can I contact you if I need some kind of clarification on the interview later on?
- If yes, how can I best contact you?
- Can you suggest a stakeholder that might be interested in having an interview with me about the topic that is indispensable for my research?

Thank you for your time and participation in our research?

Appendix E: Example of grouping process for concepts emerging from data

Appendix F: Subsidies and mortgages available

Examples of subsidy schemes available:

Name subsidy	Description	By who?
Subsidy adaptive reuse monuments	Costs for research into the feasibility of the adaptive reuse are covered + wind and watertight measures are covered when building is under construction	Rijksoverheid (NL Government)
Sustainable monument loan	The amount of the loan depends on the investments in energy saving measures. Starts with minimum 2,500 euros to a max of 100,000 euros.	Nationaal Restauratiefonds
MIA and VAMIL	Environmental Investment Allowance (MIA): 36% of investment costs can be deducted.	Belastingdienst (Tax Office)

	Arbitrary Depreciation of Environmental Investments (VAMIL): For investments in environmentally friendly business assets, the random depreciation is limited to 75% of the costs.	
Free sustainability advice	The reimbursement amounts to a maximum of €500.00 for a Quick Scan and to a maximum of €1,000.00 for a Feasibility Study or Customised Advice.	Restauratiefonds

Mortgages available:

Number of mortgages DML+ **[2019]**	**21**
Amount mortgages **DML+ [€] [2019]**	8.234.598
Number of mortgages **DML [**number**] [2019]**	95
Amount mortgages **DML [€] [2019]**	5.240.323
Subsidy amount for sustainability research **[€] [2020]**	145.019
Amount requests sustainability research **[**number**] [2020]**	149
Amount sustainability research final **[**number**] [2020]**	147

Source: Restauratiefonds and RCE

Appendix G: Overview of experts' roles within CE implementation

Description of the role, tasks, and objectives of the main experts involved.

Expert type	Sustainability expert	CH expert	
		Municipality	RCE
Role	Advisory role, as a consultancy firm, intermediate role	Advisory role Legislative role	Advisory role Legislative role
Tasks	Tailor-made advice, targeting: Analysis building Concept development Concrete technical solutions Support implementation process with legal and financial knowledge	In accordance with the Heritage Act, municipalities are responsible for the *granting of all-in-one permit for physical aspects*, *supervision* and *enforcement* of monuments. Moreover, some but not all municipalities offer:	Advice from architecture historians, who draws on information from colleagues with expertise in architecture, building physics, materials, specific building types, interior, movable

	This is all done with a combination of architectural-historical and construction-technical knowledge. Some consultancy firms also offer their expertise in connections; a network with the government, monument preservation, the construction and restoration world.	*Permit check* *Monument visit when drawing up sustainability plan* *Historic research* Municipalities **do not**: Take over the role of the owner Do not **submit** monument permits Do not apply for subsidies Do not do architectural inspections	heritage, art and urban planning. The RCE will give a positive or negative advice based on the damage to the monumental value.
Objectives	CE development beginning phase	No focus on CE, mostly on energy	No focus on CE, mostly on energy
	First set CH boundaries, then look what sustainability possibilities are	Conserve everything that can be conserved, with a focus on how it is now.	Conserve everything that can be conserved, with a focus on how it is now.
	Sustainability can be seen as a new layer in history of the monument	Meeting owner's wishes while respecting or even enhancing monumental value	Meeting owner's wishes while respecting or even enhancing monumental value

Appendix H: Target areas by ERM

Target areas for repair and restoration strategies monuments, by ERM.

Target area	Strategy
Walls	Wall with foundation problems: partial or total repair of the foundation
	Cracks in masonry: small cracks can be injected with a suitable injection mortar, recessing necessary with larger cracks: replacement of bricks
	Damaged bricks: bricks are cut down to the solid core and then heaped up with a suitable repair mortar
	Damaged joints: apply new joints

	Damaged natural stone: weathering control; casting new natural stone elements
Windows and glass	Stained-glass: gluing and placing lead strips on cracks
	Wooden frames, windows and shutters: timber rot, partial replacement of damaged wood with same type of wood
Roofs	Tiled roof; leakage due to broken, cracked or peeling tiles: replacement per roof plane.
	Slate roof: On a monument, only slates that comply with the highest classification of NEN 12326, namely W1, T1 and S1, may be used. These requirements assume a minimum expected life span of 80 years.
	Thatched roof: treatment with algaecide if algae/mosses manifest themselves, partially worn-out roof can be supplemented with new thatch.
Paintwork	Repair of weathered, cracking and/or peeling paintwork
Cast iron and steel	Rust control
Parquet	Fill cracks, fissures and fly-outs as soon as possible.
Molds and insects	Research species – pest control – partial repair heavily damaged wooden parts

Source: https://www.stichtingerm.nl/onderhoud-en-restauratie/herstel-onderhoud

Appendix I: Quotes supporting the research

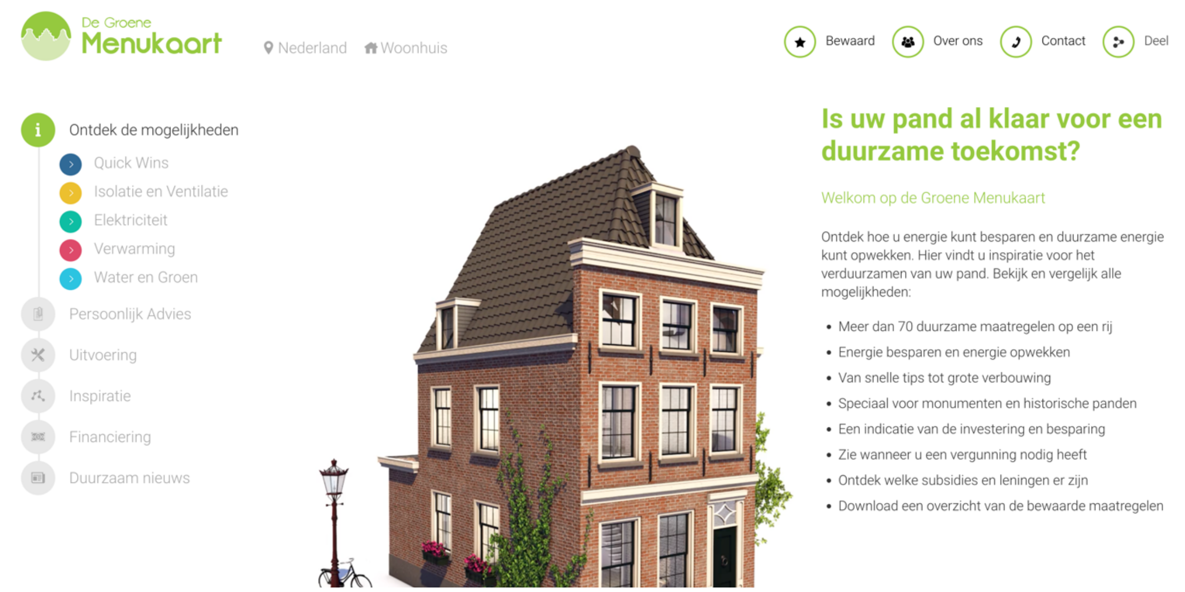
Theme	Concept	Quotes
Knowledge gap	**Unawareness of sustainability and law**	*'People often don't know what sustainability or circularity is, so they just do what they like' (S2)* *'Due to lack of knowledge transfer, owners sometimes also have no idea about their obligations for the house' (C4)*
	Lack of expertise	*'The level of knowledge among architects, contractors and advisors is often not up to standard, so that wrong choices are made' (C1)* *''There is often misinformation from reliable sources for monument owners because sustainability and circularity are still very new to them' (C4)*
	Knowledge gap municipalities	*There is very little knowledge about the circularity of materials' (C2)* *'Sometimes the RCE has to take over because the municipalities lack basic knowledge' (C2)* *'The decentralisation that has taken place means that municipalities are now responsible for many more tasks, which has resulted in a fragmentation of knowledge' (C1)*

		'There is a real difference in quality between the various municipalities, because in Amsterdam, for example, there are 10 FTEs available for heritage and in a small municipality 0.2 FTEs.' (S5)
Knowledge development	**Best practices**	*'We are now working on a knowledge base where knowledge articles, videos with explanations and all kinds of things are shown to give people an idea of what is possible' (C1)* *'People need to know what is possible, and this can best be shown in one well-known place'(C5)*
	Enhancing educational resources	*'There are not many craftsmen left in the Netherlands, the specialisms are becoming scarce, so educational opportunities must be created to train people with the right knowledge'. (C6)*
	Integrate CE practices in standard conservation	*'It is easier if standard conservation is included in sustainability and circularity, this automates the process and the knowledge is less dispersed'. (C6)*
	Lifecycle approach	*'Yes, there is still room for improvement when you look at the use of a building, for example; there may be no need to make any adjustments at all if a particular room is not used' (S4)*
Lack stakeholder involvement	**Lack communication**	*'Yes, there is often considerable miscommunication between parties, so how do you ensure that the right information reaches the right people, and that people don't just do whatever they want' (C4)* *'At a school, a foundation did not communicate well with the board, which ultimately led to the installation of solar panels without a connection, with the result that they were unusable' (S5)*
	Absence of stakeholders	*'Yes, ideally every discipline should be represented in a sustainability process, but this does not always happen, so it is difficult.' (S7)*
Stakeholder engagement and collaboration	**All relevant stakeholders present**	*'A heritage expert is important for cultural-historical values, and consultancies and architects often have the best knowledge of sustainability measures' (S2)* *'There should be more cooperation, so that the right knowledge can be brought together' (S2)* *'Municipalities can also join forces and work together, that way they can bring several specialists together' (C3)*
	Connecting factor	*'From the owner's point of view, it is often difficult to find all the right people, so a contractor can often help because he has an overview of the whole process and can bring the right people together' (S1)*
	Voice to society	*'Social sustainability is also very important, so the public and the people in the neighbourhood must be included in zoning plans' (S5)*

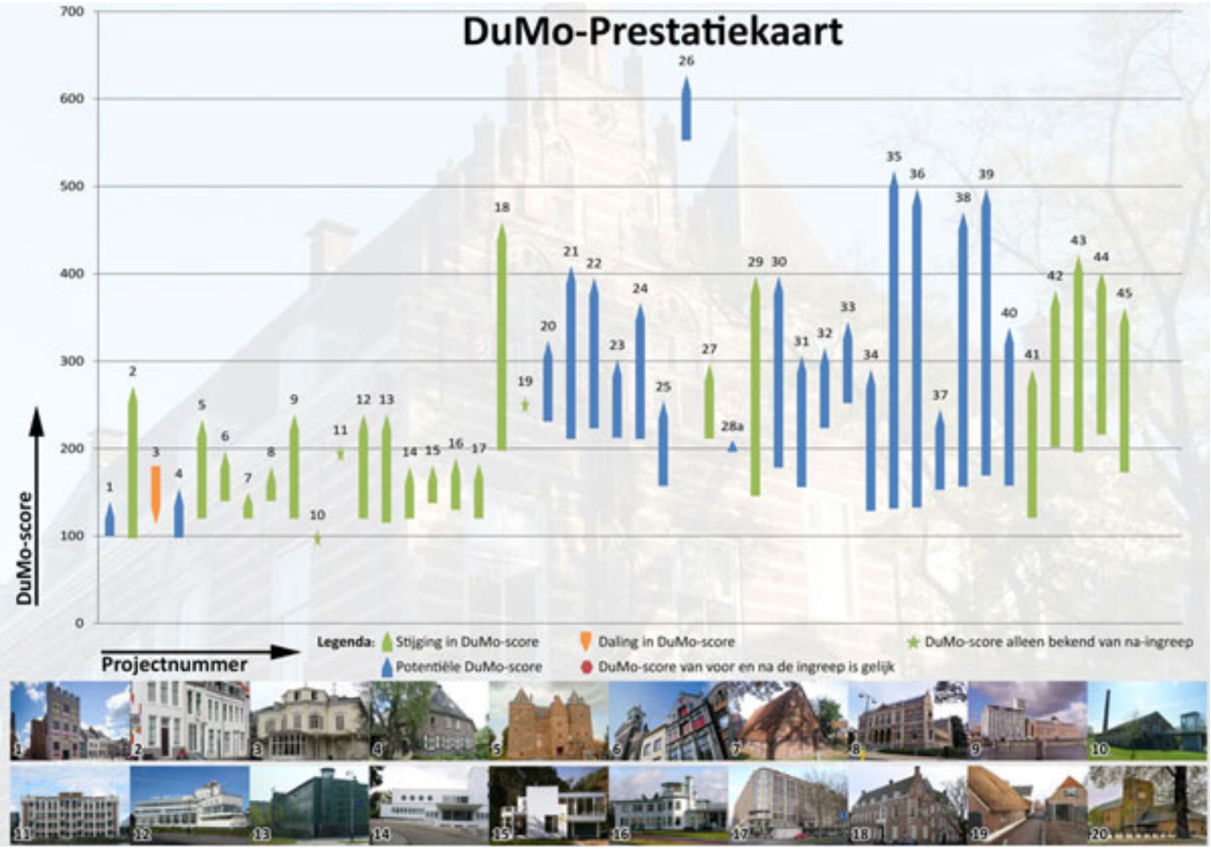
		'By opening a counter, all interested parties can make their voices heard; this increases the feasibility of a project because all interests can then be better taken into account, a kind of placemaking' (S7)
Maintaining intangible identity	**Monumental value**	*'The experiential value may not be affected' (C1)* *'So we also look at the authenticity of the components; something that is very authentic may not just go away' (C3)* *'Location, history, these are contextual values that are also included in a decision on whether or not something is allowed' (C3)* *'Ensemble value is something that needs to be taken into account' (C1)* *'We also look at the story that a building has to tell, which parts tell a story' (C2)*
Maximum cultural value retention	**Essence of CH must be determined**	*'By determining the essence of a building, for example through a building archaeological survey, it is easier to determine where there are possibilities' (C3)*
	Modular, scalable, and adaptable	*'What works well are designs that are modular, scalable and adaptable so that it does not affect the cultural-historical value and can always be removed' (S2)* *'When an adaptation is reversible, so that it is temporary rather than permanent, we are much more inclined to go along with the plan' (C3)*
	Neighbourhood approach	*'Monuments often do not offer optimal space for solar panels, for example, because of skewed roofs, limited space and suboptimal roof strength. Therefore, in the municipality of Gouda, we collaborated with a nearby industrial park, which made their roofs available for solar panels so that the entire neighbourhood could benefit. The generated energy was not delivered back to the grid but consumed within the neighbourhood. This meant that the value of the monument did not have to be affected. (C3)*
	Material bank	*'An interactive environment where you can exchange materials could ensure that elements of a building are preserved' (S2)* *'Demolition companies can contribute to a materials bank to collect all valuable parts and exchange them later' (S5)*
Bureaucracy	**No dynamic character**	*'The fact that the permit process can often only be completed in one go, without any adjustments in between, makes it difficult for owners to implement a plan. It just takes a long time' (C1)* *Yes, you actually need a permit for almost everything, there is no flexibility' (S1)*
	Legal language	*'All communication with the municipalities through the letters is in very legal language, which means that many people have no idea what they are dealing with either' (C4)*

	Response time	*'Well, waiting for a ruling just takes a long time, especially with national monuments, as an owner I would not wait for that either' (C3)*
Policy support	**Simplify permit process**	*'I had a conversation with someone at the municipality and he told me that they have an option for owners to contact them and propose their plan, and that the policy officer already fills everything in for them and gives the right advice'(C1)*
	Pre-determined criteria for permits	*'What can help is to create a kind of criteria for permits, so that they can be dealt with more quickly. If it has to do with a certain type of insulation, it can be accepted immediately' (C3)*
	Tips and tricks	*'For example, a checklist for a knowledge base may help when submitting an application for a permit, and that this is also known by every municipality'. (S7)*
	Iterative process	*'If a plan that has been submitted is rejected, it is better to contact the resident and give them advice on how to do it better, and that they can then submit the plan again immediately without having to start all over again.' (S3)*
	Standard involvement municipality	*'If the municipal standard is included in the decisions from the beginning, they can immediately indicate whether something is possible or not.' (C6)*
	Standardized processes for certified companies	*'When the municipality knows that a particular consultancy firm or architect is doing a good job, an accelerated process can be designed for them' (C4)*
Lack availability resources	**Complex financial structure**	*'Part of the funding opportunities come from the government. The RCE itself does not have great financial possibilities, so funding is often obtained from the culture budget instead of other ministries with, for example, budgets for the built environment'. (C6)*
	Subsidy not available for every owner	*'Yes, subsidies are often not for everyone because certain requirements have to be met, for example only for private owners' (C3)*
	Interested in short term profit	*'Owners want to see immediate results in their wallet, when this doesn't happen, they don't know what their own benefit is and can therefore withhold the CE transition' (S3)*
Creating financial opportunities	**Memberships of CH**	*'By sharing the costs of our heritage, we can also aim for more memberships to bring in money". (S7)*
	New market opportunities	*'By positioning a monumental building as sustainable or circular, you put it back on the map, which in turn attracts more tourism, for example' (S2)*

Appendix J: Examples sustainability implementation tools for CH

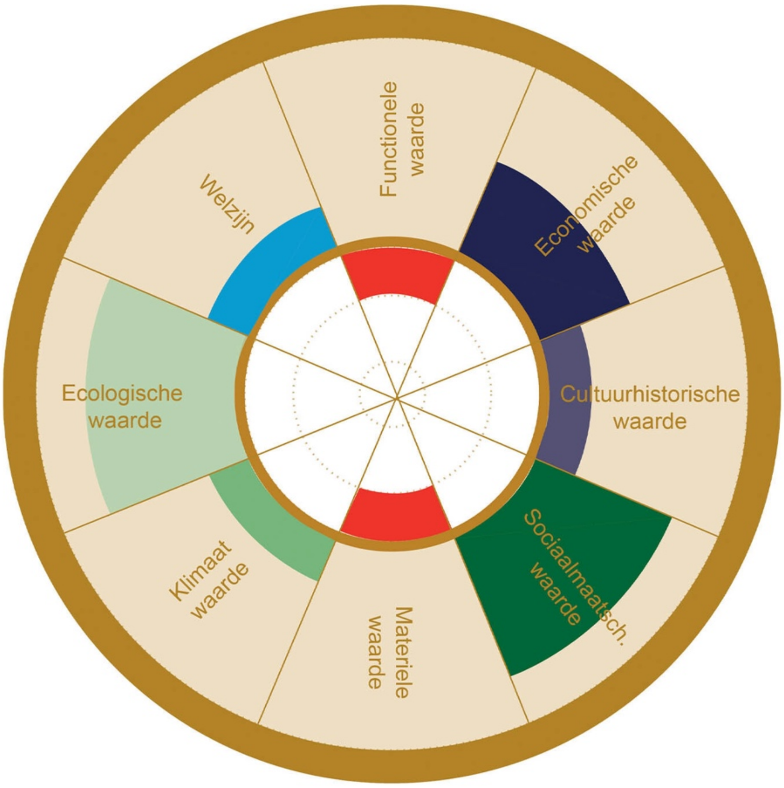


Source: https://www.degroenemenukaart.nl/nl/landelijk/woonhuizen/



Source: https://www.dumoprestatie.nl/dumo-prestatiekaart/

Erfgoed kompas



Source: brokkenmakers.nl