DELFT UNIVERSITY OF TECHNOLOGY

IMPLEMENTING CBMs IN REAL ESTATE DEVELOPMENT FIRMS

AN EXPLORATIVE STUDY

HENOC BALDERAS ZAVALA

MASTER THESIS

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Implementing Circular Business Models in Real Estate Development Firms

An exploratory study

by

Henoc Balderas Zavala

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Executive Summary

Implementing CBMs in Real Estate Firms

An exploratory study

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Abstract

The efforts to embed a Circular Economy (CE) within every organization in the Netherlands have taken both, scholars and practitioners, to look into the design of Circular Business Models (CBMs) that allow to make this transition possible; one of the Dutch industries taking this approach is the real estate development sector. Different business modelling tools have been proposed to design CBMs, however, to this date no academic research has been performed on their implementation process within real estate development firms. This study can be seen as the next step on the current developments on CBMs within real estate organizations and through a qualitative analysis of nine in-depth semi-structured interviews taken from people involved in the development of real estate assets in the student housing private sector, investigates the process of CBMs implementation and proposes a conceptual framework that encompassed it. The resulting framework includes 19 elements that emerged from the analysis grouped into 5 categories that represent the relationship of these elements to a core category. These categories and relationships are seen as the first conceptualization of the process within a real estate development firm and foster further studies to investigate and evaluate the validity of these arguments.

Keywords: Circular Economy, Circular Business Models, real estate development, student accommodation, process, visual coding paradigm.

Introduction

For the past years, the Circular Economy concept has spread to a broad range of areas of study (Geissdoerfer, Savaget, Bocken, & Hultink, 2017). However, there is still confusion about what the CE means for a given institution; how it can be translated into different industries, or how it can be implemented within a company (Araujo Galvão, de Nadae, Clemente, Chinen, & de Carvalho, 2018; Bey, Hauschild, & McAloone, 2013; Geissdoerfer et al., 2017; Lacy & Rutqvist, 2015).

One specific sector that is concerned with changing the current linear consumption system is the building industry (Adams, Osmani, Thorpe, & Thornback, 2017; ARUP_&_BAM, 2017; ARUP, 2016; Heshmati, 2017; Mangialardo & Micelli, 2018; Pomponi & Moncaster, 2017). As an important economic sector that is a major user of the linear system, the building industry has been targeted by different institutions as one of the pillar industries that needs to adopt CE principles (Ministry of Infrastructure and the Environment, 2016).

From recent studies about CE in the building industry it can be seen that there is a strong appeal to focus on the economic aspect of implementing CE in the built environment, particularly on redevelopment projects and from the point of view of a real estate developer (Adams et al., 2017; AMRO_ING_RABOBANK, 2018; ARUP_&_BAM, 2017; ARUP, 2016; Ghisellini, Ripa, & Ulgiati, 2018; Leising, Quist, & Bocken, 2018; Mangialardo & Micelli, 2018; Pomponi & Moncaster, 2017). Efforts are being made to translate CE principles into economic gains but until now there has been no clear economic case that proves CE is feasible for everyone. Nevertheless, scholars are proposing to develop new Business Models (BMs) as the first step to recognize the economic value of CE (N M P Bocken, Short, Rana, & Evans, 2014; Nancy M P Bocken, de Pauw, Bakker, & van der Grinten, 2016; Ritala et al., 2018; Rizos et al., 2016; Urbinati et al., 2017). In consequence, focusing on how business

models display the added economic value of CE seems like the most logical path to find the value that the CE brings to the construction industry.

Bouwman, De Vos, & Haaker (2008) defined business models as a description of how an organization intends to create and capture economic value with its product. Based on this definition, the essence of a business model is in defining how any organization delivers economic value to customers, influences customers to pay for this economic value, and turns those payments into profit (Teece, 2010). Organizations do this by structuring management tools that are broken down into components that contribute to decision-making processes. The link between CE principles and BMs was found in the literature, and is described as Circular Business Models (CBMs) (Blok, 2018; Urbinati et al., 2017). No single definition of CBMs was found on the literature but in summary it can be said that the objective of a circular business model is to create, deliver and capture value through the implementation of circular strategies. Furthermore, a circular strategy can be defined as a business proposition that follows a circular economy principle, e.g., extending resource value based on the principle of slowing loops (Nancy M P Bocken et al., 2016; Böckin, Willskytt, Tillman, & Ljunggren Söderman, 2016).

From a literature review on CBMs in the building industry it was found that there is little to no research to be found in CBMs at the building industry, even when BM innovation is argued as one of the economic enablers of CE in any industry (N M P Bocken, Short, Rana, & Evans, 2014; Nancy M P Bocken, de Pauw, Bakker, & van der Grinten, 2016; Ritala et al., 2018; Rizos et al., 2016; Urbinati et al., 2017). Both, scholars and practitioners have already proposed CBMs or circular strategies for the building industry; however, these propositions remain theoretical and general, and do not show the actual implications of implementing CBMs but stay only as premises for each organization to grasp. Finally, there is no attention placed on the individual challenges of a single company to implement this new kind of BMs.

In consequence, it was stated that there is a research gap on the practical implementation of CBMs. These CBMs aim to display the added economic value that CE principles bring to each sector where they are implemented. However, until now and to the author's knowledge, there is no framework that captures the process of implementing the proposed CBMs in the real estate industry, identifies the characteristics of this process and acknowledges the consequences of undertaking this process. For this reason, it was decided to explore and define the process of how a real estate development firm can implement CBMs and to conceptualize this process into a visual framework. By recognizing and illustrating this process, this research aimed to facilitate and foster the implementation of CBMs by real estate developers. The scope of this study was narrowed down to exploring the implementation of CBMs through the point of view of a real estate development firm focusing on redevelopment projects for student accommodation in the Dutch market. Furthermore, to explore this phenomenon the following research question was formulated:

What is the process of implementing Circular Business Models in a Real Estate Development firm?

Due to the relative novelty of the topic being studied it was decided that the nature of this research turned explorative, meaning that that the essence of the study will be exploring the problem of developing a detailed understanding of the phenomenon (Creswell, 2002). Therefore, a literature review on existing frameworks to implement CBMs outside the building industry was performed first. Second, the methodology to analyze the phenomenon of study was developed. This methodology was based on in-depth semi-structured interviews performed to a sample of 9 participants from an organization selected with the use of a sampling criteria. Third, the data gathered from the interviews was analyzed following a coding method proposed by Corbin & Strauss (2008) based on three coding phases, i.e., open coding, axial coding and selective coding, that results in a visual coding paradigm where the findings of the research are conceptualized and presented. Finally, the discussion of the findings and conclusion of the study are described. In the next sections, all of these parts are described.

Literature Review

Based on the literature review, it was found that scholars have focus on developing two tools related to CBMs: business modelling tools and business model innovation frameworks.

Three circular business model tools were described in the literature review, i.e., the circular business model canvas (Lewandowski, 2016), framework for sustainable circular business model innovation (Antikainen & Valkokari, 2016), and the circular business mapping tool (Nußholz, 2018). Furthermore, the research performed by Talukder (2017) was also included because of the analysis he made on other business modelling tools and the outcome of his study, i.e., the Business Combo Model. From these business modelling tools it was acknowledged that the groundwork to design CBMs is mostly based on the business model canvas developed by Osterwalder & Pigneur (2010). Additionally, visualization tools were recognized as the most practical tools to develop business models and introduce Business Model Innovation (BMI). Unfortunately, none of these tools presented a description of the CBM implementation process.

Furthermore, different business model innovation frameworks were also found on the literature; however, it was noticed that the research performed on them is not as rich as with the business modelling tools. Four frameworks were described: the circular business model implementation framework (Mentik, 2014), the circular business model transition framework (Mouazan, 2016), the 5 I framework (Talukder, 2017), and the framework for circular business model transformation framework (Frishammar & Parida, 2018). From this review it was recognized that similar characteristics can be found on all of the frameworks. The proposal to understand the CE and its implications within organizations as a first step, identifying enablers and challenges for CBM implementation, explicitly recognizing the current BM, designing a CBM and analyzing its implications on the supply chain, and developing an experimentation phase were the CBM can be scaled up were some of the characteristics that seem to be paramount for the implementation of such CBMs. However, all of the proposed frameworks seem to be particular to a specific industry, e.g., manufacturing industry, and have not been tested in larger samples or more general populations.

Consequently, the common characteristics found on the described frameworks allowed to form the basis to develop a framework specific for the building industry. Besides, the limitations found on each of the described tools granted the understanding of the challenges that needed to be overcame when developing a new circular business model innovation framework, thus, strengthening the foundations of the analysis.

Methodology

Because of the explorative nature of the research the proposed methodology to study the implementation process of CBMs in real estate development firms was through the knowledge of experts within an organization involved in this process. Therefore, a method using in-depth interviews was selected. To analyze the data gathered in the interview transcripts, a coding method derived from the work of Corbin & Strauss (2008) was implemented. This allowed to reduce the complexity of the analysis, breaking down the information into small portions, i.e., codes, that afterwards could be linked. Therefore, the methodology aimed to gather a broad range of expertise to gain a full picture of the implementation process while reducing its complexity by highlighting small pieces of information that, in the end, could be grouped to provide a clear understanding of the CBM implementation process.

Then, to develop the implementation framework, nine interviews were performed. This sample population was taken from The Student Hotel and met the criteria defined to fulfill the objectives of this study. These criteria included choosing participants that were involved with business modelling, circular economy and development of student accommodation. For consistency, an interview protocol was developed to guarantee that the right data was being collected. This protocol focused on acknowledging the experiences of the participants regarding BMs, BMI, CBMs and Circular Strategies. Following this protocol, the interviews

were performed in person, audio recorded and transcribed during an interview period of one month. To guarantee validity of the data, the members check method was used. Once the data was validated by the interviewees, the analysis started. The analysis followed the method proposed by Corbin & Strauss (2008), evaluating small portions of data and coding them. This coding was performed in three steps, i.e., open coding, axial coding and selective coding. Each step allowed the raw data from the transcripts to be narrowed down into manageable units (categories) that could be related to each other, enabling the visualization of the relationships between them.

Results

From the analysis of the interview transcripts different elements emerged as codes. The analysis of these codes resulted in nineteen axial categories that were found to be related to a core category. Each of these axial categories has a unique relationship to the core category and can be positioned within a visual coding paradigm (Figure 1). This visual tool helps to illustrate the nature of these relationships and facilitate the understanding of the implementation process. Five types of relations are proposed to be manifested when implementing CBMs, these are: causal conditions, strategies, intervening conditions, context and consequences.

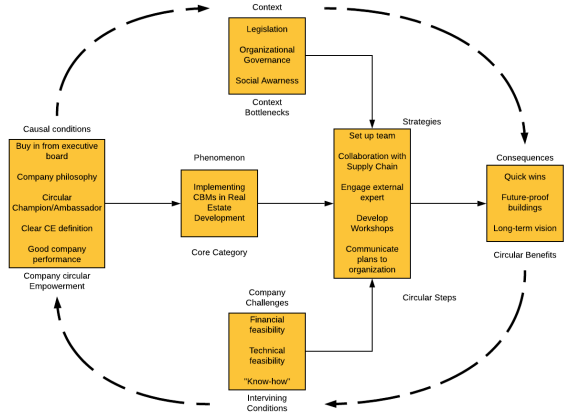

Figure 1Visual coding Paradigm of CBM implementation in a Real Estate Firm (own illustration).

Causal conditions are actions that precede the core category and are needed for its development. This relation is stated as 'Circular Company Empowerment' and is composed of five axial categories: 'buy-in from executive board', 'company philosophy', 'circular champion', 'clear CE definition' and 'good company performance'.

In response to the core category, several actions described as strategies take place, this relation is stated as 'Circular Steps' and five axial categories were found to be part of it: 'set up a team', 'collaboration with supply chain', 'engage external expert', 'develop workshops' and 'communicate plans to organization'.

Two sets of conditions affect the 'Strategies'; these are context and intervening conditions. Context conditions are stated as 'Context Bottlenecks' and comprise three axial categories: 'legislation', 'organizational governance' and 'social awareness'. Intervening conditions are stated as 'Company Challenges' and also three axial categories are present: 'financial feasibility', 'technical feasibility' and 'know-how'.

The last relationship found is the consequences which are stated as 'Circular Benefits'. These are the expected results of implementing the 'Strategies'. Three consequences were found: 'quick wins', 'future-proof buildings' and 'long-term vision'.

The conceptualization of the process gives a clear vision of how the implementation of CBMs manifests in a real estate development firm; it shows the preceding conditions that seem to enable initiation of the process, specific follow-up steps in the implementation of CBMs, particular factors that affect these following actions, and finally the expected outcomes of the process. Each of the selective categories that are included within the visual paradigm is formed by the axial categories that emerged from the expertise of people going through this process within TSH. Therefore, the 19 categories that emerged from the analysis are proposed as the characteristic elements of implementing CBMs within a real estate development firm.

Discussion

Given the implications of developing an CBMs' implementation framework for real estate

development firms from a single case study five main arguments were discussed.

First, it is argued that the novelty and particularity of some of the elements presented in this research limit the connections that can be made with previous academic efforts. Hence, when it is stated that certain factors like the 'company good performance' are direct causal conditions to the implementation of CBMs in real estate, a restricted number of conclusions can be made due to the lack of preceding information that can be related; therefore, the explorative nature of the study.

Second, the elements that can be indeed associated to previous academic studies, like the intervening factors that shape the implementation of CBMs, are not all found in the CBM literature but must be traced to more general studies on CE implementation. This more general association does not weaken the nature of the relationship but is considered to strengthen the basis of the study. Therefore, when different categories included within the proposed model are also found as forces that shape the implementation of the CE, it is expected that these categories can also be accepted as forces that shape the implementation of CBMs on further studies.

Third, it is argued that a theoretical line can be drawn from general conclusions of studies about CE's implementation challenges to this specific study on CBMs implementation. This relationship seems to be of great value since it allows the deconstruction of abstract concepts in general studies to specific and practical elements found in this study that can be measured and tested in further research. Hence, when scholars argue that one of the big barriers of CE implementation is the managerial decisions taken within an organization, this reasoning can be connected to a specific measurable factor like the level of engagement of the executive board.

Fourth, more than just identifying elements that have been previously established in the scientific literature, the value of this study is argued to be placed on the proposed interrelationships that are drawn between the proposed core category and the proposed categories, e.g., 'circular steps'. In consequence, the relationships expressed in the visual coding paradigm are as important as the elements contained within them. Then, establishing causal conditions, strategies, intervening conditions and consequences are also part of the main findings of this study. However, the relationships proposed in this research continue to be a theoretical proposition and the specific qualities of both elements and relationships require further investigation.

Finally, the findings of the research represent one of the first links between CBM studies and research being performed in real estate regarding the CE. Thus, it is expected that further studies will be derived from this work.

Conclusion

From the arguments presented during this study it is concluded that implementing CBMs in a specific real estate development firm can be represented as a set of 19 elements interrelated to a core category that were derived from the expertise of the people involved within this process in the selected firm. Four main relationships were proposed, i.e., causal conditions, strategies, context and intervening factors and consequences; these relationships state the before and after of the implementation process, and the factors that shape this event. For the purpose of this research, these relationships were labeled as 'Company Circular Empowerment', 'Circular Steps', 'Context Bottlenecks', 'Company Challenges', and 'Circular Benefits'.

This whole process can be represented by a visual coding paradigm (Figure 1). This illustration echoes the arguments presented in the literature review where it was stated that most of the practitioners and academics are in favor of visual tools that reduce the complexity of processes. In addition, this tool allows the elements within the process to be conceptualized and places each of these new concepts in a specific position within the framework. Furthermore, it helps to reduce the complexity of the implementation process through the identification of the building blocks described in the previous section.

Finally, even when the relationships within the process are portrayed as linear, the process is regarded as a continuous entity that needs to be

constantly reviewed. This characteristic allows to embrace the dynamic nature of the process, fosters future studies and, in a sense, depicts the 'circularity' of such implementation process.

Due to the scope and lack of resources, the framework presented in this study could not be tested nor could the elements that are contained within it. Therefore, it is recommended that further studies focus on testing both the framework and the elements that comprehend it; aiming to see if these arguments still hold in other organizations and, moreover, if they can be generalized to a greater extent. Furthermore, it is important to evaluate if the proposed framework delivers the expected outcomes or how different results affect the overall process. All in all, the elements presented in this study are a first description of the factors surrounding the implementation process, but now, these elements allow for a more detailed qualitative or quantitative studies to be performed, which was not possible before. Hence, the importance of this study and the large spectrum of possible future studies that it fosters .

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"A building is not something that you finish. It is something that you start".

-Steward Brand

1.0 Introduction

In recent years, the concept of a *Circular Economy (CE)* has gained grounds thanks to the Ellen MacArthur Foundation[1] (EMF) which published a series of reports (EMF, 2013a, 2013b, 2014) promoting the benefits of a CE. Since then, the CE concept has evolved into a full spectrum of studies that range from product development[i] to strategic design, from a single stakeholder point of view to the interactions of supply chains[ii]; and from a particular industry to the complex systems within cities[iii]. Therefore, the CE concept has been gaining traction within academia, industry, and policymaking (Geissdoerfer et al., 2017). However, currently, there is still confusion about what the CE means for a given institution; how it can be translated into different industries, or how it can be implemented within a company (Araujo Galvão et al., 2018; Bey et al., 2013; Geissdoerfer et al., 2017; Lacy & Rutqvist, 2015).

This study focuses on the phenomenon that arise when *Circular Business Models (CBMs)* are introduced within real estate development firms and seeks to contribute to the current stock of knowledge on CE implementation. The focus on real estate was chosen due to the opportunity to collaborate with one of the front runners in innovation of the commercial real estate sector in the Netherlands, i.e., *The Student Hotel (TSH).* The rapid growth of this company has had in the last few years reflects a unique company philosophy that cares to include Corporate Social Responsibility (CSR) within its developments. As a result, TSH's implementation of CE principles into their real estate products provided the perfect environment in which to explore the process first-hand.

[1] The Ellen MacArthur Foundation is a British registered charity dedicated to promoting and accelerate the global transition to a circular economy (see https://www.ellenmacarthurfoundation.org)

Different tools and frameworks have been developed to ease the paradigm change of going from linear to circular (Antikainen & Valkokari, 2016; Leising, Quist, & Bocken, 2018; Lewandowski, 2016; Nußholz, 2018; Pomponi & Moncaster, 2017; Ritala, Huotari, Bocken, Albareda, & Puumalainen, 2018); however, none of these tools have been implemented within the real estate sector and the best processes to introduce them still remains uncertain.

This thesis builds upon this knowledge gap and, through exploratory research, studies the process of implementing CBMs in Real Estate Development firms. The findings of this research result in a conceptual framework that links the causes, factors, and consequences of undertaking this process.

The framework that emerged from this study is represented using a visual coding paradigm (Figure 23) and explains the relationships between the factors, actions and consequences of the implementation of CBMs by real estate developers (Creswell, 2002).

This chapter states the research problem and presents the research scope and the research gap. The research framework is defined, i.e. the goal, research question, and sub questions. Finally, the research design and outline are described.

1.2 Research Problem

1.2.1 Research Background

There is a problem with our current way of consuming products. This consumption model was introduced in the early days of industrialization, and it is described as a 'take, make-use-dispose' system (Araujo Galvão et al., 2018; EMF, 2013a). This system is causing great sustainability problems around the world; as summarized by Geissdoerfer et al (2017), problems are seen in the three spheres of sustainability, i.e., People, Planet, and Profits.

In addition, human population is increasing as never seen before and it is projected to grow to 9 billion by 2050 (EMF, 2013a). This population trend translates into more consumers in the coming years that, if nothing changes, will continue the same linear consumption system, thus proliferating the problems that this linear system entails.

To address this situation, the concept of a Circular Economy (CE) has recently gained importance. Policymakers around the world are already focusing on this concept, as it can be seen in the European Circular Economy package and the Chinese Circular Economy Promotion Law (Geissdoerfer et al., 2017). Moreover, this topic has become an important research field with an

increasing amount of related studies undertaken in the last decade (Winans, Kendall, & Deng, 2017). But then, what is a CE?

1.2.2 Circular Economy

According to different authors (Andersen, 2007; Araujo Galvão et al., 2018; Geissdoerfer et al., 2017; Leising et al., 2018; Rizos et al., 2016), the CE concept has no clear evidence of a single origin but is rooted in different schools of thought like industrial symbiosis, industrial ecology, systems theory, ecological economics, and cradle-to-cradle (C2C), and has been around - in some way or another- since 1966 (Leising et al., 2018). Additionally, Winans et al (2017) mentioned that the concept of CE has evolved differently depending on the social and political system where it was implemented.

In spite of this situation, it is well recognized that CE has gained momentum thanks to the reports published by the EMF (EMF, 2013a, 2013b, 2014). In these reports, the CE is defined as:

> *"An economic and industrial system where material loops are closed and slowed, and value creation is aimed for at every chain in the system, therefore is restorative or regenerative by intention and design"*

This concept promises to separate our economic growth from raw material extraction and bring additional benefits along the way (Rizos et al., 2016). It has been estimated that *"the transition to a circular economy in the mobility, food, and built environment sectors could lead to emissions reductions of 48% by 2030 and 83% by 2050, compared with 2012 levels"* (MacArthur, Zumwinkel, & Stuchtey, 2015). In summary, the CE seems like the "golden snitch" that could end our current linear consumption model; the problem, as always, is how to "capture it".

Consequently, both practitioners and academics are searching for ways to develop the CE within our society (Ritala et al., 2018). As with any new concept, problems arise that delay implementation. Araujo Galvão et al (2018) conducted a comprehensive study of the current general barriers to achieving a CE. The authors concluded that to adopt a CE, efforts are required to refine existing measures as well as to deploy a wide range of policies to overcome the recognized barriers; these efforts are specific to each sector. This study also highlighted the need for **more exploratory research methods**, since most of the papers analyzed were based on literature reviews. Additionally, it was found that 40% of the articles read were case studies, suggesting that **on-site research regarding the CE is of great interest among scholars** (Araujo Galvão et al., 2018).

As it can be seen, the interest in CE is present but further exploratory on-site research within specific sectors is still needed.

1.2.3 Circular Economy in the Built Environment

One specific sector that is concerned with changing the current linear consumption system is the building industry (Adams et al., 2017; ARUP_&_BAM, 2017; ARUP, 2016; Heshmati, 2017; Mangialardo & Micelli, 2018; Pomponi & Moncaster, 2017). As an important economic sector that is a major user of the linear system, the building industry has been targeted by different institutions as one of the pillar industries that needs to adopt CE principles (Ministry of Infrastructure and the Environment, 2016).

Scholars have acknowledged that the construction sector is a highly material-intensive industry; construction and demolition activities generate large amounts of waste and, on a global scale, this industry is still the largest consumer of raw materials, accounting for 25-40% of global carbon dioxide emissions (Adams et al., 2017). However, most of the recent research about the CE has mainly focused on short-lived manufactured products, *"neglecting the complexities inherent within buildings"* (Pomponi & Moncaster, 2017).

Attempts to link the CE concept to the day-to-day practices within the construction sector have, most often, been limited to energy consumption and carbon emissions (Pomponi & Moncaster, 2017). While topics related to energy efficiency are being widely explored, the CE is still a relatively new topic within the building industry (Leising et al., 2018).

Nonetheless, initial efforts that do not focus on energy consumption and carbon emissions have been made (Adams et al., 2017; Ghisellini et al., 2018; Leising et al., 2018; Mangialardo & Micelli, 2018; Pomponi & Moncaster, 2017). Description of the recent developments of CE within the building industry can be found in Appendix 1.

From these initial efforts to link CE concepts to the construction sector, three important aspects are acknowledged:

1. Both, scholars and practitioners, stress the importance of researching the **economic value of implementing CE in the built environment** (Adams et al., 2017; AMRO_ING_RABOBANK, 2018; ARUP_&_BAM, 2017; ARUP, 2016; Ghisellini et al., 2018; Leising et al., 2018; Mangialardo & Micelli, 2018; Pomponi & Moncaster, 2017);
2. Scholars recognize that **redevelopment projects** have major 'circular' benefits over new construction, i.e., less use of energy, preservation of value, resource efficiency, and less generation of CO_2 emission (Adams et al., 2017; Ghisellini et al., 2018; Mangialardo & Micelli, 2018; Pomponi & Moncaster, 2017); and
3. Some scholars acknowledge **real estate developers** as the main actor in the supply chain to promote the introduction of CE principles in real estate redevelopment projects (Disseldorp, 2018; Kusters, 2013; Leising et al., 2018; Rood, 2015).

Based on these points, it can be seen that **there is a strong appeal to focus on the economic aspect of implementing CE in the built environment, particularly on redevelopment projects and from the point of view of a real estate developer.**

Efforts are being made to translate CE principles into economic gains but until now there has been no clear economic case that proves CE is feasible for everyone. Nevertheless, **scholars are proposing to develop new Business Models (BMs) as the first step to recognize the economic value of CE** (N M P Bocken, Short, Rana, & Evans, 2014; Nancy M P Bocken, de Pauw, Bakker, & van der Grinten, 2016; Ritala et al., 2018; Rizos et al., 2016; Urbinati et al., 2017). In consequence, focusing on how business models display the added economic value of CE seems like the most logical path to find the value that the CE brings to the construction industry. A general description of business model literature is presented next.

1.2.4 Circular Business Models

To define Circular Business Models (CBMs) it is important to first define the concept of Business Models (BMs). According to Nußholz (2018) BMs describe how companies create value converting resources and capabilities into economic value. Some scholars say that BMs were first created in the 1990's with the establishment of e-business (Nielsen, 2014). BMs have been investigated by many scholars from various disciplines ranging from computer science to strategy; this has contributed to a long list of definitions that can be found in the literature (Dasilva & Trkman, 2013). To avoid complexity, the definition of Bouwman, De Vos, & Haaker (2008) will be used in this thesis. Here, **business models are defined as a description of how an organization intends to create and capture economic value with its product**. This type of model enables cooperation and communication within and between organizations (Mäkelä & Lehtonen, 2011).

Based on this definition, the essence of a business model is in defining how any organization delivers economic value to customers, influences customers to pay for this economic value, and turns those payments into profit (Teece, 2010). Organizations do this by structuring management tools that are broken down into components that contribute to decision-making processes. One example of these components is illustrated by Osterwalder & Pigneur (2010) through nine building blocks, i.e., customer segments, value propositions, channels, customer relationships, revenue streams, key resources, key activities, key partnerships, and cost structures. The nine building blocks are drawn from their famous Business Model Canvas. Further description of these building blocks can be found in Appendix 2. It is important to clarify that a business model is not the same as business strategy. As summarized by Cha (2017), business models are the direct result of a business strategy, *"a means for the coherent implementation of a strategy but not the*

strategy itself". Therefore, the link between CE principles and BMs was found in the literature, and is described as Circular Business Models (CBMs) (Blok, 2018; Urbinati et al., 2017).

Lewandowski (2016) states that the fundamental component of a circular business model is the value proposition. Moreover, Nußholz (2018) states that the circular business model concept was developed to help companies adopt circular practices. She goes a step further and describes that the aim of a circular business model is to reconcile commercial value with the adoption of circular strategies. Thus, **the objective of a circular business model is to create, deliver and capture value through the implementation of circular strategies.**

Several studies in the literature have examined circular strategies (Nancy M P Bocken et al., 2016; Böckin et al., 2016). These studies developed frameworks to identify circular business strategies based on two circular economy principles: resource efficiency and the slowing down or closing of loops. For example, Nancy M P Bocken et al. (2016) take a product design perspective and focuses on postulating circular strategies that allow the slowing down or closing of loops on a product level. In another example, Willskytt, Böckin, André, Ljunggren Söderman, & Tillman (2016) gives a more generic approach and presents a typology that illustrates ways to increase resource efficiency. Therefore, **a circular strategy can be described as a business proposition that follows a circular economy principle**, e.g., extending resource value based on the principle of slowing loops. The transition from a BM to a CBM is illustrated in Figure 2; in this figure, the difference between these BMs is marked by the introduction of new business strategies, e.g., circular strategies.

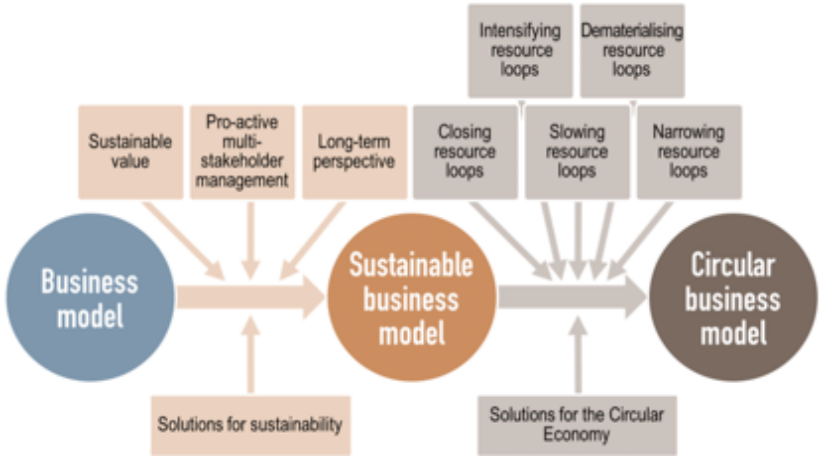


Figure 2 Comparison of traditional, sustainable and circular business models taken from (Geissdoerfer, M. et al., 2018.)

1.2.6 CBMs in the building industry

After a thorough literature search on ScienceDirect, Google Scholar, and the TU Delft repository, only two studies focused on CBMs within the building industry were found: Leising et al. (2018) and van den Brink (2016).

Leising et al. (2018) presents a framework that focuses on supply chain collaboration; however, one of the proposed building blocks for this framework is the implementation of business model innovation (BMI). Following the archetypes developed by (N M P Bocken et al., 2014; Ritala et al., 2018), Leising et al. (2018) propose nine circular strategies as possible key enablers for CBMs: *optimize material and energy efficiency, create value from waste, substitute with renewables, deliver functionality, adopt stewardship role, encourage sufficiency, repurpose for society, inclusive value creation, and develop scale-up solutions*. Nonetheless, because of the focus on the whole supply chain, detailed propositions for a specific actor within the supply chain, e.g., a real estate developer, are not drawn. Additionally, the authors recommend deepening the conceptualization of BMs- hence CBMs - due to its novelty in the building industry.

Van den Brink (2016) focuses on developing 'business model prototypes' that serve as variants for the creation, delivery and capture of value within a CBM; he bases his model on the Value Mapping tool for sustainable business thinking developed by Bocken and Short (2015). For this CBM to work, he introduces a new actor into the supply chain, i.e., the Services Provider. This actor enables the introduction of CE principles into the process and allows the development of CBMs around his functions. Although this research represents a great advancement in the current state of knowledge, the model developed remains theoretical and cannot be tested in the real world since the proposed new actor is not present in the current construction supply chains. Nevertheless, two important aspects can be taken from this study. First, van den Brink (2016) mentions that "*one of the main challenges in implementing CBM in construction is to be found at the organizational level*". Second, he concludes that there is a need for practical CBMs implementation cases given the lack of studies on this topic.

Given the lack of research about CBMs specific to the construction industry, a more generic search using the Google search engine was performed to see if practitioners in the Dutch building industry had already tackled this problem. From this search, five reports were found in the literature: *Circular Economy Finance Guidelines* developed by FinanCE, a group formed by the three most important banks in the Netherlands (AMRO_ING_RABOBANK, 2018); *Circular Construction* (van Sante, 2017); *A Future-Proof Built Environment (*AMRO, 2017); *Circular Economy in the Dutch construction sector* (Rijkswaterstaat, 2015); and *Circular Business Models for the Built Environment* (ARUP_&_BAM, Carra, & Magdani, 2017). In these reports, practitioners analyze the current status quo of the building industry, postulate needed changes for a circular building industry, give examples of other industries applying CBMs, identify some of the bottlenecks of circular implementations and, as a result, present different CBMs that can be

implemented in the built environment; these CBMs are presented in Table 1. However, none of the CBMs proposed have been tested or put forward for academic research.

All proposed circular business strategies from the five reports were compared and analyzed. The report developed by the group FinanCe was the most extensive and included all of the proposed strategies captured in the other four reports. Therefore, the report by FinanCe was selected for further description. A detailed description of the Circular Strategies outlined by FinanCE is given in Appendix 4.

From the review on CBMs in the building industry, the following facts were recognized:

1. There is little to no research to be found in CBMs at the building industry, even when BM innovation is argued as one of the economic enablers of CE in any industry (N M P Bocken, Short, Rana, & Evans, 2014; Nancy M P Bocken, de Pauw, Bakker, & van der Grinten, 2016; Ritala et al., 2018; Rizos et al., 2016; Urbinati et al., 2017).
2. Both, scholars and practitioners have already proposed CBMs or circular strategies for the building industry; however, these propositions remain theoretical and general, and do not show the actual implications of implementing CBMs but staying only as premises for each organization to grasp. Therefore, **there is the lack of research on CBMs implementation in the building industry**.
3. The current focus on CBM development is taken from the perspective of the whole supply chain; there is no attention placed on the individual challenges of a single company to implement this new kind of BMs. As implied by Cha (2017), different firms deliver different outcomes due to their unique characteristics. Thus, the transition to new BMs implies the **need for single organizations to be investigated;** however, none of the current studies tackles this challenge.

It can therefore be argued that the lack of research on CBMs implementation in single organizations presents an appealing opportunity to promote the introduction of these new BMs and enable the transition to a CE. Furthermore, it could also be argued that without the acknowledgement of this process, it does not seem feasible that the proposed CBMs can be widely implemented throughout the building industry; if this uncertainty cannot be clarified, the forecasted CE potential benefits have the possibility of going into oblivion.

In summary, there is a research gap on the practical implementation of CBMs. These CBMs aim to display the added economic value that CE principles bring to each sector where they are implemented. Scholars and practitioners have already proposed CBMs at the building industry; however, until now and to the author's knowledge, there is no framework that captures the process of implementing the proposed CBMs in the real estate industry, identifies the characteristics of this process and acknowledges the consequences of undertaking this process.

Table 1 Summary of practitioners' proposed CBMs for the built environment (own illustration

FinanCE	ING	ABN AMRO	Rijkswaterstaat	ARUP & BAM
Circular Inputs	Not mentioned/part of another strategy	Circular Inputs	Not mentioned/part of another strategy	Not mentioned/part of another strategy
Circular Design	Circular Design Construct demountable buildings Design buildings with fewer materials	Not mentioned/part of another strategy	Adaptive Design Modular Design Low material design Design for deconstruction Design for recycling/C2C	Circular Design
Sharing Business Model	Not mentioned/part of another strategy	Sharing Platforms	Not mentioned/part of another strategy	Circular Use
Life Time Extension	Maximize life span	Life Time Extension		
Product-as-service	Not mentioned/part of another strategy	Product-Services Systems		
Material/Resource Recovery	Material Banks Demolish and Recycle	Value Recovery	Recycle for (circular) design	Circular Recovery
Circular Facilitator and enablers	Bio-based Construction Transformation Resource Passport	Not mentioned/part of another strategy	Material Passport	Not mentioned/part of another strategy

1.3 Goal of Research

The goal of this research is to explore and define the process of how a real estate development firm can implement CBMs and to conceptualize this process into a visual framework. By recognizing and illustrating this process, this research aims to facilitate and foster the

implementation of CBMs by real estate developers. Moreover, this research provides a basis for further studies on CBM implementation by scholars focused on the built environment.

From the academic point of view, this research follows the efforts of scholars examining how CE principles can be introduced in the built environment, more specifically in the real estate sector. However, since to date there is no evidence of *in situ* research to understand the process of implementing CBMs in the building industry, this study is the first of its kind. Furthermore, it will expand the work of scholars developing business models for real estate by accruing knowledge on CBMs and how they are understood and implemented in the building industry.

From an industry perspective, this research will provide insights for those real estate developers that want to make a transition to a circular economy but still don't see the value of doing it or do not know how to make this transition. It will allow the visualization of the elements that constitute this process and define a clear path for the implementation of CBMs, fostering the recognition of the economic added value of changing the linear consumption system in real estate.

1.4 Research Scope

The scope of this research is delimited to The Netherlands, thus to the Dutch Real Estate Market. The research scope is also delimitated to analyze only redevelopment projects because of the previously mentioned inherent circular characteristics (Adams et al., 2017; Ghisellini et al., 2018; Mangialardo & Micelli, 2018; Pomponi & Moncaster, 2017). Moreover, and due to the large range of real estate assets, this research only focuses on student housing. This choice is made because of the current growing market and opportunities that exists within the Netherlands regarding this type of real estate asset, and because of the collaboration with TSH. A short overview of the student housing market is given in Appendix 3, but overall it shows that the current situation of this market creates a good environment to introduce innovative ideas that give competitive advantages like the introduction of CE principles. Finally, the implementation process will only be explored from the point of view of the real estate developer due to the importance that some scholars give to this actor within the real estate industry, as also described earlier.

Therefore, this study is narrowed down to exploring the implementation of CBMs through the point of view of a real estate development firm focusing on redevelopment projects for student accommodation in the Dutch market.

1.5 Research Question

Based on the research problem, postulated goal and research delimitations the research question is as follows:

What is the process of implementing Circular Business Models in a Real Estate Development firm?

The derived sub questions are:

1. Which frameworks exist for implementing CBMs in other industries besides the building industry?

As previously mentioned, it was found that scholars and practitioners have already develop CBMs for the building industry. However, none of these CBMs come with a framework that outlines implementation processes within different and particular organizations; furthermore, none of the proposed CBMs have been scientifically validated. Consequently, this sub question aims to investigate if there are implementation frameworks for CBMs outside the building industry and if so, recognize the elements that are present to draw a baseline.

2. How can a framework for implementing CBMs be designed based on the experiences of an organization itself?

Due to the lack of knowledge on CBMs implementation in real estate there is a need to establish a clear methodology that allows analysis of the phenomenon of study, especially since the research will be performed *in situ* with the collaboration of a Real Estate Developer.

3. What can the experiences from a real estate development firm tell about the implementation of CBMs in such firms?

The theoretical information that is presented in literature is one thing, but another is how this information or knowledge is perceived and implemented by its actual stakeholders. In this study, the point of view of a Real Estate Developer is taken; therefore, the factors that encompass implementing CBMs are taken from the people within this stakeholder.

4. What are the implications of introducing the designed framework for CBMs implementation within different real estate development firms?

This final sub question looks into the implications of scaling up the designed framework into other real estate development firms, its delimitations and probable outcomes according to the analysis between the identified frameworks in the literature review and the results of this study.

1.6 Research Design

The relative novelty of the topic being investigated means that there is a lack of previous research, hence a lack of relationships among identified variables that portray the nature of the phenomenon, i.e., the process of implementing CBMs in real estate. This means that the essence of the study will be exploring the problem of developing a detailed understanding of the

phenomenon (Creswell, 2002). Therefore, the research is explorative rather than explanatory (test hypotheses about cause-and-effect relationships) or descriptive (describes the characteristics of variables previously recognized to identify relevant aspects of a phenomenon). Explorative research fits when not much is known about the research problem or no information is available on similar problems that can be extrapolated (Sekaran & Bougie, 2016).

The explorative steps to perform this study are illustrated in Figure 3 and follow a qualitative scientific structure; this means that detailed procedures of inquiry are included, and the study follows a traditional form of reporting (Creswell, 2002).

Figure 3 Research Design (Own illustration)

Therefore, a literature review on existing frameworks to implement CBMs outside the building industry was performed first. Second, the methodology to analyze the phenomenon of study was developed. This methodology was based on in-depth semi-structured interviews performed to a sample of 9 participants from TSH selected with the use of a sampling criteria. Third, the data gathered from the interviews was analyzed following a coding method proposed by Corbin & Strauss (2008) based on three coding phases, i.e., open coding, axial coding and selective coding, that results in a visual coding paradigm where the findings of the research are conceptualized and presented. Finally, the discussion of the findings and conclusion of the study are described.

1.7 Research Outline

Following the research design this thesis is structured as follows: chapter two presents the literature review, chapter three describes the methodology developed to study the phenomenon, chapter four shows the results of the analysis, chapter five discusses the discussion of the research, and chapter six gives the conclusions of the study and provides answers to the main research question. Enjoy the reading!

2.0 Literature Research

As outlined in Chapter 1, CBMs for the building industry have already been proposed; however, a framework for their implementation does not exist within the literature. This chapter presents a literature review of CBMs outside the building industry.

For this literature review, two academic search engines were used, ScienceDirect and Google Scholar. The search terms were 'Circular Business Model(s)' AND 'implementation' AND 'framework'. This search generated several results and those research papers that presented the concepts as described in the previous chapter were analyzed further. After applying this filter, it was recognized that there are two focus of research: business modelling tools and business model innovation frameworks. Most recent studies have been made around business modelling tools; thus, these tools are analyzed first. After the business modelling tools are presented, the business model innovation frameworks are described.

2.1 Business Modelling Tools

Business modelling tools aim to design business models within organizations. All identified business modelling tools are visual tools. As mention by Nußholz (2018) the visualization of business models is a key aspect for its implementation. *"They allow to reduce the complexity of the process, enable the discovery of tangible structures within companies and create a common understanding"* (Nußholz, 2018). Furthermore, it has been proven that in practice, visual thinking

is indispensable to work with business models (Osterwalder & Pigneur, 2010). This visualization allows to better understand and communicate the business model, generate new ideas and remove obstacles for innovation (Eppler & Hoffmann, 2011). Therefore, these types of tools facilitate communication within a company but also with a company's external stakeholders (Zhang, 2012).

Nevertheless, even when visualization tools have been recognized as great enablers for business model innovation, according to Nußholz (2018) to this date only a few people have focused on developing circular business model visualization tools, despite the popularity that they have in traditional management practices. In the following sections, these tools are described to find how they are being implemented and if common proposals for CBMs implementation can be drawn from them.

2.1.1 Circular Business Model Canvas

The circular business model canvas was developed by Lewandowski (2016). This tool is based on the Business Model Canvas but introduces two new building blocks to the work of (Osterwalder & Pigneur, 2010), i.e. Take-Back-Systems and Adoption Factors. The tool was developed as a response to the lack of frameworks available to design business models that enable the implementation of circular economy principles (Lewandowski, 2016). Lewandowski reaffirms the need of this type of tools to stimulate and foster implementation of the circular economy.

The implementation of this tool, follows the reasoning of the business model canvas (Osterwalder & Pigneur, 2010). Furthermore, the business model canvas can be used to develop circular business models because, as Lewandowski states, "*all the business models are to some extent linear and circular at the same time" (Ibid.)*. However, he found out that some elements pointed out in literature extended beyond the existing components of a traditional business model.

Lewandowski tackles this problem by linking the framework proposed by the Ellen MacArthur Foundation (EMF), i.e., ReSOLVE, to business model components and design processes. His comprehensive study about circular business models, design methods and tools, and the postulated components that a circular business model must have, resulted in the two new buildings blocks mention earlier, i.e., Take-Back-Systems and Adoption Factors.

Take-Back-Systems refer to how the principle of reverse logistics[2] can be implemented in a business model. This new building block includes take-back-management, channels and customer relationships. It was included to acknowledge the importance of closing material loops in circular economy.

Adoption factors describe how any company can anticipate and counterattack rejection factors in the implementation of circular economy principles. Lewandowski describes two types of rejection factors: external and internal.

Internal factors concern organizational issues related to the implementation of the circular business model. External factors include technological, political, sociocultural, and economic issues.

Complementing the tool, Lewandowski postulates three main challenges that need to be considered to successfully implement a circular business model (see Figure 5). These are: fit between value preposition and costumer segments, cost structures and revenues stream, and changes towards circular business models and adaptation factors.

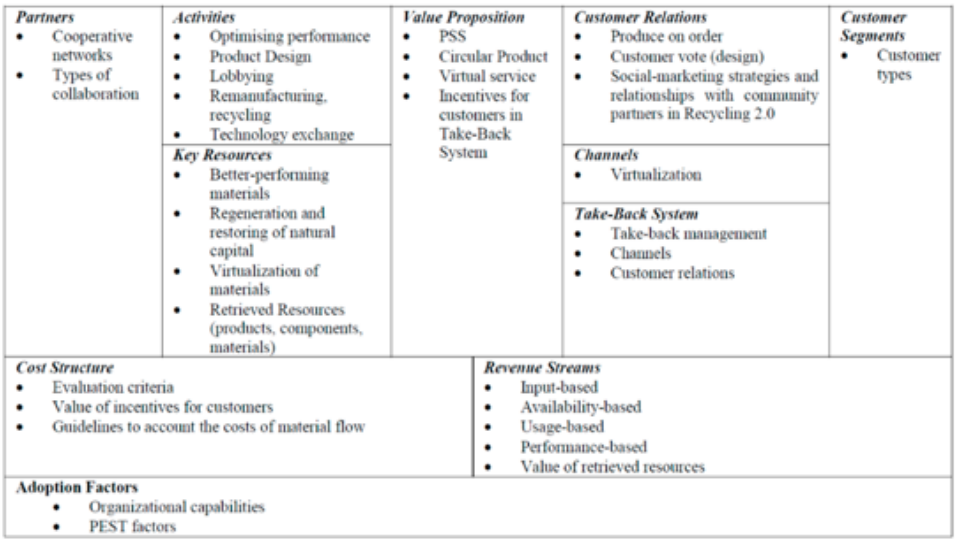


FIGURE 4CIRCULAR BUSINESS MODEL CANVAS BY (LEWANDOWSKI, 2016)

[2] *Reverse logistics refers to the sequence of activities required to collect the used product from the customers for the purpose of either reuse or repair or re-manufacture or recycle or dispose of it* (Agrawal, Singh, & Murtaza, 2015).

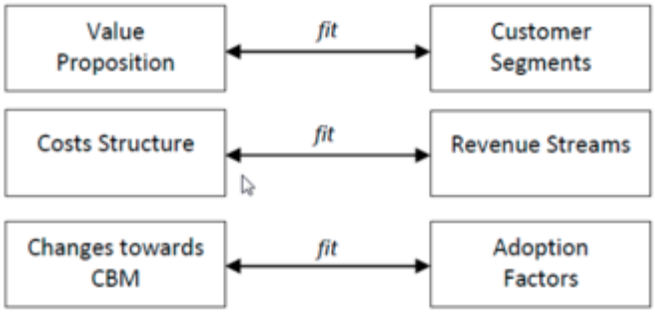


FIGURE 5 THE CHALLENGE OF TRIPLE FIT BY (LEWANDOWSKY, 2016)

The Circular Business Model Canvas is proposed as a novel tool to design CBMs. The inclusion of the two new building blocks seems to enable organizations to introduce CE principles; however, the implementation of this tool is left out of the research's scope. The building block 'adoption factors' and its derived 'fit challenge' proposition, i.e., changes towards CBM vs Adoptions Factors (see Figure 5), seem to tackle the issue of the tool's implementation but no guideless are drawn to understand how this process should be managed or introduced in a specific organization. Therefore, it is acknowledged that this tool still misses an implementation framework.

2.1.2 Framework for Sustainable Circular Business Model Innovation

The framework for sustainable circular business model innovation was developed by (Antikainen & Valkokari, 2016) as a response of the lack of tools and frameworks that include identified circular economy enablers for business innovation. The baseline of this framework is the implementation of recognized trends and drivers at the ecosystem level, understanding stakeholders' value within an organization, and the evaluation of impacts brought by sustainability and circularity.

Antikainen and Valkokari work is built upon different ideas and structures related to circular economy and sustainability. One explicit reference is the use of the business model canvas structure (Antikainen & Valkokari, 2016). The innovation on their work is the inclusion of a multilevel analysis of the business ecosystem. They include the macro, meso, and micro level surrounding any business due to the systems thinking that the CE brings. Furthermore, the impact of the business is divided into sustainability benefits and costs integrating the triple bottom line, i.e. People, Profit, Planet, to the business model.

To the left of the tool, Antikainen and Valkokari (2016) include the idea of constant iteration with sustainability and circularity evaluations of the business model. This aspect is postulated to

improve the business model by gathering constant data on sustainability and circularity, and in consequence, optimize the processes.

The circularity aspect is implemented in the visualization of the displayed needed actors, relationships, cycle stages, and flows of information. In this central part of the framework, it is proposed to test any circular strategy chosen or toolkits that help to evaluate the circularity impacts.

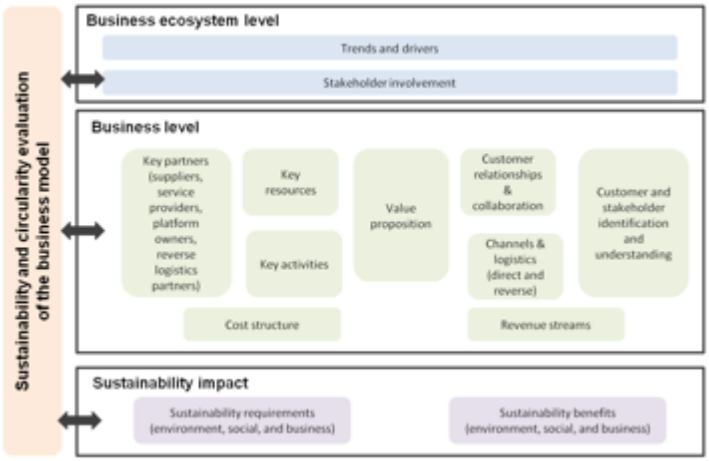


Figure 6 Framework for sustainable circular business model innovation (Antikainen & Valkokari, 2016)

Antikainen and Valkokari evaluated their tool in a case study with a social enterprise and after its implementation the stakeholders involved regarded the framework as a good and simple way to communicate the business model, yet this process is not described. Furthermore, the sustainability and circularity iterations were not tested because of the longer time that this analysis takes.

The innovation of this framework seems to rest on the introduction of external awareness elements to the core business and the definition of explicit sustainable propositions. However, and even when this tool has already been tested, indications of how it can be implemented are left out of the scope; instructions on who should be involved or how this process is managed are not described, hence risking the opportunity to replicate its implementation within different organizations. Consequently, it can also be said that this framework also lacks a description of the steps needed for its implementation.

2.1.3 Circular Business Mapping Tool

Developed by Nußholz (2018), this tool allows the user to visually map a business model of organizations focused on prolonging the useful life of products and closing material loops. Her tool is also based on the proposition of (Osterwalder & Pigneur, 2010) and uses the value

dimensions, i.e., value proposition, value creation and delivery, and value capture, as a framework. Moreover, her work follows the definitions of (Nancy M P Bocken et al., 2016) on circular strategies and links lifecycle value management with traditional business model design thinking.

The novelty of her tool is the "*standardized representation of the elements and possible cycles of circular business models to prolong the useful life of products, parts and close material loops*". This proposition is based on the idea that business model design needs to switch from a single-use cycle towards business models that can create and recreate value along the product lifecycle with less environmental impact (Nußholz, 2018).

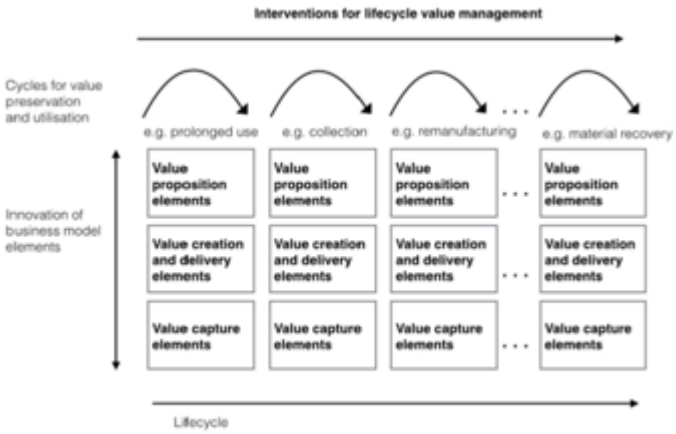


Figure 7 Conceptual framework for circular business innovation (Nußholz, 2018)

The implementation of this idea modifies the linear vision of the value dimensions. Value propositions become more fluid and subject to re-definition along the product lifecycle (Araujo & Spring, 2006), value creation and delivery require different value networks for cycling resources (Wells & Seitz, 2005), and value capture results in a modification of the cost and revenue structures (Schenkel, Caniëls, Krikke, & van der Laan, 2015). This results in the creation of different value architectures for each cycle.

(Nußholz, 2018) proposes four business interventions represented in her tool to embed circularity in the business model. These are:

- Collect and reintegrate
- First sale (enabling prolonged useful life)
- Additional sale(s) of the product or parts to other users
- Material Recovery

These interventions along with the value dimensions form the circular business model mapping tool are presented in Figure 7.

Figure 8 Circular Business Model Mapping tool (Nußholz, 2018)

In her research (Nußholz, 2018) tested the tool with product focus companies that are trying to implement circular strategies related to lifetime extension and closing loops. Nevertheless, she admits that her tool might not fit for all circular business models emerging in practice, especially those that are not focused on multiple cycles. Hence, is still not known how this tool can react to other type of circular strategies.

As with the previous tools, Nußholz (2018) only seems to focus on designing CBMs, leaving its implementation in specific organizations outside of the scope. Even when this tool was also tested in different organizations, this process was not described. It appears that because all of the tools are based on the Business Model Canvas (Osterwalder & Pigneur, 2010), their implementation is given less attention or is left for further investigation.

2.1.4 Business Combo Model

The Business Combo Model (BCM) results as the final work of Talukder (2017). In his study, Talukder departs from a similar premise stating the lack of modelling tools and implementation frameworks for CBMs, and how this situation hinders the introduction of CE principles. However, his study focuses on the furniture manufacturing industry in Bangladesh.

Talukder starts by analyzing and evaluating the existing business modelling tools. From this analysis he identifies certain features that should be included within a business modelling tool and that until his evaluation no modelling tool seem to accomplish in its full length (Table 2). In Talukder's analysis, certain modelling tools already described in this literature review like the Business Model Canvas (BMC) by Osterwalder et al. (2010), the Sustainable Circular Business Model (SCBM) by Antikainen et al. (2016), and the Circular Business Model Canvas (CBMC) by

Lewandowsky (2017) are also included. Nonetheless, he also includes other modelling tools like the Business Cycle Canvas, BCC (Mentik, 2014); the Sustainable Business Model Canvas, SBMC (Sempels, 2014); the Value Mapping Tool, VMT (N. Bocken, Short, Rana, & Evans, 2013); Play-it Forward tool, PIF (Dewulf, 2010); and the Moonfish Circular Business Model, MCBM (Widmer, 2016).

Table 2 Evaluation of Existing Circular Business Modelling Tools adapted from (Talukder, 2017)

BMs	Business Rationale	System Thinking	Collaboration	Sustainability Impacts	Competition
BMC	X				
BCC	Poor	X	X		
SBMC	X	Poor	Poor	Poor	
SCBM	X	Poor	X	X	
CBMC	X	Poor	Poor		
VMT	Poor		X	Poor	
PIF	X			X	
MCBM	Poor	Poor			

After the analysis presented in Table 2, Talukder concludes that important features like competition, systems thinking and collaboration are absent or poorly interpreted in most of the business models (Talukder, 2017). Collaboration is described as the mechanism in which supply chains relationships are created and sustained to generate competitive advantage; systems thinking is described as the ability to consider the relationship between the organization's behavior and other processes; and, competition is seen as the ability to include elements within a CBMs that allow to analyze the external environment where the new BM wants to be implemented (*Ibid.*). Due to the lack of these elements in one specific business modelling tool, Talukder proposes a new tool that encompass all the identified features presented in Table 2, i.e., the Business Combo Model (Figure 9)

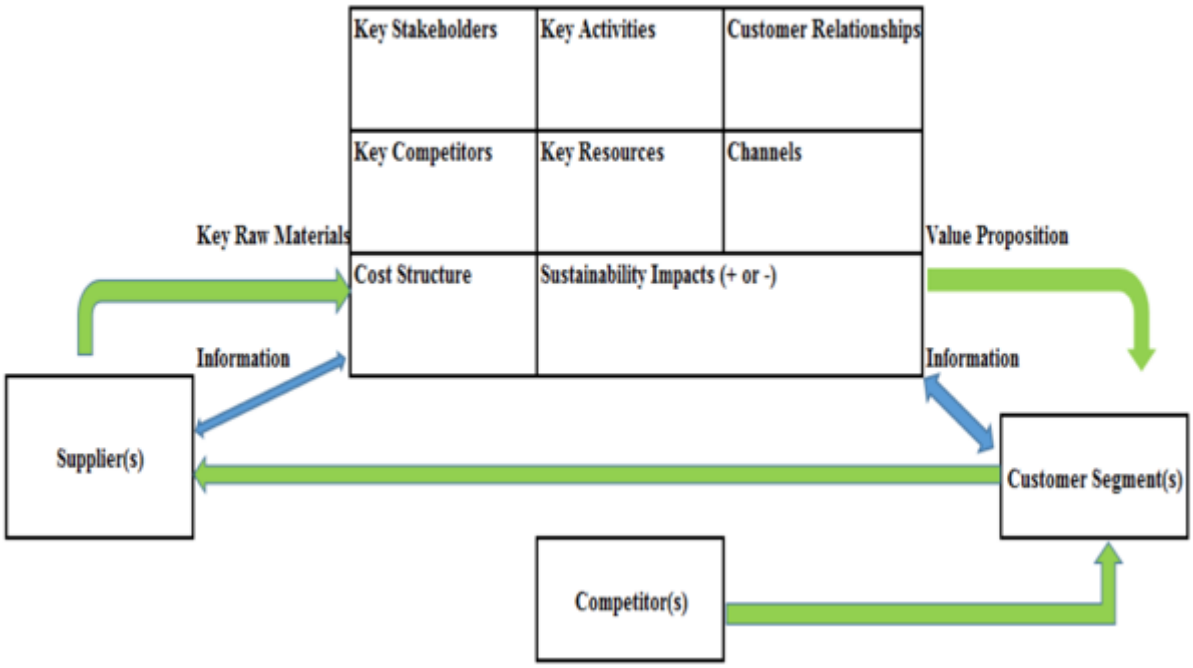


Figure 9 Business Combo Model (Talukder, 2017)

The Business Combo Model (BCM) is derived from the BMC (Osterwalder & Pigneur, 2010), the BCC (Mentink, 2014), and the SCBM (Antikainen & Valkokari, 2016). With this combination, Talukder proposes to include all the previously mentioned features in one tool.

As mentioned before, Talukder goes on and test his tool in two case studies in the furniture manufacturing industry in Bangladesh. From this evaluation Talukder seems to prove that his tool achieves its goal and present a new a and better way to design CBMs. Nevertheless, the scope of his study limits the reach of his results and it only can serve as another option for designing CBMs that stills needs to be validated with larger samples. Furthermore, Talukder's tool, as well as the other business modelling tools presented so far do not explicitly describe the implementation process of CBMs; nevertheless, Talukder's does present an implementation framework to complement his business modelling tool. Then, the next section of this literature review focuses on the existing implementation frameworks.

2.2 CBMs implementation frameworks

From the previous literature review on business modelling tools it is recognized that these business modelling tools do not actually describe how they can be implemented but leave it for further study. Nußholz (2018) clearly states tha the exploration of tools or frameworks that can

complement the circular business model mapping tool are still needed. Therefore, in this section, the existing implementation frameworks found on literature are described.

2.2.1 Circular Business Model Implementation Framework

The Circular Business Model Implementation Framework was developed by Mentik (2014) as a response to the lack of procedures to implement business modelling tools and to complement his Business Cycle Canvas (BCC). Mentik starts by doing an extensive analysis of the existing business modelling tools to portray the level of implementation that each tool has (See Table 3).

Table 3 Summary of CBM innovation tools adapted from (Mentik, 2014)

Method or tool	Implementation
Business Model Generation (Osterwalder & Pigneur, 2010)	Only very high-level
STOF method (Bouwman et al., 2008)	Only Critical Success Factors (CSFs) and Critical Design Issues (CDIs)
New framework on circular design (EMF, 2013b)	Not practical
Practical guide for PSS development (Tukker & Tischner, 2006b)	Practical but very briefly
Circular Economy Toolkit (Evans, 2013)	Nothing
Guided choices towards circular business models (Joustra et al., 2013)	Only very high-level
Sustainable Business Model Canvas (Sempels, 2014)	Nothing
Play it forward (Dewulf, 2010)	Nothing

As shown in Table 3, Mentik concluded that these business innovation tools do not have clear implementation methods. Some methods do cover challenges in the implementation phase like Tukkers' one page of guidelines for management report or Joustra's financial analysis of the business case, including risk analysis[3]. However, compared to other methods in other fields, e.g., lean start-up, these considerations seem incomplete. Mentik (2014) argues that this might be

[3] See Mentik (2014) for a more explicit description.

because of the nature of the challenges that implementation of BMI carries, meaning that implementation requires a lot more managerial and organizational skills than simply designing a new BM on paper (*Ibid.*).

In consequence of Mentik's analysis, he proposes the Circular Business Model Implementation Framework (Figure 10). Mentik derives this framework from the 4 I Framework (Frankenberger, Weiblen, Csik, & Gassmann, 2013) but includes a starting Phase 0, i.e., Preparation. In this phase, Mentik proposes the introduction of an innovation team and the understanding of the CE concept within the organization before anything other activity.

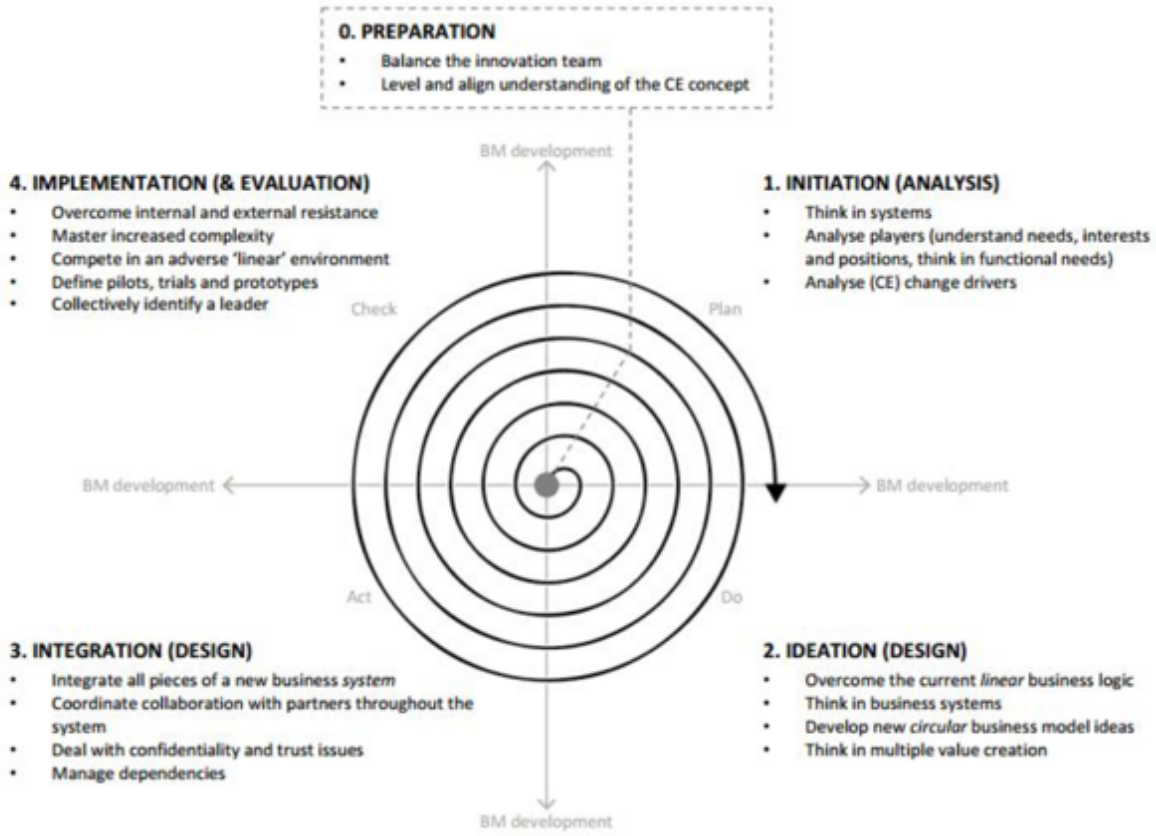


Figure 10 Circular Business Model Implementation Framework (Mentink, 2014)

Mentik divides its framework in four quadrants: Plan, Do, Act, and Check. In each one of these four quadrants he places one of the phases. Then, phase 1 Initiation is related to all the planning activities that need to be performed before the CBM is designed. Phase 2 Ideation revolves around the actual design of the CBM. Phase 3 Integration deals with the activities needed within the organization and its supply chain for the implementation of the CBM. Phase 4 Implementation focuses on evaluating the performance of the implemented CBM and its future application. Finally, Mentik proposes the use of loop iterations instead of forth and back iteration to achieve more efficient innovation.

2.2.2 Circular Business Model Transition Framework

The Circular Business Model Transition Framework was developed by Mouazan (2016) as a response to the gap between how companies understand CBMs and the way companies try to implement them (Mouazan, 2016). Furthermore, this framework was presented as the logical result after analyzing the drivers, obstacles and conditions for the transitions towards CBMs. Then, Mouazan first highlights the drivers at internal and external level that take companies to adopt CE principles at the top of his framework (Figure 11).

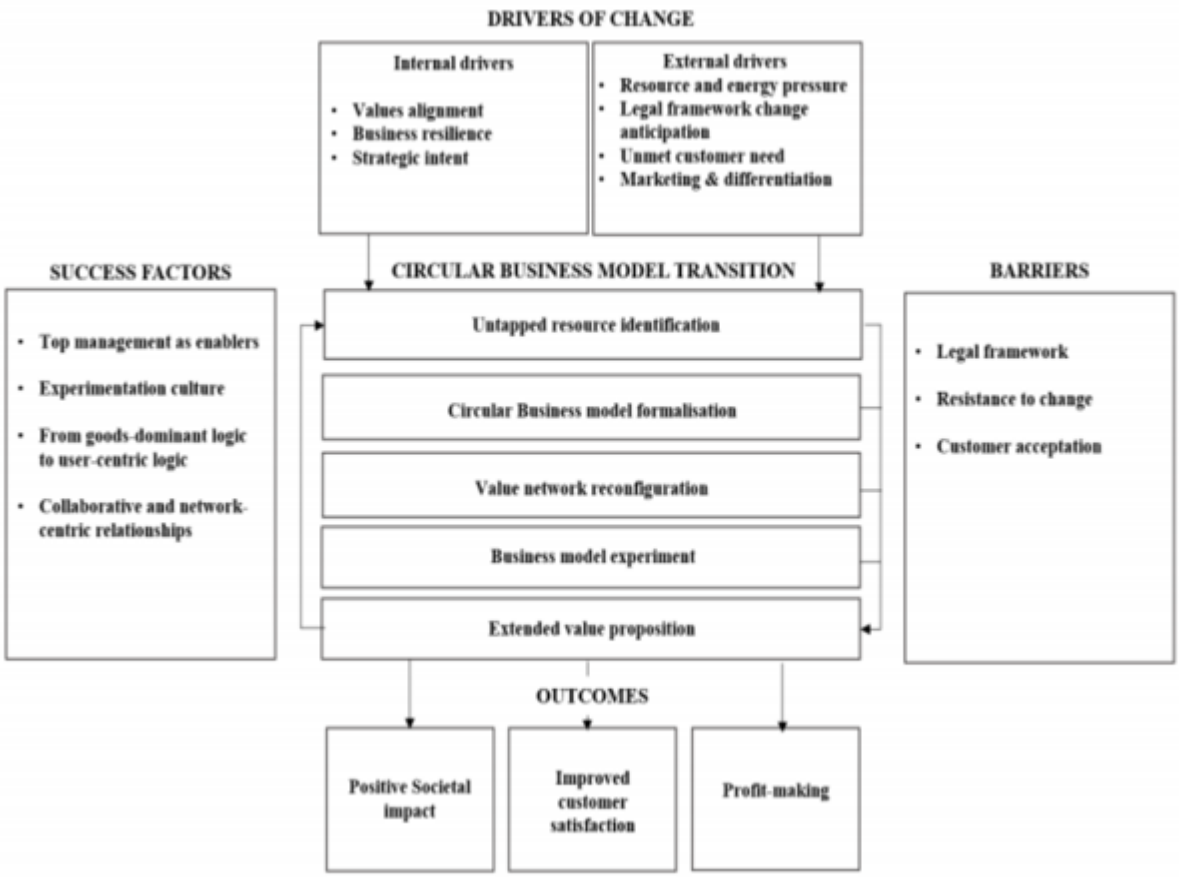


Figure 11 The Circular Business Model Transition Framework (Mouazan, 2016)

After highlighting these drivers of change, Mouazan addresses a set of condition that enable and challenge the implementation of CBMs and placed them on both sides of the framework. At the core of the framework, Mouazan sets a series of steps that he finds necessary for the transitions towards CBMs. At the bottom of the framework the outcomes of implementing CBMs is illustrated.

In this framework, five steps are presented for the transitions towards CBMs. The first element is the identification of untapped resources. After identifying these resources, it is proposed to

start with the design of the new BM, i.e., the CBM. Following, Mouazan (2016) introduces the systems thinking mentality and proposes to reconfigure the value network. Next to this reconfiguration, the experimentation phase is introduced. Finally, this process ends with the recognition of a new set of value propositions derived from the CBM implemented. However, Mouazan recognizes that these steps do not necessarily follow a linear pattern, but each phase may feed the other resulting in a dynamic approach (*Ibid.*).

2.2.3 The 5 I Framework

The 5 I framework was developed by Talukder (2017) as a complement to his business combo model. As well as Mentik's (2014) framework, Talukder also derives his framework from the 4 I framework (Frankenberger et al., 2013) but complements it with the ideas from Mentik (2014) and Mouazan (2016). This combination of frameworks results in five stages with back and forth iterations as seen in Figure 12.

The framework starts with the identification of the elements needed for the implementation of a CBM, including recognizing which challenges might be present. The second phase deals with the analysis of the universe where the CBMs want to be implemented. The third phase embarks on the design of the CBM. The fourth phase comprehends the integration of the CBM within the organization. The fifth phase introduces the experimentation period where the CBM tries to be scaled up. Finally, Talukder (2017) integrates the outcome elements from Mouazan's (2016) work and ends his framework with the analysis of the sustainable outcomes that the implementation of a CBM might bring.

Unfortunately, Talukder (2017) did not test his 5 I framework due to time constrains, thus it remains unknown how practical this framework might be given its conceptual basis. Talukder arguments that given the theoretical validity of the frameworks from where he is deriving his work, e.g., the 4 I framework (Frankenberger et al., 2013), it can be understood that his framework also can be portrayed as valid; however, this seem to be uncertain until scientific experimentation can corroborate this claim.

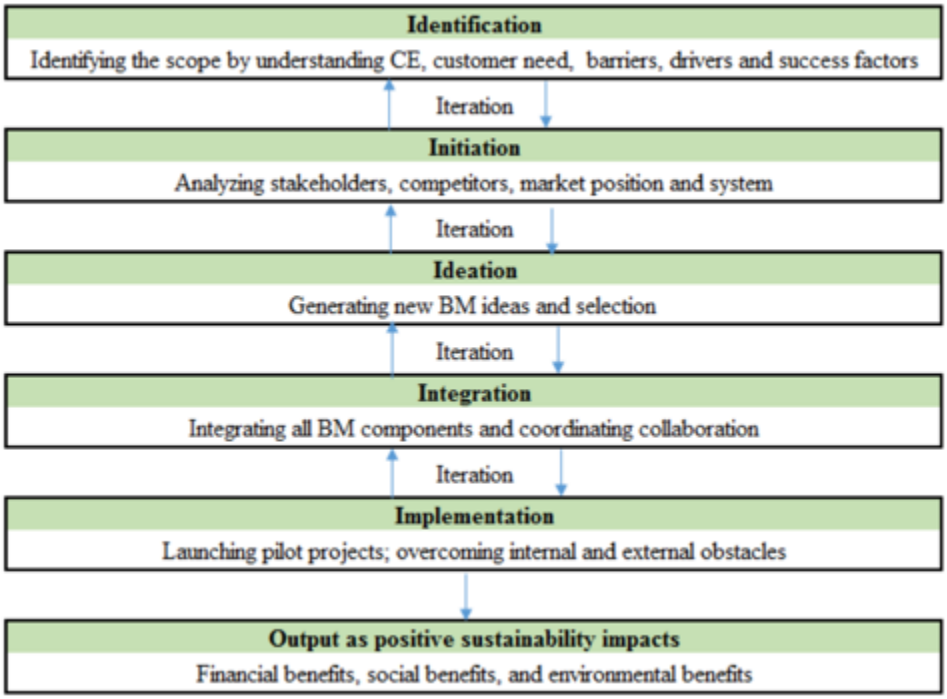


Figure 12 The 5 I Framework (Talukder, 2017)

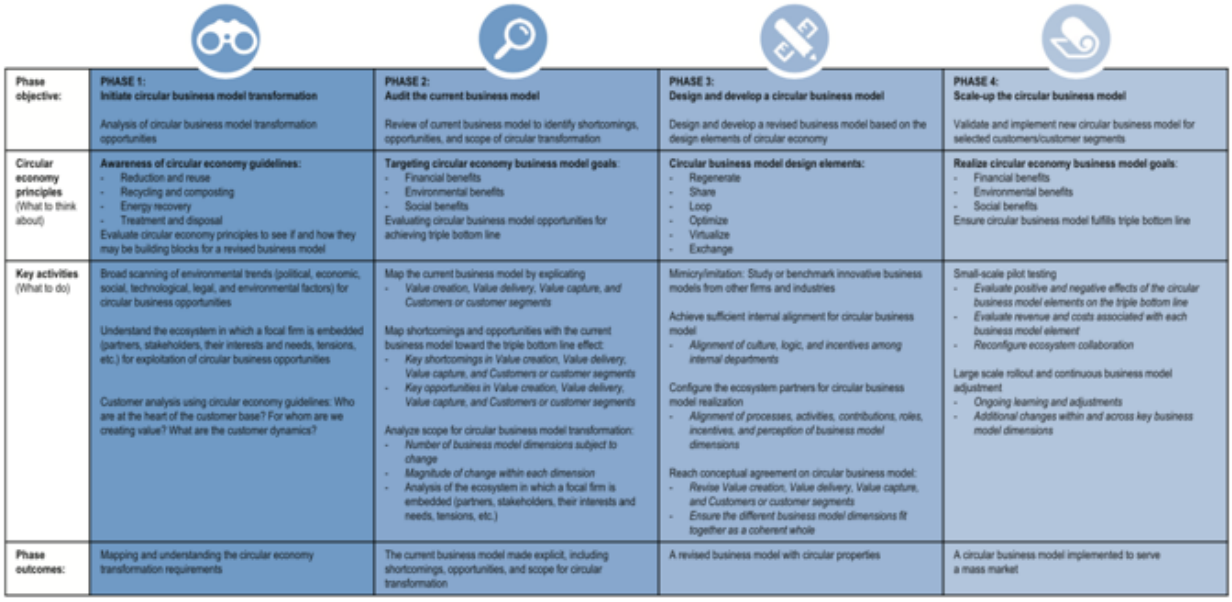
2.2.4 Framework for Circular Business Model Transformation

Developed by Frishammar and Parida (2018) the framework for circular business model transformation is derived from a multiple case study on eight large manufacturing companies that are going through business model transformations. The result of this analysis is a step-by-step process for the transition to CBMs (Frishammar & Parida, 2018) that can be seen in Figure 13.

This framework is divided in four phases that include an objective, a relation to CE principles, key activities to perform, and the outcome of the phase. Then phase one start with activities to bring awareness of CE principle and its opportunities within the organization that ends with a set of requirements for a CE transformation. Phase two focuses on recognizing the current BM running within the organization and making it explicit. Phase three deals with the design of the CBM, but its mentioned that the CBM does not need to be created from scratch but can be imitated from other industries. The final phase implements the idea of experimentation to scale up the CBM.

Frishammar and Parida (2018) argue that the process of implementing CBM is *"fundamentally a discovery-driven approach"* meaning that this process is characterized by trial and error. Therefore, even when they do not seem to integrate iterations within their framework, they

recognize that this is a central characteristic of the implementation process. Furthermore, they argue that the experimentation period, where organizations are trying to develop new business models, rises risks because organizations have less accurate information about what the future might bring. Nevertheless, the development of implementation frameworks help organizations *"managing risk and uncertainties because it allows to understand what a circular transformation might look like"* (Frishammar & Parida, 2018).



	PHASE 1: Initiate circular business model transformation	PHASE 2: Audit the current business model	PHASE 3: Design and develop a circular business model	PHASE 4: Scale-up the circular business model
Phase objective:	Analysis of circular business model transformation opportunities	Review of current business model to identify shortcomings, opportunities, and scope of circular transformation	Design and develop a revised business model based on the design elements of circular economy	Validate and implement new circular business model for selected customers/customer segments
Circular economy principles (What to think about)	**Awareness of circular economy guidelines:** - Reduction and reuse - Recycling and composting - Energy recovery - Treatment and disposal Evaluate circular economy principles to see if and how they may be building blocks for a revised business model	**Targeting circular economy business model goals:** - Financial benefits - Environmental benefits - Social benefits Evaluating circular business model opportunities for achieving triple bottom line	**Circular business model design elements:** - Regenerate - Share - Loop - Optimize - Virtualize - Exchange	**Realize circular economy business model goals:** - Financial benefits - Environmental benefits - Social benefits Ensure circular business model fulfills triple bottom line
Key activities (What to do)	Broad scanning of environmental trends (political, economic, social, technological, legal, and environmental factors) for circular business opportunities Understand the ecosystem in which a focal firm is embedded (partners, stakeholders, their interests and needs, tensions, etc.) for exploitation of circular business opportunities Customer analysis using circular economy guidelines: Who are at the heart of the customer base? For whom are we creating value? What are the customer dynamics?	Map the current business model by explicating - *Value creation, Value delivery, Value capture, and Customers or customer segments* Map shortcomings and opportunities with the current business model toward the triple bottom line effect: - *Key shortcomings in Value creation, Value delivery, Value capture, and Customers or customer segments* - *Key opportunities in Value creation, Value delivery, Value capture, and Customers or customer segments* Analyze scope for circular business model transformation: - *Number of business model dimensions subject to change* - *Magnitude of change within each dimension* - *Analysis of the ecosystem in which a focal firm is embedded (partners, stakeholders, their interests and needs, tensions, etc.)*	Mimicry/imitation: Study or benchmark innovative business models from other firms and industries Achieve sufficient internal alignment for circular business model - *Alignment of culture, logic, and incentives among internal departments* Configure the ecosystem partners for circular business model realization - *Alignment of processes, activities, contributions, roles, incentives, and perception of business model dimensions* Reach conceptual agreement on circular business model: - *Revise Value creation, Value delivery, Value capture, and Customers or customer segments* - *Ensure the different business model dimensions fit together as a coherent whole*	Small-scale pilot testing - *Evaluate positive and negative effects of the circular business model elements on the triple bottom line* - *Evaluate revenue and costs associated with each business model element* - *Reconfigure ecosystem collaboration* Large scale rollout and continuous business model adjustment - *Ongoing learning and adjustments* - *Additional changes within and across key business model dimensions*
Phase outcomes:	Mapping and understanding the circular economy transformation requirements	The current business model made explicit, including shortcomings, opportunities, and scope for circular transformation	A revised business model with circular properties	A circular business model implemented to serve a mass market

Figure 13 Framework for Circular Business Model Transformation (Frishammar & Parida, 2018)

2.2.5 Other implementation frameworks

Lewandowsky (2016) also mentions another framework to understand and apply the mechanisms of the CE in businesses, i.e., Scott's (2015) 7-P model. This model is described by Lewandowsky (2016) as a tool with a practitioner's approach that presents seven components, which can be divided into three steps:

1. Learn and understand the fundamentals of CE, what change will concern, and decide establishing sustainability as an objective;
2. Organize and implement the mechanisms of CE related to the process: preservation, people, place, product, and production;
3. Finally, enable and support implementation of CE, mainly through building teams and managing.

Furthermore, Talukder also mentions two more implementations frameworks: the Business Model Generation (Osterwalder & Pigneur, 2010) and Guided Choices Towards Circular Business Models (Joustra, de Jong, & Engelaer, 2013). However, these two frameworks were also analyzed

by Mentik (2014) and, as shown in Table 3, are only mentioned to have high-level references to its implementation, thus they are not regarded as practical for the implementation of CBMs.

2.3 Summary

This chapter presented the literature review in which the concepts needed to answer the first sub question were defined and can be stated as follows:

Which frameworks exist for implementing CBMs in other industries besides the building industry?

Based on the literature review, it was found that scholars have focus on developing to tools related to CBMs: business modelling tools and business model innovation frameworks. Because more recent business modelling tools were found on the literature this type of tools were analyzed first.

From the review of business modelling tools, it was recognized that different tools have been proposed as alternatives to design CBMs. Following the work of Nußholz (2018), and due to its novelty, three circular business model tools were described in this literature review, i.e., the circular business model canvas (Lewandowski, 2016), framework for sustainable circular business model innovation (Antikainen & Valkokari, 2016), and the circular business mapping tool (Nußholz, 2018). Furthermore, the research performed by Talukder (2017) was also included because of the analysis he made on other business modelling tools and the outcome of his study, i.e., the Business Combo Model.

From these business modelling tools it was acknowledged that the groundwork to design CBMs is mostly based on the business model canvas developed by (Osterwalder & Pigneur, 2010). Additionally, visualization tools were recognized as the most practical tools to develop business models and introduce Business Model Innovation (BMI). Unfortunately, none of these tools presented a description of the CBM implementation process. Thus, important aspects of the CBM process including how the process starts, who should manage it, who should be involved and the steps for its development, are not defined with these tools. On the contrary, the subject of CBM implementation was left for further research.

Therefore, a look into the other proposed tools was taken. Different business model innovation frameworks were also found on the literature; however, it was noticed that the research performed on them is not as rich as with the business modelling tools. Four frameworks are described in this section: the circular business model implementation framework (Mentik, 2014), the circular business model transition framework (Mouazan, 2016), the 5 I framework (Talukder, 2017), and the framework for circular business model transformation (Frishammar & Parida, 2018). From these frameworks it can be noticed that two of them (Mentik, 2014; Talukder, 2017) are based on the same implementation framework, i.e., the 4 I framework, and are quite similar; however, the other two are different. Mouazan (2016) focuses on the success factors, enablers and bottlenecks of CBMs implementation, while Frishammar & Parida (2018) give more emphasis to recognizing the current BM and the design of the CBM.

Similar characteristics can be found on all of the frameworks tough. The proposal to understand the CE and its implications within organizations as a first step, identifying enablers and challenges for CBM implementation, explicitly recognizing the current BM, designing a CBM and analyzing its implications on the supply chain, and developing an experimentation phase were the CBM can be scaled up are some of the characteristics that seem to be paramount for the implementation of such CBMs. However, all of the proposed frameworks seem to be particular to a specific industry, e.g., manufacturing industry, and have not been tested in larger samples or more general populations.

Lastly, from this literature review important aspect of CBM implementation were recognized. Both Lewandowsky (2016) and Mentik (2014) acknowledge that one of the major impediments of CBMs implementation has to do with challenges within organizations, such as managerial issues. Thus, they recommend focusing further research on this aspect more than only on designing new BMs (or CBMs). This suggestion resembles the words of van den Brink (2016) as presented in the definition of the research problem in Chapter 1, strengthening the argument to pursue specific research on CBM implementation at the organizational level. Furthermore, the common characteristics found on the described frameworks allow to form the basis to develop a framework specific for the building industry. Besides, the limitations found on each of the described tools grant the understanding of the challenges that need to be overcame when developing a new circular business model innovation framework, thus, strengthening the foundations of the analysis.

3.0

Methodology

In this chapter, the methodology to recognize and design a framework for CBM implementation within a real estate development firm is described. This information is then used to answer the second research sub-question.

As mentioned in the research design description, due to the limited academic research on the topic of CBM implementation within the building industry, the current study is explorative in nature, meaning that the objective of the study is to investigate a problem and develop a detailed understanding of a phenomenon (Creswell, 2002).

Different methodologies can be found in literature that can be used in explorative research, e.g., Case Studies, Grounded Theory and Action Research (Creswell, 2002). Each has advantages and disadvantages; however, all of these methodologies aim to gather preliminary information to help describe the phenomenon of study (Ibid.).

As mentioned by Pomponi & Moncaster (2017), the complexities inherent to buildings are not representative of other industries. In consequence, it was proposed to use a methodology that only focused on a specific population (real estate development firms), could extract information from a particular and small sample (given the lack of cases in the industry) and that could conceptualize that information into a visual framework. In consequence, the methodology used in this study (Figure 14) was developed with the inclusion of analysis elements derived from the work of Corbin & Strauss (2008).

A detailed description of each of these steps is presented in the next sections.

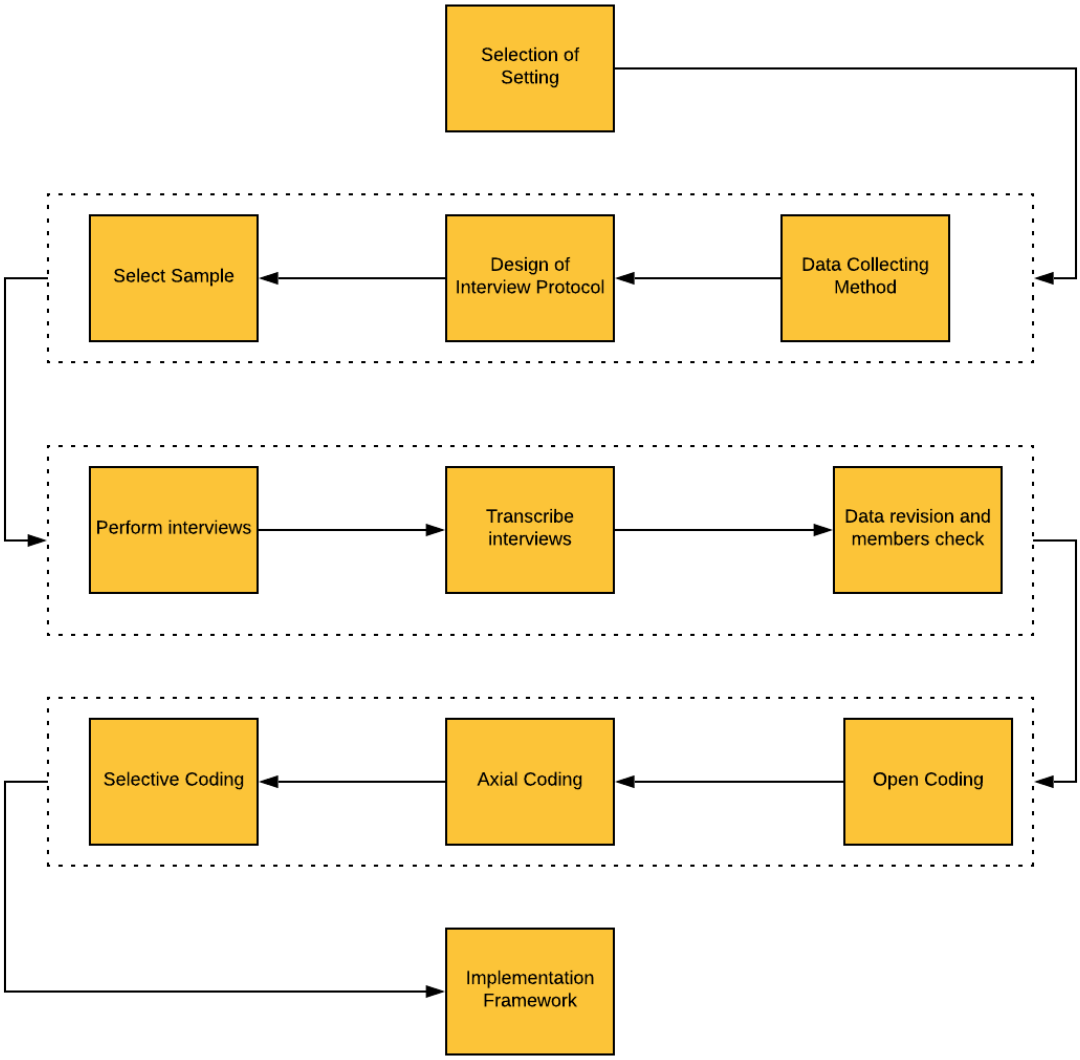


FIGURE 14 METHODOLOGY

3.1 Setting

Based on the understanding that impediments to CBM implementation are relates to managerial and organizational issues, it was determined that the best way to study the process of CBM implementation was from within an organization, i.e., The Student Hotel (TSH), via the perspective of employees involved in these procedures.

In addition to TSH, three other Real Estate Developers were approached to participate in the study; two of them did not reply to the invitation and the third mentioned that they were not currently considering the implementation of CE principles. Therefore, TSH was the only organization studied for this research.

TSH has been developing student accommodation in the Netherlands for the last six years. Recently, TSH has begun to implement new sustainable solutions and have turned their ambitions towards achieving a CE. Even with the CE concept still in its infancy, TSH's constant drive to innovate has led them to begin looking for concrete steps to realize their ambitions and develop the first 'circular' student accommodation building in the Netherlands. Since this was already an ongoing process within TSH, the choice of using this setting to understand CBM implementation within the Real Estate industry was determined to be appropriate, especially considering the exploratory nature of the study.

In addition, the TSH business model of developing and operating real estate assets allowed this study to call on a broad range of expertise and perspectives of employees used in the sample group.

3.2 Data Collection Method

Different data collection methods are available for qualitative research but the most used are observations, focus groups, and in-depth interviews (Rosenthal, 2016). In-depth interviews were chosen as the data collection method for this study because they allow for the extraction of detailed knowledge from participants' experiences (Charmaz, 2006; Creswell, Hanson, Clark Plano, & Morales, 2007).

In-depth interviews can be classified as structured, semi-structured, or unstructured (Dunn, 2000). Due to the need to discuss a specific topic and to have a comparable set of questions between interviews, semi-structured in-depth interviews were chosen as the specific method of study.

The procedure for the interviews was defined by an interview protocol (Appendix 5) that covered the topics that needed to be discussed. This protocol was used during all the interviews and aimed to gather the pertinent information about the process that TSH is using to implement CE principles in their product, i.e., implementing a CBM in real estate development.

The interview protocol focused on four main topics: BM awareness, BMI process, CBM implementation and Circular Strategies. These four topics were derived from the argument presented in the research problem in Chapter 1 about the description of CBMs and from the common elements recognized within the implementation frameworks in Chapter 2. From this literature review it was acknowledged that the transition from a traditional BM to a CBM is defined by establishing a circular strategy and redefining the business model (Zott & Amit, 2010). Therefore, the first two topic focus on acknowledging the 'redefining the BM' process and the last two topics on the 'selecting a circular strategy' process. Furthermore, each topic was chosen specifically to develop an understanding of the following:

BM awareness. - As noted in the literature, the first step to BMI is to recognize the current BM of an organization. However, due to lack of time or knowledge some employees are not completely aware of their company's BM. Therefore, the first interview questions were designed to understand: the level of awareness of the participants about TSH's current BM, the processes in place to develop and review this BM and the people involved in this process. This allowed the identification of necessary factors that are present before any new innovations (like CBMs) are implemented.

BMI process. - This section of the interview protocol was developed to assess the level of understanding that the participants had about: the innovation process of a business model within TSH, the relevant managerial and organizational procedures, and the people involved in this process. This allowed the identification of the elements present while the implementation process is ongoing.

CBM implementation. - Related to BM awareness, this set of questions was developed to recognize the level of awareness about and the experience that the participants had with the CE and CBMs, acknowledge the challenges that CBMs imply, and recognize implementation steps within the organization. This allows to identify the factors that intervene when CBMs implementation occurs.

Circular Strategies. - This last set of questions was developed to: understand the perception of the participants about the different ways in which CE principles can be applied, recognize the understanding that participants have about circular strategies, and try to see if there was a common understanding on which circular strategy works better for the organization.

3.3 Sampling

Determining sample size is a critical step in any study. Whereas in quantitively studies the aim of the sample is to find a generalizable sample, in qualitative studies the objective is to understand meaning behind phenomena (Rosenthal, 2016). Therefore, sampling does not necessarily need to follow statistical methods. It is more about *"balancing between the need to obtain a rich experiential description from interviewees, without sacrificing the equal representation of experiences across the population of possible participants"*(Patton, 2005). This can be translated as finding thorough experiences that represent a broad range of the population. However, this method lacks the possibility of drawing conclusions from the sample to a general population (Corbin & Strauss, 2008).

Then, the sampling method selected for the in-depth interviews was purposive sampling. Purposive sampling was adopted because it is considered useful when there is a limited number of people that have the expertise in the area being researched and the focus is on a specific field

or group (Anderson, 2010). Furthermore, predefined criteria were established to delimitate the sample population to the scope of the research. Hence, participants needed to be:

1. currently or previously involved in strategic management (thus involved in business model development or innovation);
2. aware of the Circular Economy concept and involved with at least one circular strategy; and
3. involved with TSH, thus focused on redevelopment projects of student accommodation.

Based on these criteria, a first sample of eleven subjects was chosen. This sample included most of the top management professionals involved with the implementation of CBMs within TSH; however, the finance and operations directors could not be reached to be interviewed because they were unavailable within the interview timeframe. In consequence the sample ended up with 9 participants (Table 4).

Table 4 Interviews' sample

Position
Real Estate Development Director
CSR Officer
Head of Technical Development
Sustainability Expert
Construction Director
Design Director
Managing Director
Accelerator
Support Officer Sustainable Business

Each one of the participants fulfilled the proposed criteria, thus all of them were involved in the process of developing or analyzing business models, were aware of the CE concept and were involved in the implementation of CE principles in real estate related to the development of student accommodation in the Netherlands with TSH. Moreover, the various expertise

represented within the sample group allowed for a more holistic perspective of the phenomenon, giving insights from a managerial perspective, e.g., Managing Director and Real Estate Director, but also from technical and economic perspectives, e.g., Head of Technical Development and Support Officer for Sustainable Business.

3.4 Interview procedure

Following the previously described protocol, all interviews were conducted face-to-face in English and they lasted approximately one hour. Seven of the participants were Dutch, one was American, and one was Canadian. During the months of July and August 2018, seven of the interviews were performed at TSH's headquarters in Amsterdam, one interview was performed at Rabobank offices in Utrecht, and one interview was conducted at TSH's offices in Madrid. The setting where the interviews were held was not determinant since all the interviewees stated they felt free to talk. Overall, the interviews were performed over a period of one month.

The interviews began by informing the participants that the interview was going to be audio recorded. Interviews were recorded to facilitate the flow of the interview and allow the interviewer to focus on the answers and any follow-up questions. Next, it was agreed that due to confidentiality reasons the interview transcripts would not be published publicly (including in the public version of this thesis) nor would any statements be linked to specific interviewees. With this agreement the interview became more open and transparent. Subsequently, a short presentation outlining the purpose of the interview was given to the interviewee, following which the audio recording and the formal interview began.

The interview protocol did not change during the data collection period. At times when the interviewees' answers required clarification, different follow-up questions were asked depending on the answers given by the participants. This made every interview slightly different, but the protocol of the interviews remained consistent. Moreover, although all participants were aware of the concepts being discussed, sometimes certain terms needed to be clarified, e.g., the difference between CBMs and Circular Strategies. These clarifications were only given if specifically asked by the interviewee, to minimize interference with the participant's knowledge. Any follow-up questions and clarifications were included as notes in the transcripts for the analysis, e.g., participant did not know the difference between CBM and Circular Strategy.

After asking the participants about their knowledge on CBMs and Circular Strategies, the participants were shown different circular strategies selected from literature (Appendix 6). The purpose of this was to establish a common understanding about the concept of Circular Strategies and to focus on the process of implementing them more than on the concept itself.

After the interview was finished, it was mentioned that the interview transcript would be sent to the interviewee for validation of the statements, i.e., member checks.

3.5 Data Revision

The interview transcripts were generated and reviewed immediately after each interview. This allowed the opportunity to check that all the information derived from the interviews was collected properly and to make any comments on the transcripts (if needed) while the information was still recent. Member checking was used to ensure trustworthiness and credibility of the study. This concept proposes to send for revision the interview transcript to the interviewee before further analysis (Corbin & Strauss, 2008). Furthermore, the immediate revision of the data allowed for readjustment and improvement to the data collection method. The method to review the data is illustrated in Figure 15.

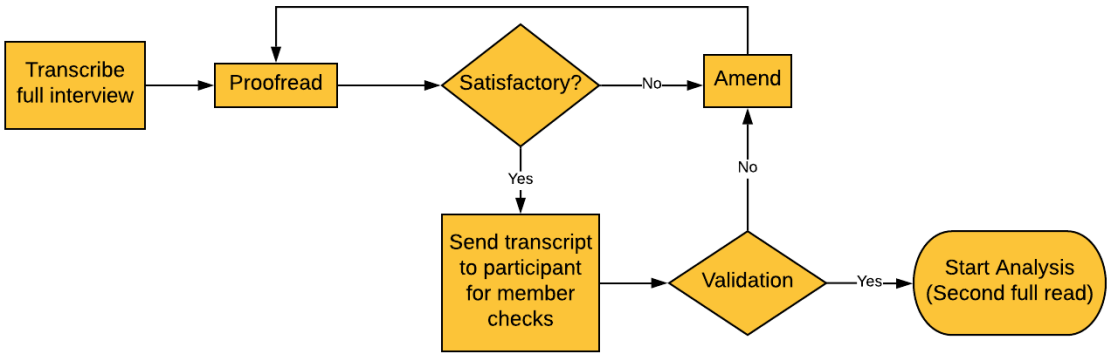


FIGURE 15 DATA REVISION, I.E. MEMBER CHECKS (OWN ILLUSTRATION)

After ensuring validity through members check the analysis phase started. This phase dealt with the coding of data from the transcripts. This concept is derived from the work of Corbin & Strauss (2008) approach and was chosen because it allows to systematically structure large amounts of qualitative information into manageable units, i.e., codes (Corbin & Strauss, 2008). Three coding steps are proposed by Corbin & Strauss (2008): open coding, axial coding and selective coding. Each step helps structure the raw data and conceptualize the phenomenon of study. Then, the first 'coding step' is open coding. This 'step' starts by analyzing the raw data from the transcripts to identify words or phrases that align to the looked-up elements, in this case elements that could be conceptualized within the four previously mentioned topics, i.e., BM awareness, BMI process, CBM implementation and Circular Strategies. This first phase results in a list of open codes that allow to proceed with the next phase, axial coding. This second 'coding step' proposes to look into the open codes to recognize common characteristics within them and propose categories where the open codes can be grouped to reduce the complexity of the data. Then, axial coding lets to have a second list of codes that are more encompassing. Moreover, axial coding permits

to recognize a core category that serves as epicenter for the other categories. The selection of how the left categories relate to the core category is named as selective coding and is proposed as the last 'coding step' (Corbin & Strauss, 2008). Within this last coding step, the visual coding paradigm comes to existence through the visualization of the relationships established between the core category and the other categories developed in axial coding. As proposed by Corbin & Strauss (2008), selective coding allows to place the previously identified categories, within a theoretical process framework. Hence, the main reason to choose this coding method is because it gives a structured step-by-step procedure to develop a process framework derived from empirical work (Figure 16). Finally, the software ATLAS.ti was used for the coding of the data gathered during the interviews. A detailed description of each of the coding phases is given next.

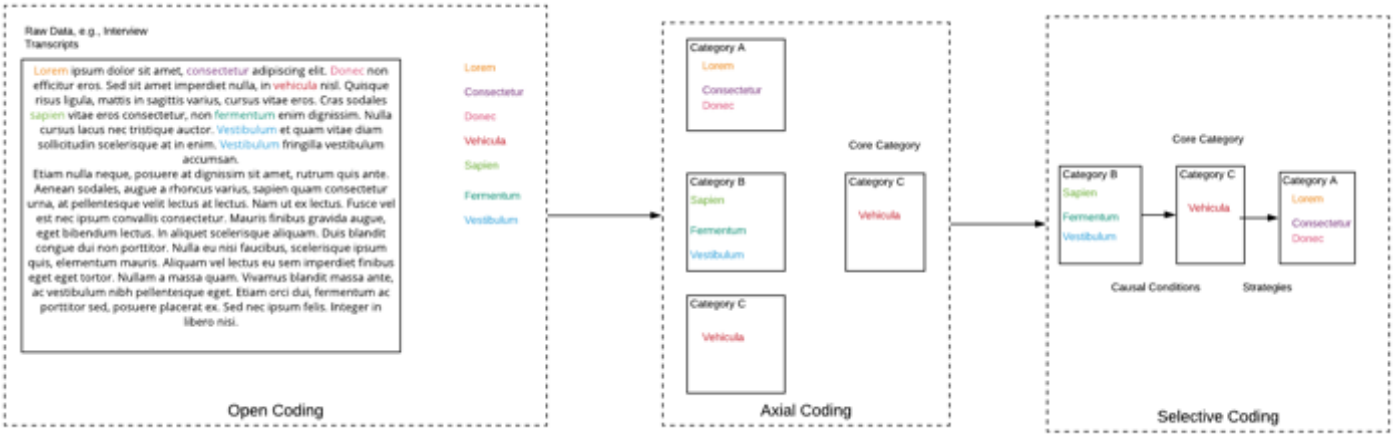


Figure 16 Illustrative example of coding method

3.6 Open Coding

There are different methods proposed by Corbin & Strauss (2008) to conduct data analysis through open coding. These are: line by line, sentence by sentence, several phrases or sentences, paragraph by paragraph and the whole document.

The sentence by sentence method was chosen due to the formatting of the transcripts and the ease of visualization of sentences within them. An illustration of this procedure follows.

The analysis started by coding each word or phrase that was perceived as an argument or element that gave answer to the question being asked. For example, when the participants were asked which tools they had used to develop BMs (Figure 17) words and phrases like *tools, workshops* and *full-day* were coded. Then, every time the code *tool* (for example) was found in one of the transcripts, this indicated that there was an argument present in that data that describes a tool used for developing BMs; the same logic was applied for all other identified codes.

Interview Transcript	First Codes (open codes)
Have you used a tool to develop BMs or strategies?	
Not so much a tool.	
The only tool that I think is helpful when it comes to defining strategies is more of a meeting tool.	Tools
Currently is called Growth Hacking or Agile, Scrum, whatever the buzz word of the term is.	Tools
I've worked with a lot of those.	Traditional
Where you get 5 or 6 key decision makers, key people in the room, and you spent half a day or a day focus on a topic.	Decision-makers; workshop
We're so busy in our day-to-day life, we're so busy with our meetings, with everything that we can't focus	Status quo
In my expertise, if you have a tool like that where, it's a one-day workshop or two days, and you have a clear goal or path to that goal, you get the right people in the room, you can make some decisions very fast	Full day; workshop; vision; team composition
I know, and I'm part of it here at TSH, the Growth Hacking (Agile) is really important for us.	Innovation
As we are growing in our portfolio, in our network of hotels, but also in the number of people, we don't want to lose that entrepreneurial spirit that got us where we are today	Entrepreneurial spirit
The entrepreneurial spirit was twofold; less people making decisions and also taking risks	Strategy

Figure 17 Illustrative example of coding from a transcript (reconstructed)

Furthermore, if arguments were perceived as elements that gave answer to any of the other questions that were asked, these arguments were also coded. Consequently, elements like *traditional, decision-makers, status quo, team composition, innovation* and *strategy* were also identified as codes (Figure 17). For example, the code *decision-makers* could be related to the question *who decides/define the BM*.

Finally, arguments that were perceived as relevant information for the final framework even when they could not be related to one of the questions being asked were also coded. For example, the code *Entrepreneurial Spirit* was coded (Figure 10) because it was perceived as an important argument that fosters business model innovation (BMI).

After finalizing the analysis of a transcript, a list of all codes identified was produced and the next transcript analyzed. The same procedure was applied to all the transcripts.

3.7 Axial Coding

The second coding step was axial coding. In axial coding, the codes generated from the open coding step were grouped into categories. Categories are themes of basic information identified in the data and used to understand a process (Creswell, 2002; Corbin & Strauss, 2008).

Categories were created that grouped different open codes with a perceived relation. From the previous example, the codes *Entrepreneurial Spirit* and *Innovation* were perceived as part of a category (axial code) named *Company Philosophy*. After a category was created other codes present in the list of open codes were analyzed to see if they could fit within this category. This process of creating categories and grouping open codes is portrayed in Figure 18. As this process continued, the number of open codes recognized in the data was narrowed down to fewer and more general codes. This conceptualization ended when no more categories were identified, and all the open codes were related to one or more categories.

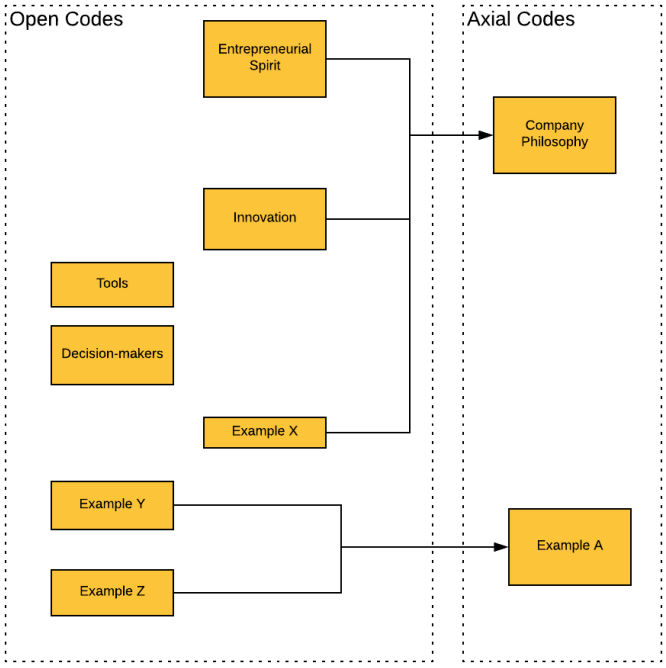


Figure 18 Illustrative example of axial coding (reconstructed)

The second step in axial coding was selecting a core category or phenomenon (Corbin & Strauss, 2008). To select a core category the recommendations of Corbin and Strauss (2008) were followed. This meant that the core category was selected based on the following:

- All the other major categories could relate to the core category;
- The core category appeared frequently within the data;
- The core category was logical and consistent, meaning that there was no forcing of the data; and
- When conditions varied, the arguments still held, although the way in which a phenomenon was expressed might have looked somewhat different.

3.8 Selective Coding

With the core category defined, the analysis then developed the relationship between the remaining categories and the core category, i.e., selective coding (Corbin & Strauss, 2008). As mentioned before, this 'coding step' was included because it allows to place the remaining axial categories in a specific relation to the core category, therefore, developing a process framework that is illustrated by a visual coding paradigm (Figure 19). Consequently, the analysis was performed by questioning each of the categories remaining. This involved analyzing the relationship of a particular category to the core category by asking the following questions:

- Is this category a causal factor that influences the phenomenon?

- Is this a strategy taken as a response to the phenomenon?
- Is this category an influence on the strategies taken more than to the phenomenon per se? If so, is it contextual or specific?
- Is this a consequence of the strategies taken as a response to the phenomenon?

Then, according to Creswell (2002) the relationships between the core category and the other categories are defined as:

1. Causal Conditions: categories of conditions that influence the core category.
2. Context: the general contextual conditions that influence the strategies.
3. Core category: the idea of phenomenon central to the process.
4. Intervening conditions: the specific conditions that influence strategies.
5. Strategies: the specific actions or interactions that result from the core phenomenon.
6. Consequences: the outcomes of employing the strategies.

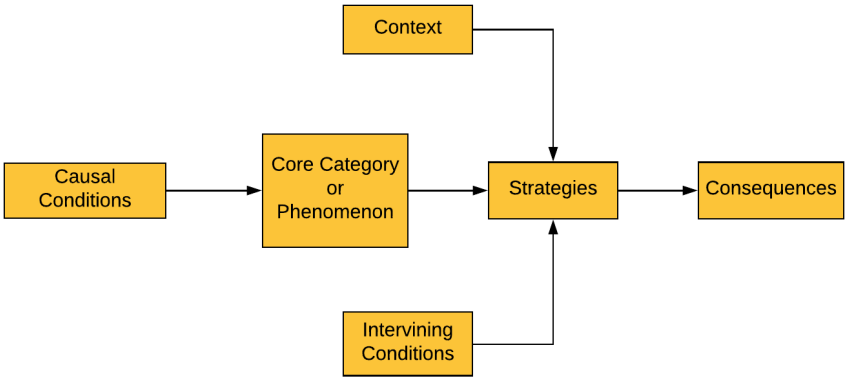


Figure 19 Coding Paradigm. Adapted from (Corbin & Strauss, 2008)

In consequence, the remaining categories were analyzed by applying selective coding, resulting in a coding paradigm where the process of implementing CBMs in real estate was conceptualized.

3.8 Summary

In this chapter the methodology employed to understand the process of implementing CBMs in a real estate development company was described. Therefore, the second sub question can be answered:

How can a framework for implementing CBMs be designed by the experiences from an organization itself?

Because there were no previous studies that investigated CBM implementation in real estate, the nature of this study was explorative. Explorative studies are qualitative since there are no variables that can be measured, described or tested (Creswell, 2002). Different qualitative methodologies can be applied in explorative research but because of the goal of this research and the complexities involved in the building industry the proposed methodology to study this phenomenon was through the knowledge of experts within an organization involved in the CBM implementation process.

A methodology using in-depth interviews was proposed. This qualitative method allowed extraction of information from people involved in the phenomenon to understand and describe it. However, there is the possibility of gathering too much information that makes the analysis too complex. For this reason, a coding method derived from the work of Corbin & Strauss (2008) was implemented to reduce the complexity of the analysis, breaking down the information into small portions, i.e., codes, that afterwards could be linked.

Therefore, the methodology aimed to gather a broad range of expertise to gain a full picture of the phenomenon while reducing the complexity of the process by highlighting small pieces of information that, in the end, could be grouped to provide a clear understanding of the CBM implementation process. Thus, a framework that encompasses the experiences of an organization can be developed by conceptualizing these experiences within a visual coding paradigm. This tool allows visualization of the CBM implementation process through different relationships linked to the phenomenon itself.

To develop this framework, nine interviews were performed. This sample population was taken from within TSH and met the criteria defined to fulfill the objectives of this study. These criteria included choosing participants that were involved with business modelling, circular economy and development of student accommodation, to provide different perspectives around the same topic. For consistency, an interview protocol was developed to guarantee that the right data was being collected. This protocol focused on acknowledging the experiences of the participants regarding BMs, BMI, CBMs and Circular Strategies. Following this protocol, the interviews were performed in person, audio recorded and transcribed during an interview period of one month.

To guarantee validity of the data, the members check method was used. Once the data was validated by the interviewees, the analysis started. The analysis followed the method proposed by Corbin & Strauss (2008), evaluating small portions of data and coding them. This coding was performed in three steps, i.e., open coding, axial coding and selective coding. Each step allowed

the raw data from the transcripts to be narrowed down into manageable units (categories) that could be related to each other, enabling the visualization of the relationships between them.

4.0 Results

This chapter presents the results of the analysis of the in-depth interviews. These findings emerged from the coding methodology described in the previous chapter. With this information sub-question three is answered at the end of the chapter.

As mentioned previously, the first step of the analysis was open coding. After analyzing and comparing all of the interview transcripts, 69 unique codes were identified in the data (Appendix 8). From these 69 codes, 23 axial categories were established (Appendix 9). These axial categories were identified following the procedure explained in the previous chapter; they were derived from the open codes and grouped to reduce the complexity of the raw data.

From these 23 axial categories and following the recommendations described in the previous chapter, the core category was identified and labeled as 'Implementing CBMs in Real Estate Development'. To analyze which axial categories could be included within the core category a series of questions were applied on each axial category, e.g., Can all the other axial categories be related to this specific category? (see all questions in Chapter 3 section 3.7 Axial Coding). Derived from this analysis four axial categories (Figure 20), i.e., Acknowledge Status Quo, Define Vision, Define Circular Strategy, and Key Performance Indicators (KPIs), were included within the core category.

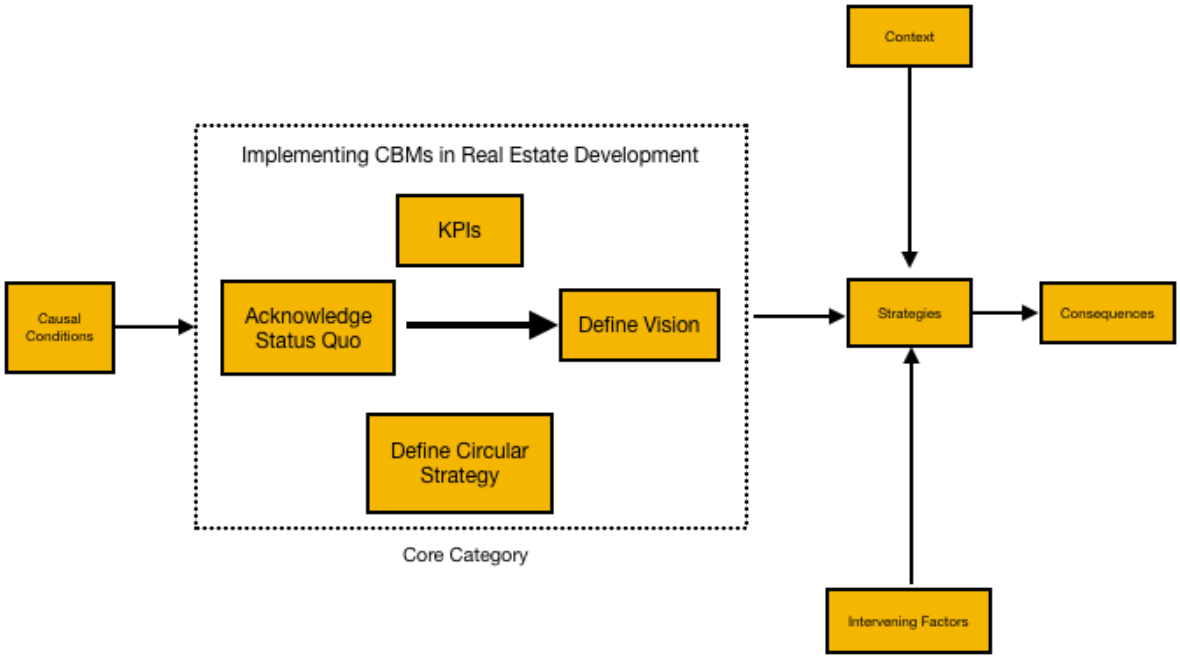


FIGURE 20 CORE CATEGORY WITHIN VISUAL CODING PARADIGM

The selection of these four axial categories within the core category follow the interpretation that they are inherent characteristics of the CBM design procedure. As shown in the literature review in Chapter 2, the design procedure is an independent process from the implementation itself; CBMs can be designed without developing an implementation framework related to them. Therefore, *acknowledging the status quo, defining a circular strategy, choosing certain KPIs and defining a vision* can be seen as the independent process of CBM design, and can be developed without any relation to its implementation. The focus of this study is given to the process of implementing a CBM that has already been developed, rather than to its design. In consequence, further consideration is not given to the specifics of each of these axial categories, but they are considered as part of the core category.

After establishing the core category, the next step was relating the 19 remaining axial categories to the core category (Figure 22), i.e., selective coding. The relationships were derived using the coding paradigm proposed by Corbin and Strauss (2008) and presented in Figure 19. Furthermore, each of the relationships was renamed to frame it in relation to the process of CBM implementation as shown in Figure 21. Consequently, 5 encompassing selective categories were developed: 'Company Circular Empowerment', 'Circular Steps', 'Context Bottlenecks', 'Company Challenges' and 'Circular Benefits'.

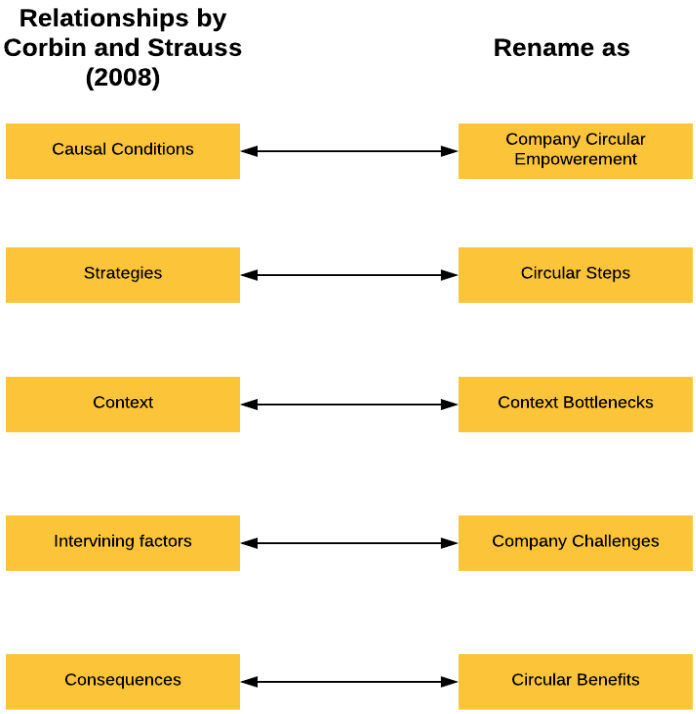


FIGURE 21 RENAMED RELATIONSHIPS BETWEEN CATEGORIES

The relationships proposed by Corbin and Strauss (2008) were supported by the data since all of them were identified. Hence, all the answers related to the BMI process reflected a sense of process archetype. Participants started by describing “enablers” or reasons to start the process (causal conditions), then they described actions to develop the new CBM (strategies), they mentioned what they expected from this implementation (consequences) and, finally, they described what factors they expected could hinder the process (context and intervening conditions). The only mentioned element that could not be found on the framework proposed by Corbin and Strauss (2008) was the iterative nature of the process described in the next section.

Figure 22 Selective Coding

The analysis was finalized with the development of the coding paradigm presented in Figure 23. Here, all the relationships between the categories are illustrated and allow to visualize the CMB implementation process within a Real Estate Development firm.

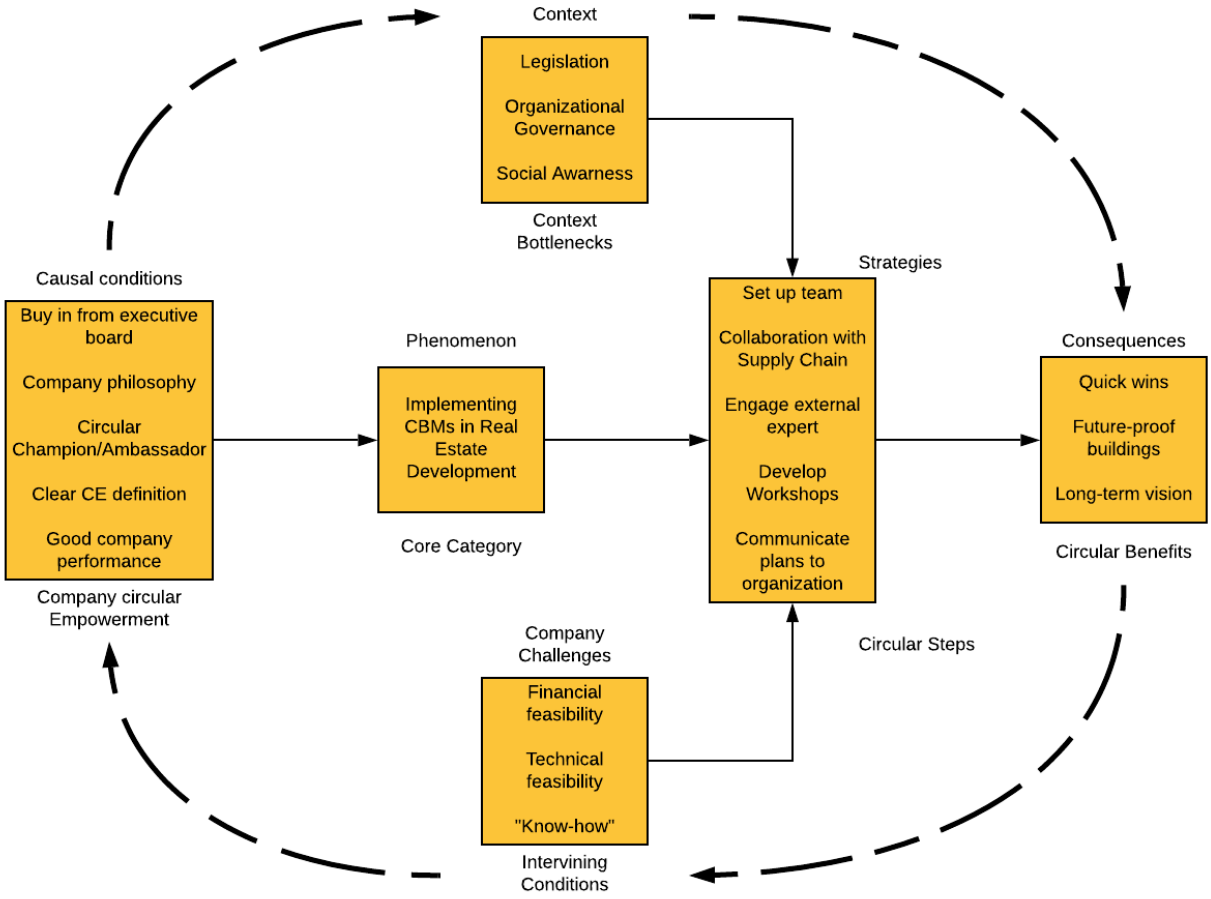


Figure 23 Coding Paradigm of CBMs implementation process within a Real Estate Development firm

4.1 Visual Coding Paradigm

The visual coding paradigm is the outcome of the analysis and illustrates the process of CBM implementation within a Real Estate Development firm. This process is characterized by three main relationships, i.e., 'Company Circular Empowerment', 'Circular Steps' and 'Circular Benefits', and two relationships that affect specifically the 'Circular Steps' but shaped the overall process, i.e., 'Context Bottlenecks' and 'Company Challenges'. The core category is placed in between the 'Company Circular Empowerment' and the 'Circular Steps'; therefore, these two relationships are deemed as the most important due to their direct relationship with the core category.

The 'Company Circular Empowerment' selective category is expressed as the needed factors for the core category to exist and the 'Circular Steps' selective category as the logical results of its development. The relationships developed by these selective categories and the core category are assumed to be unidirectional starting from the 'Company Circular Empowerment' category forward, meaning that the relations cannot exist the other way around.

The 'Circular Benefits' are portrayed as the results of the 'Circular Steps' and have a direct relationship with them; if the 'Circular Steps' change the 'Circular Benefits' would also change. These consequences cannot be altered without a modification of the 'Circular Steps', therefore, this relationship is deemed as secondary to the core category.

Finally, the last two selective categories, i.e., 'Context Bottlenecks' and 'Company Challenges', are regarded as external elements to the process but have a direct relationship to the 'Circular Steps', thus to the core category; therefore, these relationships are stated as tertiary.

The circular arrows encompassing the visual coding paradigm were added to this framework due to the iterative nature that the participants portrayed this process needed to be. This means that this process should be in constant review to analyze if the elements portrayed are still valid and/or if new elements need to be added.

In the following section a description of each of the categories in the visual coding paradigm is presented.

4.1.1 Company Circular Empowerment

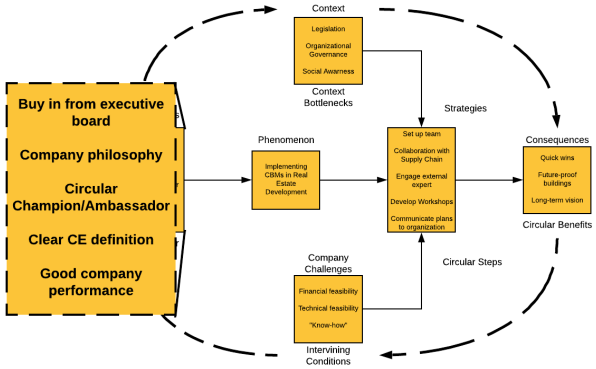


FIGURE 24 CAUSAL CONDITIONS

When asked how BMs were innovated within the organization, all participants responded by describing a series of factors that, according to their experiences, were present (or should be) at the start of the innovation of any BM. Recurring concepts in the transcripts like *top management*, *innovation* and *leader*, allowed the characterization of these elements as axial categories. In consequence, these axial categories were identified as having a causal relationship to the core category, as illustrated in Figure 24.

Five axial categories were established in this study as having a causal relationship to the core category and represent broad characteristics within the organization that seem to enable the

core category, these are: 'Buy-in from executive board', 'Company Philosophy', 'Champion/Ambassador', 'Clear CE definition', and 'Good Company Performance'.

Buy in from executive board

Buy in from the executive board reflects the need of awareness and involvement at the highest levels within an organization in order to promote a change in a given BM, thus triggering BMI. According to open codes like 'Lead by example' included in this axial category (see Table 5 in Appendix 9), all of the participants agreed that to implement any given CBM, first, the top management -in this case the executive board- needed to know about CE, believe in it, and give support to implement these principles. If this support could not be found within the executive board, the participants found it difficult to proceed with any given change to the BM. This argument can be explicitly seen in the following quote from one of the senior participants in a management position.

"You can't really make any big decision…you can't turn a business model if you don't have backing from the top management"

Senior Executive[4]

Therefore, 'Buy in from executive board' was identified as one of the first causal relations to the core category. The degree and quality of involvement of the executive board could not be investigated due to time constrains, therefore, were out of the scope of this study but provide an opportunity for further studies to be performed.

Company philosophy

Company philosophy was identified as what drives an organization to start the process of implementing CBMs. In this study, the elements mentioned the most had a strong focus on innovation, Corporate Social Responsibility (CSR) and an entrepreneurial spirit. This is reflected in the following quote by another of the senior executives at the firm.

"If we want to be leaders and keep the disruptive concept that got us here, then we have to be able to stay sharp and entrepreneurial".

Senior Executive

Different characteristics were mentioned to motivate a company to implement CBMs, but in general most of these elements could be related to the company's philosophy, ergo the category

[4] All the quotes are generically referenced due to confidentiality reasons

name. Therefore, this axial category was recognized to have another causal relationship to the core category. Three specific elements are stated in this study, i.e., Innovation, CSR, and Entrepreneurial Spirit, however, other elements like branding were also mentioned. The specifics of this category are left out of the scope but proposed for further research.

Circular Champion/Ambassador

Circular Champion (or Ambassador) refers to a specific person or group of people that deeply cares about the implementation of CBMs, and constantly encourages its development. This category emerged from the arguments on BMI, as one of the elements that enables this transition. Codes like 'Leader' and 'Lead by example' could be constantly found in the discussion about BMI and all the participants related them to a single point of contact. Therefore, when the concept of a 'Champion' was mentioned, it was easy to relate all of these propositions to a single category. From another of the interviews it was importantly noted that this 'champion' could not only be a specific single person but a group of people enthusiastic about the implementation of CBMs and its development.

From the experiences of the participants it is argued that this axial category has a causal relationship to the core category since most of the participants within the firm recognized that the efforts taken towards CBMs implementation – and even the collaboration to performed this research- were only given because of the active participation of specific employees within the firm, and this was not the case in other organizations where the participants have been involved and did not have a 'circular champion'.

The full qualities and degree of involvement of this 'ambassador' cannot be stated but one characteristic that kept appearing in the data is that BMI has better acceptance when the promoting champion has a high position within the organization. This is illustrated in the following quote.

"We have the luck that our development director is really engaged with the topic [CE]. I think this is very important".

Sustainability Expert

Clear CE definition

A 'Clear CE definition' refers to the common understanding that people inside an organization have about the implementation of CBMs. This axial category emerged from the discussion about how CE principles can be implemented and the biggest challenges this process faces. As

mentioned in the research problem in Chapter 1, one of the problems in CE implementation is the variety of definitions that can be found and the lack of a common understanding in general. This was also confirmed throughout the interviews, since none of the participants mentioned an equal definition of the CE. Nonetheless, similar characteristics about the CE concept were found in the understanding of the participants and, moreover, similar aspiration of what CE principles should bring to the firm were recognized. In consequence, it was acknowledged how these similarities triggered the need of a CBM inside the firm. Then, for example, a common understanding in the firm about how 'Circular Design' should be the first approach to a CE allowed to start the process, even when there is not a full understanding of the CE concept.

In consequence, it was identified that the 'clear CE definition' axial category was another causal element for CBM implementation. As mentioned before, this does not mean that the full CE concept should be completely understood within the firm but that the people participating in its implementation should agree on its definition and have a common understanding. Without this step it seems that the process could be delayed or derailed from its original purpose.

Good company performance

Good company performance describes the characteristic that an organization has that allows it to endeavor in new ventures. As explained by different senior executives within the sample, innovation cannot happen when an organization is not performing well. Real estate development firms depend on investors and lenders, and these individuals (or organizations) base their decision on how well the company is doing. Therefore, good performance equals the ability to implement new ideas, like CBMs. This argument is illustrated in the following quote from one of the top executives when talking about the enablers to implement CE principles in real estate products.

"Overperforming in our business plan gives us more value that we can increase the investments on more circular aspects".

Top Executive

Because this argument was related to the deployment of any BM it was also identified to have a causal relationship to the core category. What 'good performance' means is not specifically defined in this research, but it seems that it is deeply linked to the financial situation of the firm. Further research is required to determine if solely financial considerations are taken to evaluate if a company is performing well enough to start implementing CBMs.

4.1.2 Circular Steps

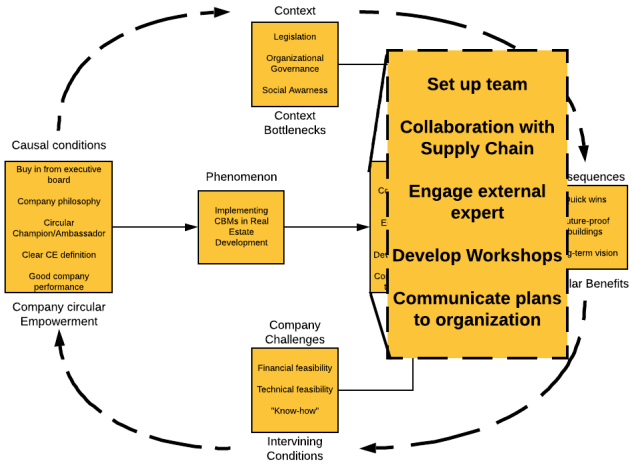


FIGURE 25 STRATEGIES RELATIONSHIP

The second relationship encompasses responses about the process for BMI within the organization. The answers reflect a series of actions that are deployed for the development of the core category. In this study, these actions are referred to as strategies (following the methodology proposed in Chapter 3) and labeled as 'Circular Steps'. These strategies include: 'setting up a team', 'engaging external expertise', 'collaboration with the supply chain', 'develop workshops' and 'communicating plans to the organization'.

Setting up a team

The "setting up a team" axial category was developed as a straightforward response to the development of the core category and refers to the action of involving a specific group of people to manage the implementation of CBMs within the organization. All interview participants acknowledged that in their belief the most effective way to control and monitor the implementation of new BMs should be through a group of specific people in charge of this transition. Different characteristics related to 'Setting up a team' were identified within the responses of the participants and are mentioned in this study as examples.

One important characteristic of the "setting up a team" axial category was the need for this team to have decision-making power. Most of the participants mentioned that top management should be involved. Moreover, the participants also recognized that it should be a multidisciplinary team but not all departments within the company may need to be represented. It was mentioned that the fewer people involved, the less complex the decision-making process turns out.

With respect to who should integrate this team, different company departments and positions were mentioned including finance, construction and design. However, no inference to how this team should be integrated can be made from the data since the knowledge about CE varies per department and per person. In addition, each CBM has different implications, thus not all departments are affected equally.

Collaboration with supply chain

Collaboration with supply chain refers to the action of engaging with the whole supply chain to come up with the best way to implement CBMs. Most of the participants clearly identified that implementing CE in the building industry cannot happen individually but calls for collective transformation, as illustrated in the following quote from one of the CE experts.

"What you need to do is combine streams from other companies and form loops within the ecosystem. It doesn't need to be one company. It usually can't be one company. You need to connect to other companies, people, governments, etc. So, it's really about connections as well"

CE Expert

Different actors within the real estate development supply chain were mentioned (e.g., suppliers, contractors, lenders). The overarching message is that the whole supply chain needs to be engaged at some point. But, again, this depends on the CBMs chosen to be implemented.

The most mentioned reason to collaborate with the supply chain is cited in the quote below. It reflects that even when real estate developers are motivated, have defined goals, and plans have been outlined, if the market is not ready, CBM implementation cannot happen and needs to be revaluated.

"…if we are going to talk about how [to implement CBMs], we need to involve our partners to see what is realistic in terms of investment, how ready is the market, etc."

Sustainability Expert

Previous research on this collaboration in the real estate development supply chain has already been done[5].

Engage an external expert

Engage an external expert refers to the action of collaborating with an external party with expertise on CBM implementation to ease the flow of the process and allow the organization to take more of a role in the discussion than in managing the process.

More than lack of understanding about CE, participants portrayed that organizations seem to look for external expertise to guide and organize the process. Moreover, it gives real estate

[5] SEE (Blok, 2018; Leising et al., 2018; Schenkel et al., 2015; Wells & Seitz, 2005)

developers the opportunity to engage with a wider network of organizations related to CE due to the expert's connections.

However, the qualities (e.g., duration or effectiveness) of this 'step' did not emerge from the data, the main reason being that implementing CBMs is still an ongoing process within the organization.

Develop workshops

Develop workshops refers to the action of carrying out workshops within the real estate development firm as a tool to implement CBMs.

Workshops were mentioned as the method with the most benefits to implement CBMs and BMI in general. Within this method different tools were recognized like the use of the Business Model Canvas. However, according to the participants, the use of specific tools to implement CBMs (or BMI) is not a common practice for real estate developers. Therefore, there is reason to engage with an external expert with expertise in developing and implementing CBMs.

Most of the participants mentioned their participation in different workshop focused on CE, and it was recognized that in these events it was easier to establish connections with possible new partners, talk directly to suppliers, engage with people that are also attracted by CE, and bring better awareness within supply chains.

The quantity and content of these workshops cannot be derived from the data, but it seems that this method is one of the actions taken in response to the implementation of CBMs.

Communicate plans to the organization

Communicate plans to the organization refers to the action of informing the entire organization about the implementation of CBM(s). It was identified that this 'step' is needed to keep the process in motion. Participants described that a CBM is defined by the top management, managed by a specific team but to 'close the loop' you need to involve everyone in the company. Some of the mentioned benefits of this step were: feedback and 'snowball ideas' - defined by the author as new ideas that generate from innovation.

Another important aspect mentioned in communicating the plans to the organization was the way in which this information is communicated. No specific methods can be derived from the data, but it was recognized that if there is not a specific and effective means of communication, the previously-mentioned benefits cannot be realized, and, in some cases, strategies can even fail.

4.1.3 Context Bottlenecks

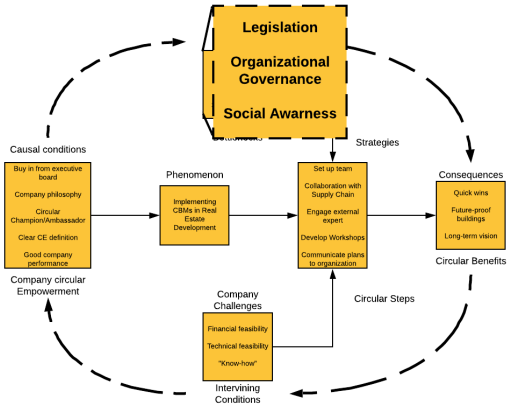


FIGURE 26 CONTEXT RELATIONSHIP

The context factors are labeled as 'Context Bottlenecks', and they represent the external challenges that a real estate developer faces when implementing CBMs. Three axial categories embody these factors: Legislation, Organizational Governance, and Social Awareness.

These axial categories are deemed as external forces to the process since no correlation could be established between the 'Context Bottlenecks' and the 'Circular Steps'. This means that changes within the strategies do not reflect upon these bottlenecks.

Legislation

The 'Legislation' axial category encompasses challenges mentioned by the participants regarding legislation when implementing CBMs. Since at the time of the interviews no CBMs had been implemented within the participants' organization, participants could not identify a specific problem related to CBM implementation. However, all participants pointed out that legal challenges will affect the implementation of any given CBM due to the novelty of the concept and the issues that arise even during the design of CBMs.

Participants mentioned different broad issues related to both public and private law that affect the design of CBMs, but it was acknowledged that these challenges depend upon the selected CBM and the location of the building (e.g., the 'Product-as-a-Service' CBM was identified by some of the participants as the most challenging CBM under Dutch legislation due to the ownership status of the elements, whereas the 'Circular Enabler' CBM was not seen as problematic in relation to Dutch law).

Because of the recognized relationship between the design of CBMs and the legal challenges that it presents, the 'Legislation' axial category was created to indicate organizations about the legal challenges that implementing a CBM might bring. Then, every time a real estate development firm embarks on this process there is a recognizable element within the framework that allows consideration for any given legal issue that might be present and prepares organizations to develop actions to overcome them.

One specific example of a challenge between CBMs and present Dutch law is given in Appendix 10. This example focuses on the introduction of leased facades in real estate assets and shows how the present building system hampers the implementation of these Pay-per-use CBMs, the reasons for these impediments and the proposed solutions to overcome this challenge.

Organizational governance

The 'organizational governance' axial category describes the challenges that governance structures face when implementing CBMs. This axial category is considered to be external to the organization given that no correlation between the strategies and this category could be established within the data. This means that only a unidirectional relationship could be recognized between this category and the 'Circular Steps'. Therefore, it was acknowledged that the type of governance has an impact on the strategies but changes in these strategies do not influence the organizational structure of the organization.

As illustrated in the quote below, most of the participants mentioned that in real estate companies where innovation seems to be more fluid it is because new ideas come from any level within the organization and they are heard and considered by the top management.

"Well, we think we're a flat organization, so good ideas and radical good ideas that could change the business model they can come from every direction."

Top Executive

On the contrary, based on participants' past experiences in former companies, organizations with rigid structures and long-standing procedures tended to block innovation, and thus BMI.

Finally, hierarchical rigid organizations were mentioned to be more efficient at communicating plans to all levels within a company but had difficulties setting up teams, developing workshops, and engaging supply chains due to the fact that decision-makers usually stand at the top of the hierarchy. On the other hand, flat organizations seem to be less rigid and allow more flexibility in decision-making, supply chain engagement and setting up teams, but lack the structure to communicate effectively.

Social awareness

The 'social awareness' axial category encompasses the challenges that the society at large faces when implementing CBMs. As mentioned in the research problem in Chapter 1, the benefits from a real estate development perspective come from the value that is assigned to the real estate product (Kraag, 2015). This value depends on the social perception that people have about the value propositions offered by the real estate product (Kraag, 2015; Teece, 2010). Therefore, if

society is aware of the benefits that the CE brings, they may attach more value to circular propositions. In consequence, the implementation of CBMs could be enhanced.

Furthermore, even when the Dutch government (in essence the voice of the society) seems to be quite interested in fully implementing the CE by 2050 (Ministry of Infrastructure and the Environment, 2016), the participants perceive that society at large is still not aware of the CE concept, let alone its benefits for the built environment. This was mentioned as important because the type of real estate assets being studied were commercial properties (or income-producing real estate), thus more `social circular awareness´ could result in more appealing circular products. Although this relation cannot be validated in the context of the current study, it is mentioned as an illustration of the importance of social awareness as an external factor that influences the implementation of CBMs.

This axial category is included so that organizations consider the "readiness" of society to introduce CBMs, similar to the way that *'Collaboration with supply chain'* considers the readiness of the supply chain, to be prepared to enable CBM implementation.

4.1.4 Company challenges

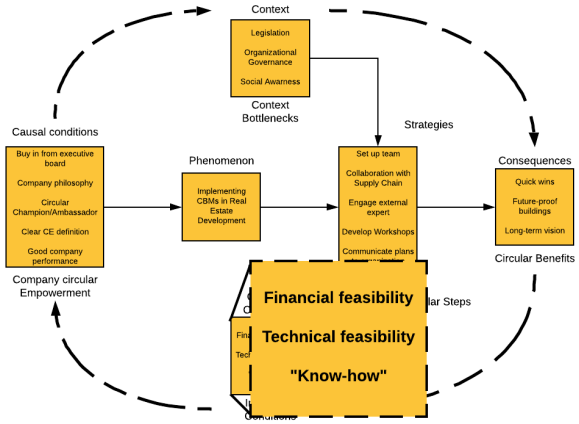


FIGURE 27 INTERVENING FACTORS

The next set of factors that influence the implementation of CBMs are those that seem to be correlated to the 'circular steps'. This selective category is labeled as 'Company Challenges' and includes three axial categories, i.e., financial feasibility, technical feasibility, and 'know-how'. These factors are deemed internal, thus depend on the characteristics of each of the 'Circular Steps' and are particular to each real estate development firm.

These mentioned axial categories are proposed to allow organizations to recognize the internal challenges inherent to the CBMs' implementation process and prepared organizations to take actions to tackle these internal challenges.

Financial Feasibility

Financial feasibility refers to the challenges within the organization that rise from the financial implications of the implementation of CBMs. This axial category was the most mentioned

challenged when asked about the problems inherent to implementing CBMs in real estate. However, it was admitted that this challenge does not comes from external factors but depends on the real estate developer's financial vision. Participants stated that some developers are more concerned about sustainability and are trying to implement a long-term vision; in consequence, more resources are deployed to fulfill this vision. On the other hand, developers that still look at financial feasibility in the short-term (less that 5 years according to participants) cannot seem to justify the different investments that CBMs require.

Furthermore, the 'Financial feasibility' axial category seems to be correlated to the 'Circular Steps' because the different 'steps' also influence the financial feasibility of the implementation of CBMs. It was mentioned that if, for example, the use of an external expert and the development of workshops had large financial consequences this could affect the whole financial feasibility of the implementation. Another case mentioned was the availability of personnel to focus on this process. If new team members were needed or involving current personnel will affect the performance of the real estate developer, this will also have an impact on the financial feasibility of the process.

Finally, it was also recognized that each CBM has its own unique financial implications, thus the process needs to be carefully and independently analyzed. Some CBMs were acknowledged to be more likely to be financially feasible, e.g., Circular Design and Circular Enabler, than others, e.g., Product-as-a Service and Circular Inputs.

Technical Feasibility

Technical feasibility describes the challenges within the organization that arise from the technical implications of the implementation of CBMs. The participants mentioned different characteristics that influence the development of strategies to implement CBMs; many of these characteristics were related to current technological advancements that allow or block such implementation.

Technical feasibility is stated as an internal factor because of the differences that each real estate developer has in relation to technological advancement. It was noted that there is a gap between large developers that deploy more resources into R&D or innovation departments and small developers that can only focus on financial survival. Therefore, the problem is not focused on the missing technological developments to promote the implementation of CBMs (e.g., better technology that motivates modular design, like 3D printing) but on the capacity that each real estate developer has to reach and implement these innovations, i.e., are we able to ask for or produce in-house 3D modular products?

In consequence, this factor can be correlated to the 'Circular Steps'. For example, the technology needed for the implementation of the CBM will influence the choice of team members due to

the knowledge and skills that these members might need to work with these types of technologies, e.g., are the members of the team able to manage 3D printing implementation? In addition, the technological feasibility will be affected if team members do not know how to manage 3D printing products. Another example of the correlation between technical feasibility and the 'Circular Steps' is collaboration with the supply chain. The technology requirements needed to implement a certain CBM will impact the supply chain and this impact will determine if the strategy is technically feasible.

"Know-how"

"Know-how" describes the challenges within the organization that arise from the knowledge and procedures needed to deploy the actions to implement CBMs. Implementing a new BM implies changing processes, practices and measures, and these changes cannot happen if people involved with these changes do not have the correct skills and knowledge, i.e., 'know-how'. This is why this category emerged as an internal factor that influences the deployment of strategies, i.e., 'Circular Steps'.

One clear example mentioned was that, even when a CBM was chosen and understood by top management, if the implementation team (see 'Circular Step' setting up a team) did not have a clear picture of everything related to the implementation of this CBM, the process would be delayed (e.g., the implementation team does not understand how the impacts of this new CBM are going to be measured). In consequence, most of the participants stressed the importance of bringing in-house awareness, conducting trainings or developing activities to improve skills. Therefore, all of these mentioned elements were encompassed the "know-how" axial category.

"Know-how" is stated as being internal because the degree of this factor varies with each real estate developer. It was recognized that some developers have a great degree of knowledge and skills to start implementing CBMs; however, this is not the norm and it seems more the exception to the rule than the current status quo.

4.1.5 Circular Benefits

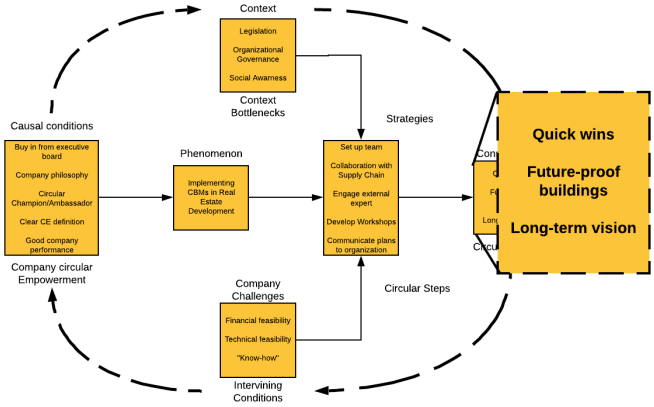


FIGURE 28 CONSEQUENCES RELATIONSHIP

The last of the selective categories is 'Circular Benefits'. This selective category describes the outcomes of deploying the previously-mentioned strategies. Three axial categories were included in this concept: quick wins, future-proof buildings and long-term vision. These consequences seem to be the result of implementing CBMs in a real estate firm.

These 'benefits' are portrayed as the short-term, medium, and long-term consequences of the 'Circular Steps'. According to the participants, they have a direct relationship, meaning that they are the direct result of applying the mentioned strategies, but the degree of this relationship cannot be established from the data.

Quick wins

Quick wins outline the short-term consequences of implementing the 'Circular Steps'. The most mentioned consequence for the implementation of CBM in a structured way was recognizing the "low-hanging-fruit" and taking it as a quick win to keep the implementation process in motion.

It was noted that, even when some circular strategies are already being used, e.g., refurbishment of buildings, if the strategies, such as setting up a team, are not implemented there is no acknowledgement of these quick wins. On the contrary, when a real estate developer implements these strategies it was mentioned that these quick wins were easier to recognize. This kept the organization motivated to keep pushing for better implementation of CBMs.

The participants that did not mentioned this "quick wins" concept stated that the circular economy was a long-term achievement and that nothing but waiting had to be done. On the contrary, participants that recognized the "low hanging fruit" saw CE as a present challenge that needed attention today.

Therefore, it is expected that the first outcome of organizations applying the proposed implementation framework will be developing and recognizing quick wins, i.e., low-hanging-fruit, that will foster the process.

Future-proof buildings

Future-proof buildings outlines the medium-term consequences of implementing the mentioned strategies.

'Quick wins' were mentioned to motive real estate developers to keep things in motion, but this consequence is not seen as the main aim of implementing CBMs. Implementing actions to achieve a CBM is expected to transform the way buildings are seen, built, and valued. Participants expected that this improvement in buildings will take time to occur, but this outcome is expected to be the most tangible result of implementing CBMs.

Participants could not specifically define what they meant by a 'future-proof building' but it could be recognized through the data that they mostly regarded this concept as a way in which buildings will have the flexibility and ability to adapt to the changes that a clear CE definition might bring to the building industry.

In consequence, the second outcome of applying the proposed implementation framework is to enhance the capacity of the real estate products of an organization to adapt to the requirements of a CE.

Long-term vision

This category outlines the long-term consequences of implementing the 'Circular Steps'. This consequence encompasses all the long-term changes that participants mentioned but that, in the end, were related to a change of perception. Then, the final outcome of this process was predicted to change the mindset of people.

From the analyzed data, it seems that a change of opinions, motivations, and goals of the people involved in real estate development are the most expected results from implementing this process, but also the longest to achieve. In general, participants believe that it will take time to prove that caring about the future of the building industry brings more benefits than not caring about it.

Then, the final result of implementing CBMs in real estate development firms seem to be engrained in the core essence of the business, modifying not only the buildings themselves but the mindset of the people responsible for their development.

4.2 Conclusion and Summary

Through this chapter, the results of the analysis were described. It started by describing the open codes that emerged from the raw data. Then, the axial categories and a core category were

developed by grouping the open codes. Finally, these concepts were interrelated to establish a visual coding paradigm using selective coding. This conceptualization illustrates the elements that can be subtracted from the experiences of the people within a real estate development firm regarding the process of implementing a CBM(s). Therefore, the answer to the third sub question can be given.

What can the experiences from a real estate development firm tell about the implementation of CBMs in such firms?

Using the methodology proposed in Chapter 3, different elements emerged as codes from the experiences of a real estate development firm, in this case The Student Hotel (TSH). The analysis of these open codes resulted in nineteen elements or axial categories that are found to be related to a core category. Each of these axial categories has a unique relationship to the core category and can be positioned within a visual coding paradigm. This visual tool helps to illustrate the nature of these relationships and facilitate the understanding of the implementation process. Five types of relations are proposed to be manifested when implementing CBMs, these are: causal conditions, strategies, intervening conditions, context and consequences.

Causal conditions are actions that precede the core category and are needed for its development. This relation is stated as 'Circular Company Empowerment' and is composed of five axial categories: 'buy-in from executive board', 'company philosophy', 'circular champion', 'clear CE definition' and 'good company performance'.

In response to the core category, several actions described as strategies take place, this relation is stated as 'Circular Steps' and five axial categories were found to be part of it: 'set up a team', 'collaboration with supply chain', 'engage external expert', 'develop workshops' and 'communicate plans to organization'.

Two sets of conditions affect the 'Strategies'; these are context and intervening conditions. Context conditions are stated as 'Context Bottlenecks' and comprise three axial categories: 'legislation', 'organizational governance' and 'social awareness'. Intervening conditions are stated as 'Company Challenges' and also three axial categories are present: 'financial feasibility', 'technical feasibility' and 'know-how'.

The last relationship found is the consequences which are stated as 'Circular Benefits'. These are the expected results of implementing the 'Strategies'. Three consequences were found: 'quick wins', 'future-proof buildings' and 'long-term vision'.

The conceptualization of the process gives a clear vision of how the implementation of CBMs manifests in a real estate development firm; it shows the preceding conditions that seem to

enable initiation of the process, specific follow-up steps in the implementation of CBMs, particular factors that affect these following actions, and finally the expected outcomes of the process. Each of the selective categories that are included within the visual paradigm is formed by the axial categories that emerged from the expertise of people going through this process within TSH. Therefore, the 19 categories that emerged from the analysis are proposed as the characteristic elements of implementing CBMs within a real estate development firm.

This empirical visual conceptualization of the process is, to the authors knowledge, the first of its kind. Therefore, a thorough analysis of its implications needed to be discussed. In the following chapter the discussion of these findings is presented.

5.0

Discussion

The previous chapter presented a visual coding paradigm that conceptualized the elements needed for the implementation of CBMs in real estate development. These elements were grouped into categories whose interrelationships were illustrated in the visual coding paradigm.

In this chapter, the implications and interpretations of this coding paradigm as a visual conceptualization of implementing CBMs in real estate development are discussed. This allows the final sub question to be answered.

5.1 Visual Coding Paradigm Implications

Having defined a framework for the implementation of CBMs in a real estate firms and its particular elements implies that now there is a structured approach in which companies can capture the principles of a CE. However, and as discussed in the last chapter, this framework could not be validated or tested due to lack of resources and the time-frame of the study. Therefore, it can only be presumed how this framework could be applied and what are the implications of such task.

To begin with, it is acknowledged that before any CBMs is designed companies would need to review the first elements within the “Company Circular Empowerment” category. These elements portray the enablers of the process and trigger its development. As discussed later in section 5.2, it cannot be confirmed that all the elements within this category are needed to start the process or if there is a specific order in which these elements should be taken. However, it is argued that if one of these elements, e.g. ‘company philosophy’, is not present, then, the process

can indeed be delayed or in any case blocked. Therefore, it is recommended that any organizations that plans to use the proposed framework reviews each of the proposed causal elements and identifies if its present or not in its organization as a first step, before any attempt to design or select a CBMs.

The next step will be to implement the proposed actions for the development of the CBM(s). It is recognized that each of the actions within the 'Circular Steps' category seems general, but it is argued that the specifics of most of these actions can be found in other studies or in the project management literature. Therefore, it is recommended that before implementing the 'Circular Steps', organizations make arrangements to develop each of these actions accordingly to the needs and capabilities of each firm. Given this situation, the composition of the team that will manage the implementation process seems paramount and could be argued to be one of the most important actions, however, this argument still needs further investigation.

Furthermore, the responsibility to recognize and manage the proposed intervening conditions, whether they are external or internal, would also need to be placed on the management team. Then, it is proposed that one of the first tasks of this team would be to make an analysis of this potential threats and to what degree are they affecting the process. Different tools, like a SWOT[6] analysis, could help to tackle these challenges but, again, these types of analysis are more related to the project management literature, thus they are only referenced and left to the management team to figure out.

Finally, the outcomes of the process are not seen as mandatory but as expectations. Thus, it is recommended that an analysis of the results of the implementation process will be also performed. This could help to evaluate the framework and recognized lessons learned. For this situation it could also be valuable to define a time-frame for the expected results, giving the fact that the framework proposes short, medium, and long-term consequences.

All in all, it seems that it is extremely important that the proposed framework goes thorough an experimentation phase so each of the relationships and its elements can be tested. Without this condition it does not seem feasible that other firms in real estate development could apply this framework and expect to harvest the proposed results.

Furthermore, the arrows in the visual coding paradigm portray the iterative nature of the CBM implementation process. Including an iterative characteristic to the process was rooted in the idea that CE is still in its infancy, hence the expectation of the participants that the CE concept will continue to be refined. In consequence, the framework could not be portrayed as a mere

[6] Strengths, Weaknesses, Opportunities and Threats.

sequence of phases that needed to be followed. On the contrary, this process needs to be as flexible as possible, so it can accommodate the constant new features that the future might bring.

From a theoretical point of view, this flexibility or iterative nature appears to unsettle the basis of the conceptualization. Stating that the theory behind this process could, in fact, be constantly changing sets a shaky starting approach. However, until now, only a few “grand theories” have withstood the passing of time. Therefore, more than an oversimplified argument, the proposed cyclical element within the framework justifies the dynamic nature of the process and warns the organizations that wants to apply the framework of the future changes that might be encountered. After all, theories are just provisional, since it can never be assured that the next experiment will keep confirming them (Hawking, 1996). In consequence, the only argument that could be proposed to include flexibility on the proposed framework is through the inclusion of the arrows encompassing the framework representing periodic revisions of the elements that include the definition of a concept, e.g., ‘future-proof building’, the CE concept itself, legal definitions, etc. The number or frequency of this revisions can only be left for the company to decide since the advancement in science cannot be predicted.

For a more effective discussion, the deeper levels of the framework are analyzed into four segments (see Figure 29). These are: Causal Conditions, Strategies, Intervening Factors and Consequences. Each one of these categories are discussed independently since each has its own implications and the proposed structure of the visual coding paradigm could not be relate to previous frameworks. Only particular elements within some of the frameworks could be identified but, overall, previous frameworks only describe phases of the process but do not specify the nature of the relationships between such phases. The only exception is Mouazan’s (2016) framework; identifying success factors, drivers of change, bottlenecks and outcomes. However, Mouazan does not place these elements within the implementation process itself but place them as surrounding categories to the process (see Figure 11), limiting the scope of his research to general conclusions. Nevertheless, Mouazan research helps to confirm and evaluate the general implications of this study making the connection between this specific study and more general studies. Therefore, after the discussion of the specific relationships portrayed in the visual coding paradigm an overall analysis of the findings is described showing the relationship between the previous literature and the findings of this research.

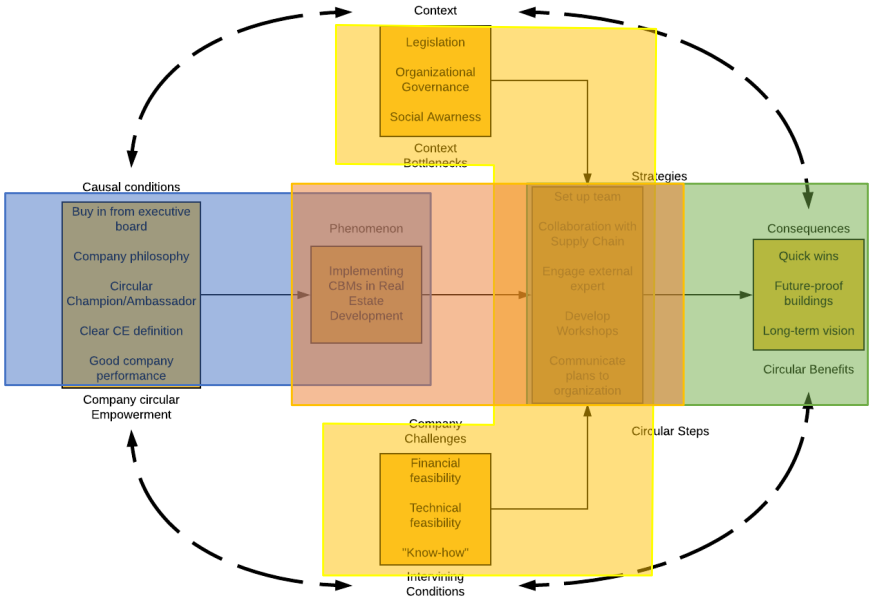


Figure 29 Visual Coding Paradigm Relationships

5.2 Causal Conditions: Company Circular Empowerment

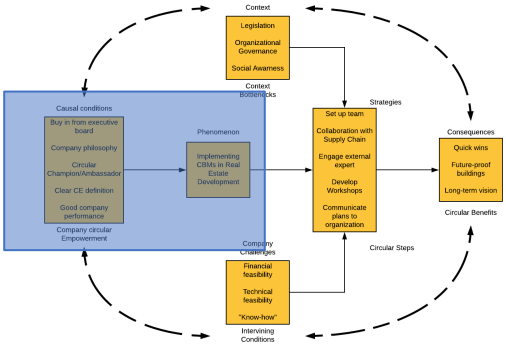


Figure 30 Causal Conditions Relationship

Previous studies on CBMs within the building industry do not focus on the causal conditions that enable to start the implementation process, therefore it is difficult to establish a relationship with previous research. However, in general studies on CE implementation the causal conditions that block or enable the CE resemble those found in this study. For example, Leising et al. (2018) mentioned the development of a circular vision as a first step in her collaboration tool for the CE in the building sector. This concept includes 'show leadership' and 'create support' for the implementation of circular strategies. These two concepts are deeply similar to the conditions of 'buy-in from executive board' and 'champion/ambassador' found in this thesis. Moreover, Rizos et al. (2016) mentions two barriers for CE implementation in SMEs: 'company environmental culture' and 'lack of capital', which relate to 'company philosophy' and 'good company performance'.

Although the stated causal conditions give substantial insights into the enablers of the implementation of CBMs, additional research is required to determine if all of these conditions are necessary, to what degree, and their specific qualities. Therefore, it is recommended that before applying this framework in other real estate development firms, each one of the elements that comprehend the 'company circular empowerment' category is tested and evaluated.

Overall, this first selective category shows organizations a point of departure to start with the circular transformation. It shows how important concepts need to be figure out first, support and motivation need to be present within the highest levels of the organization, and specific people need to be involved.

5.3 Strategies: Circular Steps

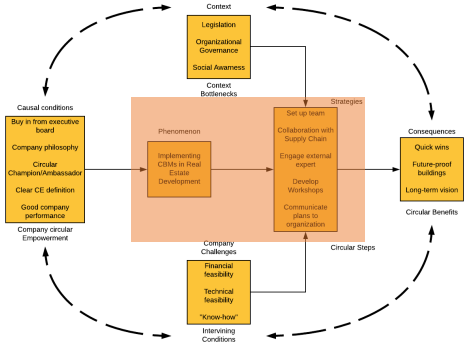


FIGURE 31 STRATEGIES RELATIONSHIP

The relationship and axial categories portrayed between the core category and the 'circular steps' could contribute vastly to the developments in CBMs implementation theory since they seem to be the first conceptualization of the actions that follow the selection of certain CBM within the real estate industry. As seen in Chapter 2, already some implementation frameworks have been proposed in other industries (Frishammar & Parida, 2018; Mentink, 2014; Mouazan, 2016; Talukder, 2017). From these frameworks it is recognized that one common characteristic can be recognized: all the focus after the design of the CBM is place on the "reconfiguration of the value network". This concept seems to refer to the collaboration between the partners or "business ecosystem" (Frishammar & Parida, 2018), and aims to integrate the developed CBM within the supply chain. However, even when this concept seems to be fundamental in such level that it was also identified within the 'circular steps', i.e., 'collaboration with supply chain', other authors do not describe guidelines or give any insight into how to perform this integration of the CBM within the supply chain. For this reason, the framework presented in this study seems to go a step further introducing the formation of a specific team to manage the integration of the CBM, proposing to engage an external party that helps to reduce the complexity of this process and implementing workshops that can foster the collaboration between partners. Overall, it could be argued that the framework for CBMs implementation in real estate presented in this study seems to give a more detailed description of the actual steps that are needed for the implementation of CBMs.

From the perspective of organizations, these 'circular steps' could help to develop a specific set of parameters that allow to manage and organize the implementation of CBMs. Acknowledging which actions are needed after a CBM is chosen could help organizations to evaluate the needed resources to foster this process. In addition, it could allow them to develop plans before any CBM is chosen and have a more integrated approach. Altogether, the objective of a theoretical model is to predict outcomes and these propositions are a first prediction but can also help to estimate more detailed needed elements for CBM implementation in Real Estate development organizations.

However, most of the individual qualities of each 'step' could not be conceptualized. Even when concrete examples were given by the participants like "keep the size of the set-up team as small as possible to avoid complexity", it would be deceiving to make conjectures about these qualities, and it is better left for further experimentation. Furthermore, the order of each 'circular step' is not purposive since this could not be derived from the data, meaning that each of the steps could be taken in any order and the outcome could be the same or completely different.

In relation to previous research, each individual action can be found in several independent studies. For example, the need to establish a team can be found in the work of Leising et al. (2018) but also in more general works as in the project management literature, e.g., in the work of Nicholas & Steyn (2017). The value of this research is that it groups all these concepts and connects them to other elements within the proposed framework.

As with the causal conditions, i.e., 'company circular empowerment', the 'circular steps' were not tested; therefore, it is not known if each is a necessary response of the core category. From the analysis of the data it seems that most of them are present in any CBMs implementation, although conclusive arguments cannot be established from this study.

5.4 Intervening Factors

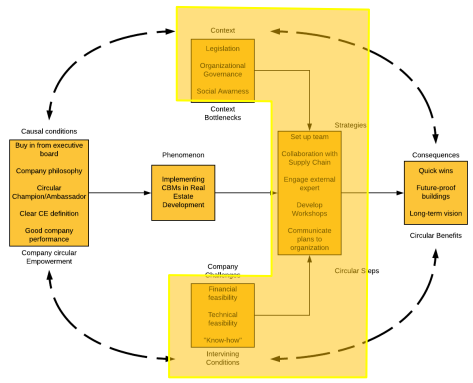


Figure 32 Intervening Factors Relationship

As mentioned in the research problem in Chapter 1, previous studies have explored the barriers of CE both in general terms and specific to the building environment (Adams et al., 2017; Pomponi & Moncaster, 2017; Rizos et al., 2016). For example, in a general observation, Pomponi and Moncaster (2017) recognized that one of the barriers to implement a CE is the *managerial aspects of its implementation*. In a narrower observation, Rizos et al. (2016), looking only at SMEs, identify that the *company environmental culture, a lack of technical know-how* and *administrative burdens* are some of the barriers for a CE – all of these relating to managerial decisions within an organization. Finally, Adams et al. (2017), looking only at construction organizations, describe that some of the implementation challenges for a CE are *lack of interest, limited awareness and lack of knowledge* – all also related to managerial decisions. Therefore, when the same elements identified in previous studies of CE implementation emerged from the participants experiences on CBMs implementation, this establishes a relationship from the general theory to the empirical analysis found in this study. Moreover, within the Circular Business Model Transition Framework (Mouazan, 2016) legal barriers to the implementation of CBMs are also stated, even when his framework is not focused in any specific industry. This theoretical link between the general and the specific strengthens the ongoing research on CE implementation and reinforces the basis of this study.

In addition, the theoretical barriers or challenges found in this study are not only identified, as in previous studies, but are also placed and illustrated within a theoretical process; Therefore, not only proposing a specific relationship to a core category, i.e., internal or external, but also a first characteristic of this relationship, i.e., correlated or not correlated. This hypothetical proposition could be portrayed as a pragmatic argument for the validity of these factors, since it is assumed to be easier to test propositions when they are specific to a process and located within it.

Finally, the conceptualization of these factors and their visualization through a visual coding paradigm bridges the gap between the former studies on CE implementation and the theory of circular business modelling. Following the arguments of Nußholz (2018), this step proposes to reduce the complexity of these elements and provide a more approachable way of working with them – showing the added value of the developed visual coding paradigm. On the other hand, the relationships and qualities of these intervening factors remain untested and no inference

about their validity could be made during this research. Despite the mentioned links with previous studies, without specific experimental investigation these factors can only be depicted as hypothetical.

5.5 Consequences: Circular Benefits

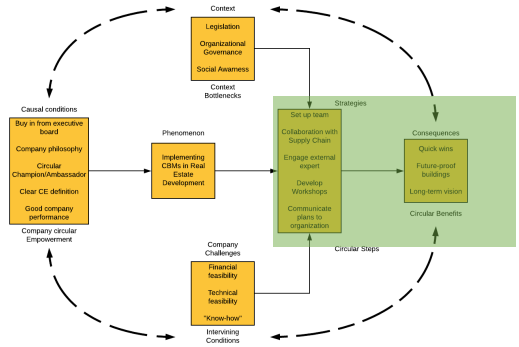


FIGURE 33 CONSEQUENCES RELATIONSHIP

As mentioned in the research background in Chapter 1, the breakthrough of CE was that the concept is able to reunite different sustainable and ecological propositions, e.g., industrial symbiosis and industrial ecology, into one unique concept that has attached an economical dimension (Winans et al., 2017). Following this reasoning, when participants were asked about CE and the reasons for its implementation, the common answer was a series of benefits that have mainly economic implications. This relationship resonates with all the literature reviewed during this research; different scholars clearly state that to put the CE principle into effect the economic implications need to be known (Adams et al., 2017; Araujo Galvão et al., 2018; Pomponi & Moncaster, 2017; Rizos et al., 2016).

Therefore, the conceptualization of the economic consequences that emerged from this analysis seem to be of great value, both for science and for the real estate industry. For science because this conceptualization provides testable propositions for further research and for the industry because it allows identification of measurable aspects that can indicate the failure or success of the process. Moreover, these propositions are the first stated consequences of applying CBMs in real estate development that can be localized within a visual framework. Hence, it is a first step to reduce the complexity of the process by having testable arguments that are known beforehand and linked to specific actions.

Unfortunately, the qualities of these arguments could not be specified. The lack of a common understanding of CE principles within the building environment derives in a variety of perceptions about, for example, what does a 'circular building' means. Hence, when it is stated that one of the consequences of implementing CBMs are 'future-proof buildings' it only reflects what the participants perceived as such, e.g., a 'future-proof building' is the one that is designed in such a way that it is easy disassembled and its elements can be reused or recycled, but this description still does not mention anything about materials and energy consumption. This situation seems to portray a dubious analysis; however, given the explorative nature of the study, it is understood

that these first arguments need to be further analyzed and examined when new developments on CE are in place.

5.6 Overall implications regarding previous research

As shown in the literature review in Chapter 2, Lewandowsky (2016) states that there are rejection factors on the implementation of CE principles. These rejection factors resonate with this study when looking at the context and intervening factors, which are both divided into external and internal elements that affect the process of implementation.

Furthermore, Lewandowsky (2016) states that the internal factors are the ones related to organizational issues but does not offer further explanation. In this study, a deeper panorama opens up showing organizational issues that a real estate developer has to face when implementing CBMs. These are related to financial, technological and procedural ('know-how') implications that this process rises on an organization, e.g., the budget and human resources that need to be allocated for the implementation of certain CBM. Lewandowsky also identifies technological and economic issues but locates them as external factors. He does not give any insight into the reasons for these choices, but it may be that Lewandowsky sees CE principles as experimental concepts, then the major technological and economic decisions will still land outside of the scope of any specific organization. In contrast, the participants of this study showed that some CBMs like 'Circular Design' are already feasible in certain aspects of a building from a technical and economical point of view, thus the decisions to overcome these challenges lay within the organization more than as an external force.

Other external challenges, as described by Lewandowsky, such as political and sociocultural, were confirmed to also be challenges within the real estate sector and this study identified these challenges as dependent on the context, i.e., external forces. The political factors described by Lewandowsky can be related to the legislation factors mentioned by the participants of this study and the sociocultural factors resemble the social awareness element that the participants deem necessary for the implementation of CBMs.

In consequence, the factors affecting implementation of CBMs, as identified in this study, are similar with those identified by Lewandowsky (2016). His more general approach substantiates this more specific research on real estate development and allows linkages between the concepts presented in this research to the bulk of existing in the literature.

Furthermore, another argument by Mentik (2014) was that "*implementing CBMs requires a lot more managerial and organizational skills than only designing new BMs* ". This argument was

corroborated in this study. Of the actions that participants identified as responses to the core category, all were related to managerial or organizational actions, i.e., set up a team, engage an external expert and communicate plans to the organization. When the participants mentioned elements that concerned the design of CBM such as 'define circular strategy', these elements end up as part of the core category itself and not part of the process. This demonstrates that the elements that are indeed part of the process are solely those that include managerial or organizational skills, as predicted by Mentik (*Ibid.*).

This situation is clearly portrayed by one of the participants who highlighted that engagement with an external party allows focus on the active discussion of this new implementation rather than on the design of the process:

"The reason why I think we need an external party is to guide. So, we don't take the designing position [in implementing CBMs] but an active role in the discussion"

Sustainability Expert[7]

The argument presented by Mentik (2014) is also in agreement with the elements in this study that are included in the causal relationships to the core category, i.e. 'Company Circular Empowerment'. All of the elements are related to managerial or organizational skills present within the organization. Then, 'Buy-in from company executives' can be stated as a managerial skill that organizations have to engage positively with their executives; 'Clear CE definition' can describe the effective organizational skills present in an organization that allow them to have a common understanding of the present challenges, and so on with the other elements.

Finally, the findings presented in this study can also be compared to the common characteristics found through the frameworks described in Chapter 2, i.e., the circular business model implementation framework (Mentik, 2014), the circular business model transition framework (Mouazan, 2016), the 5 I framework (Talukder, 2017), and the framework for circular business model transformation framework (Frishammar & Parida, 2018).

First, it was recognized that there is the need to learn and understand the fundamentals of CE. This step is comparable to the element of 'Clear CE definition' included as a causal relation to the implementation of CBMs. In all the studies this element is identified as a first step for the implementations of CBMs, confirming the necessity of this step and its prime place within the process. None of the studies described in the literature review specify who should be involved in this step; however, this study has shown that, at least in real estate development, the people

[7] References are generic due to confidentiality reasons.

that need to understand the fundamentals of the CE are the ones involved in the implementation of the CBMs, specially the top management. Therefore, the entire organization does not need to fully understand the CE concept but can only be kept informed of the process.

Second, all of the authors mentions that the mechanism of the CE should be organized and implemented (Lewandowski, 2016; Mentink, 2014; Mouazan, 2016; Talukder, 2017). This step can be related to elements within the strategies in the coding paradigm such as collaborate with the supply chain, develop workshops, etc. The specific steps that emerge in this study are related to the more general approach that other scholars take. Therefore, the category coded as 'set up a team' resembles Mentik's (2016) 'Balance innovation team' and 'communicate plans to organization' corroborates Scott's (2015) 'educate and involve all employees'. This relationship strengthens the basis of this study showing that the emerging concepts can be linked to other scientific work in more general fields of study.

Taking these considerations, it can be stated that the work done in this study resembles previous and more general research allowing this specific case to strengthen its validity and foster further experimentation of its arguments.

5.7 Summary

This chapter discussed the implications of the visual coding paradigm. The model was divided into four segments, i.e., causal conditions, strategies, intervening factors and consequences, and each segment was compared to the academic literature on CBMs and implications were discussed. With this analysis, the answer to the last sub question can be given. Then,

What are the implications of introducing the designed framework for CBMs implementation within different real estate development firms?

From the arguments presented throughout this chapter, five main implications encompassed the entire discussion.

First, it is argued that the novelty and particularity of some of the elements presented in this research limit the connections that can be made with previous academic efforts. Hence, when it is stated that certain factors like the 'company good performance' are direct causal conditions to the implementation of CBMs in real estate, a restricted number of conclusions can be made due to the lack of preceding information that can be related; therefore, the explorative nature of the study.

Second, the elements that can be indeed associated to previous academic studies, like the intervening factors that shape the implementation of CBMs, are not all found in the CBM

literature but must be traced to more general studies on CE implementation. This more general association does not weaken the nature of the relationship but is considered to strengthen the basis of the study. Therefore, when different categories included within the proposed model are also found as forces that shape the implementation of the CE, it is expected that these categories can also be accepted as forces that shape the implementation of CBMs on further studies.

Third, it is argued that a theoretical line can be drawn from general conclusions of studies about CE's implementation challenges to this specific study on CBMs implementation. This relationship seems to be of great value since it allows the deconstruction of abstract concepts in general studies to specific and practical elements found in this study that can be measured and tested in further research. Hence, when scholars argue that one of the big barriers of CE implementation is the managerial decisions taken within an organization, this reasoning can be connected to a specific measurable factor like the level of engagement of the executive board.

Fourth, more than just identifying elements that have been previously established in the scientific literature, the value of this study is argued to be placed on the proposed interrelationships that are drawn between the proposed core category and the proposed categories, e.g., 'circular steps'. In consequence, the relationships expressed in the visual coding paradigm are as important as the elements contained within them. Then, establishing causal conditions, strategies, intervening conditions and consequences are also part of the main findings of this study. However, the relationships proposed in this research continue to be a theoretical proposition and the specific qualities of both elements and relationships require further investigation.

Finally, the findings of the research represent one of the first links between CBM studies and research being performed in real estate regarding the CE. Thus, it is expected that further studies will be derived from this work.

6.0

Conclusion

The previous chapters have answered the four sub-question proposed at the beginning of this study. With this structured approach, a step-by-step logic has been introduced to give an in-depth answer to the main research question and fulfil the goal of this study. This chapter presents the answer to the main research question and, through a small summary of findings for each of the sub-questions, presents the main findings of the study and how the goal of this research was accomplished.

As described in Chapter 1, there is a strong academic focus on implementation methods of Circular Economy (CE) principles in different industries, driven by the forecasted benefits that a CE might bring to our society. However, different challenges and barriers hamper this implementation process and, until now, there has not been a proven solution to overcome these challenges. Some challenges that scholars have identified are related to the economic aspects of CE implementation. It has been acknowledged that if the economic risks and uncertainties of this process can be resolved, a big advancement can be made towards CE implementation. One of the propositions to tackle these economic risks is through the development of Circular Business Models (CBMs). These recent business models (BMs) are paving the way for CE implementation in different industries, one of them being the real estate industry; however, no academic studies have investigated CBM implementation within real estate organizations.

In consequence, it was acknowledged that there was a research gap on the implementation of CBMs within real estate development; thus, the goal of the study focused on exploring and defining this process. These propositions were put forward to fulfil the research gap and bridge

the knowledge between CBMs design and their implementation, with the aim that this new information will foster the introduction of CE principles into real estate development.

To fulfill this goal one main research question was proposed and four sub-questions were derived from this cardinal question. In the following paragraphs the main findings of this study are derived from the answers of each of the sub-questions; finally, the answer to the main research question is given.

6.1 Research Questions Answers

1. Which frameworks exist for implementing CBMs in other industries besides the building industry?

Through a literature review it was found that scholar have focus on developing two types of tools to develop CBMs: business modelling tools and business model innovation frameworks. However, after analyzing four of the most recent proposed business modelling tools it was recognized that these tools do not actually describe how the designed CBM can be implemented within an organization. Nevertheless, from these descriptions it was acknowledged that most of the business modelling tools are based on the Business Model Canvas developed by (Osterwalder & Pigneur, 2010), thus they are visual tools. This practice is regarded as an easy and effective approach to complex processes (Nußholz, 2018).

Following the analysis of the business modelling tools, four business model innovation frameworks were also analyzed, i.e., the circular business model implementation framework (Mentik, 2014), the circular business model transition framework (Mouazan, 2016), the 5 I framework (Talukder, 2017), and the framework for circular business model transformation framework (Frishammar & Parida, 2018). From these frameworks it was acknowledged that in other industries, e.g., manufacturing industry, guidelines to implement CBMs have been already drawn. Thus, they could be used as guidelines to develop a framework for the real estate industry.

Furthermore, certain common characteristics within the described frameworks were identified. It was noticed that the proposal to understand the CE concept and its implications within organizations as a first step, identifying enablers and challenges for CBM implementation, explicitly recognizing the current BM, designing a CBM and analyzing its implications on the supply chain, and developing an experimentation phase were the CBM can be scaled up were some of the characteristics that seem to be paramount for the implementation of such CBMs. Additionally, some elements like Lewandowski's triple fit challenges and Mentik's (2014)

organizational arguments were recognized as important aspect to considered when studying the implementation of CBMs. Therefore, the basis for the empirical part of the study could be drawn.

2. How can a framework for implementing CBMs be designed based on the experiences of an organization itself?

The lack of previous studies regarding CBM implementation within real estate development gave this research its explorative nature. This approach derived into a qualitative methodology to explore the expertise of the people involved within this process. To extract and understand this knowledge, in-depth interviews were selected as the strategy to follow. From this strategy, semi-structured in-depth interviews were chosen because they allowed the flexibility to tackle the complexities of explorative studies but at the same time have a comparable set of questions that simplified the analysis of the data.

To understand the implementation of CBMs, it was decided to collaborate with an organization that was going through this process and that was willing to cooperate with this investigation. Fortunately, an agreement with The Student Hotel (TSH) was made for this study. This organization develops and operates hotels across the EU and is constantly looking to innovate their products; in line with this thought was the introduction of CE principles to their real estate assets. To have a holistic picture of this process a sample of 11 people was selected. This sample included participants from different areas within TSH but also from external partners that are contributing to the implementation of CBMs within the organization. The cohesion of the sample was achieved by the introduction of criteria that each of the participants had to fulfill. From this initial sample only 9 participants could be approached due to time constrains.

The data derived from the interviews were analyzed using a method originated from the work of Corbin and Strauss (2008). This analysis method helped to narrow down the large amount of information into manageable units called codes. Afterwards, these codes were grouped into categories that could be related, thus establishing a framework that allowed to illustrate the implementation of CBMs within a real estate development firm, i.e., the visual coding paradigm.

Therefore, the implementation of CBMs in the selected real estate development firm was established through a visual coding paradigm that depicts the relationships between different factors that shaped this process and are derived from the experiences of the people immersed within it.

3. What can the experiences from a real estate development firm tell about the implementation of CBMs in such firms?

From the analysis of the data gathered through the interviews, 69 elements emerged. All of these elements were recognized as open codes following the logic of the method of analysis. From these open codes 23 categories were established. These categories were derived following the recommendation of Corbin and Strauss (2008) and helped to reduce the complexity of the raw data. Four of these categories, i.e., Acknowledge Status Quo, Define Vision, Define Circular Strategy, and KPIs were recognized as inherent to the design of any CBM and independent to the implementation process itself, thus they were group into one core category labeled as 'Implementing CBMs in Real Estate Development'. The rest of the 19 remaining categories were analyzed to understand their relation to the core category.

Derived from this analysis, five main relationships were established and relabeled to portray the circular nature of the process. These are: 'Company Circular Empowerment', 'Circular Steps', 'Context Bottlenecks', 'Company Challenges', and 'Circular Benefits'. Then, 'Company Circular Empowerment' is stated as the causal conditions that precede the core category and are needed for its development. The 'Circular Steps' are the actions that take place as a response to the core category. Two set of factors affect and shape these 'steps' and are stated as context and intervening conditions; these are the 'Context Bottlenecks' and 'Company Challenges' respectively. Finally, the 'Circular Benefits' are described as the expected consequences of implementing the 'Circular Steps'.

As a result, the perceived elements of implementing CBMs in a specific real estate firm can be portrayed as 19 elements grouped in five main categories that have a unique relationship to the proposed core category. These relationships can be illustrated through a visual coding paradigm where the conceptualization of this process can be easily identified and allows users to understand how this process is manifested within the selected real estate development firm.

4. What are the implications of introducing the designed framework for CBMs implementation within different Real Estate development firm?

Different arguments were discussed as implications to the development of the visual coding paradigm, but all were encompassed in five main postures.

First, due to the lack of previous research, some of the propositions presented in this study have limited academic support, thus a restricted number of conclusions could be drawn from this information. Therefore, it is argued that if the framework presented in this study wants to be implemented in other real estate development firms further research that investigates particular elements within the framework needs to be corroborated first.

Second, the propositions that can be associated to previous academic research are not precisely found in the CBM literature but need to be taken from more general CE literature. Thus, theoretical validity can be drawn from these general studies on CE; however, it is recommended that particular studies related to the real estate industry are performed for reliability.

Third, it is argued that a link to general and abstract conclusions on CE implementation can be placed on the findings of this study, thus enabling future experimentation of concrete hypotheses. Hence, it is proposed that further research on the experimentation of such propositions is executed.

Fourth, it was found that not only the elements that emerged from the analysis are to be found worthy of consideration but also the relationships portrayed within the framework. Thus, these relationships are also considered as propositions for future studies due to the opportunities that are found on its deeper study.

Finally, this study is seen as one of the first links between CBMs and real estate development. This situation brings limitations that cannot be overcome like the lack of big population samples where the study can be corroborated; however, it enables the opportunity to draw unspoiled conclusions that can foster more specific and detailed studies.

Following the main findings encountered in the answers to the sub-questions the main research question can be answered.

What is the process of implementing Circular Business Models in a Real Estate Development firm?

The process to implement CBMs in a specific real estate development firm can be represented as a set of 19 elements interrelated to a core category that were derived from the expertise of the people involved within this process in the selected firm. Four main relationships were proposed, i.e., causal conditions, strategies, context and intervening factors and consequences; these relationships state the before and after of the implementation process, and the factors that shape this event. For the purpose of this research, these relationships were labeled as 'Company Circular Empowerment', 'Circular Steps', 'Context Bottlenecks', 'Company Challenges', and 'Circular Benefits'.

Within the 'Company Circular Empowerment' category, five axial categories are placed as causal factors to the core category of the study, i.e., Buy-in from the executive board, company philosophy, presence of circular champion (or ambassador), a clear definition of CE, and good

performance of the company. The 'Circular Steps' include another five axial categories that represent the strategies taken as a response to the core category, i.e., set up a team, engaged external expert, collaboration with supply chain, develop workshops, and communicate plans to organization. The third major relationship is the context and intervening factors; this relationship includes six elements divided in two selective categories: 'Context Bottlenecks' containing Legislation, Organizational Governance, and Social Awareness, and 'Company Challenges' including financial feasibility, technical feasibility, and 'know-how'. The last relationship, i.e., 'Circular Benefits', is composed by three axial categories and represents the expected outcomes of the whole process, i.e., quick wins, future-proof buildings and long-term vision.

This whole process can be represented by a visual coding paradigm (Figure 23). This illustration echoes the arguments presented in the literature review where it was stated that most of the practitioners and academics are in favor of visual tools that reduce the complexity of processes. In addition, this tool allows the elements within the process to be conceptualized and places each of these new concepts in a specific position within the framework. Furthermore, it helps to reduce the complexity of the implementation process through the identification of the building blocks described in the previous paragraph.

Finally, even when the relationships within the process are portrayed as linear, the process is regarded as a continuous entity that needs to be constantly reviewed. This characteristic allows to embrace the dynamic nature of the process, fosters future studies and, in a sense, depicts the 'circularity' of such implementation process.

In relation to the application of this framework within the real estate development sector, it was argued that until the framework goes through a testing period it could be devious to say that it can work for all companies. The value of this study is placed on the recognition of the elements that can be part of the process and the relationships between these elements but there is still further research that needs to be performed to portray the proposed framework as the encompassing solution for CBMs implementation in real estate development firms.

6.2 Recommendations for future research

As described by Creswell (2002) the nature of an explorative study has advantages and disadvantages. One of the disadvantages is that the focus of study tends to be broad and abstract given the lack of previously identified testable propositions. However, the main advantage of this type of study is the opportunity to dig deep into one phenomenon to try to understand it and come up with novel propositions that can be further investigated. This research has done that and throughout this study new propositions have been found that can be put forward for further investigation.

Due to the time-frame and lack of resources, the framework presented in this study could not be validated nor could the elements that are contained within it. Therefore, it is recommended that further studies focus on validating both the framework and the elements that comprehend it. The framework itself proposes a practical solution for the acknowledgement, analysis and implementation of CBMs within real estate development firms. Acknowledgment because it allows real estate developers to identify the essential elements needed for the existence and development of the implementation process within their organizations; analysis, because it permits the observation and evaluation of the relationships that shape the process; and, finally, implementation because it shows the steps and the sequence to follow for its development. Therefore, it is important to see if these arguments still hold in other organizations and, moreover, if they can be generalized to a greater extent. Furthermore, it is important to evaluate if the proposed framework delivers the expected outcomes or how different results affect the overall process.

On the other hand, each category, its relationship to the core category and the elements within them present an opportunity for further research on CBM implementation. As mentioned before, some of these elements have already been found in previous studies. Nevertheless, in none of these studies a detailed description of these elements has been presented. It will be interesting to develop descriptive or explanatory research that investigates the qualities and characteristics of these elements. In consequence, more detailed elements could be found to test the validity of these propositions. An example could be to test the relation and specific qualities between organizational culture and the development of the implementation of CBMs within real estate development firms, but this can be proposed for each of the categories. Another important element that it is left for further investigation is the validity of each of the elements within the selective categories. All of the elements emerged from this study, but it still remains unproven if all of them prevail within different organizations. Therefore, it is important to take each of the categories and test their validity in different organizations with a larger sample.

Moreover, the elements presented in this study are a first description of the factors surrounding the implementation process, but now, these elements allow for a more detailed qualitative or quantitative studies to be performed, which was not possible before. Hence, the importance of this study and the large spectrum of possible future studies that it fosters. It is just matter of analyzing the whole framework and be curious about each of its elements.

6.3 Strengths, weaknesses and limitations of the research

As described in the methodology chapter, the nature of this study turned explorative given the lack of previous research on the topic. This resulted in the decision to take a qualitative approach and focus on the experiences of people directly involved with the implementation process. As such, this type of methodology diminishes the capacity to generalize the findings of this study. The implication is that any element that emerge from the data is specific and cannot be applied to a broad range of cases. However, this first step allows to gain useful insights on the elements that can be included within CBMs implementation frameworks and be the basis for more general theories that encompass a broader spectrum of the real estate industry. In addition, several hypotheses can be formulated from this initial study that can serve as groundwork for further research. An example of such a hypothesis could be that there is a positive relationship between real estate development firm with an entrepreneurial and innovative company philosophy and CBMs implementation.

One strength of this research is that, even though the sample was limited, the participants were able to portray different points of view given their position and expertise. For example, the managing director was able to go deeper on top management procedures, e.g., BM analysis, development and innovation, whereas the construction director was able to illustrate better how changes in the BM impact technical procedures, resources and the way projects are approached. Similarly, being able to interview external stakeholders like the CE consultant gave a different perspective on how changes in a company's BM not only have internal consequences but also with its supply chain and business environment. As a result, it is expected that this conceptualization has a broader reach and can be successfully validated, allowing more theories to develop from this first study.

Another important aspect to notice is that this is one of the few studies that focuses on a small niche within the real estate industry, i.e., student accommodation, but has great significance and potential given the large amount of student accommodation that is needed within the Netherlands. Furthermore, the collaboration with The Student Hotel (TSH) allowed insight into elements within their successful business model that are implied in their process of implementing CBMs. Elements like high executives prone to sustainable goals and a company philosophy focused on constant innovation shows what might be the stepping stone for effective changes towards CE within the real estate industry. This shows how small niches and disruptive businesses can have important insights for the whole industry.

Nevertheless, some limitations affected the overall process of the research. The major limitations for this study were related to the population and the selection of the sample. The real estate industry has a large population, but it is defined by its location. This argument raises complications for academic studies since it forces narrowed-down scopes and limits the analysis to specific locations and their derived conditions. In this case, the study focused on the real estate industry within the Netherlands. This decision affects all the arguments presented in this study since the paradigm present within the Dutch society regarding CE is implied on the perception of the participants just by being part of it. Therefore, the findings and propositions of this research are bounded to the location of study until further studies evaluate their validity in different locations.

Furthermore, the different types of real estate assets present in the industry bring another layer of limitations since not all of them are managed in the same way and do not have the same objectives, e.g., private rental housing vs social housing. In this way, the propositions made in this study only apply to a small sector within the real estate industry and further research needs to be performed to see if these arguments prevail with different assets and within the organizations that develop them.

Another limitation of the study was the time horizon. Due to time limits it was not possible to see how the implementation of CBMs turn out to be. Therefore, part of the theory stills remains speculative and can only be left for further refinement.

Finally, it is acknowledged that the sample of participants might seem small for the universe of study, but two arguments need to be considered. First, the sample was intended to be larger but the other participants that were approached did not comply with the established sampling criteria; hence, they were not involved or trying to implement CE principles. Second, the limited resources available for this research constrained the time span of the study, therefore the sample that was achieved also corresponds to time limitations. All in all, CE keeps getting more attention and it is expected that future studies can be extended to larger samples that are not limited by lack of knowledge or resources. In the meantime, this study shows the first steps to reach more detailed conclusions.

APPENDIX

Appendixes

Appendix 1 CE Applied to the building industry

The latest understanding of a 'Circular Building' can be stated as:

> *"A building that is developed, used and reused without unnecessary resource depletion, environmental pollution and ecosystem degradation. It is constructed in an economically responsible way and contributes to the wellbeing of people and the biosphere. Here and there, now and later. Technical elements are demountable and reusable, and biological elements can also be brought back into the biological cycle".* (Circle Economy, DGBC, Metabolic, & SGS Search, 2018)

CE applied in the construction industry, according to Cheshire (2016) can be summarized in the nested circle presented in Figure 34. The dimension of the circles shows the hierarchy, with the three inner circles being the most desirables.

The first element is retaining a building. This intervention is the least invasive, representing the most resource-efficient/intensive option. It is followed by refitting and then refurbishing the building, requiring more demanding interventions. After these circles, the more difficult operations involve reclaiming or remanufacturing components, with the last circle being the most difficult operation, i.e., recycling or compost buildings in order to create new products or return materials to the biosphere (Mangialardo & Micelli, 2018).

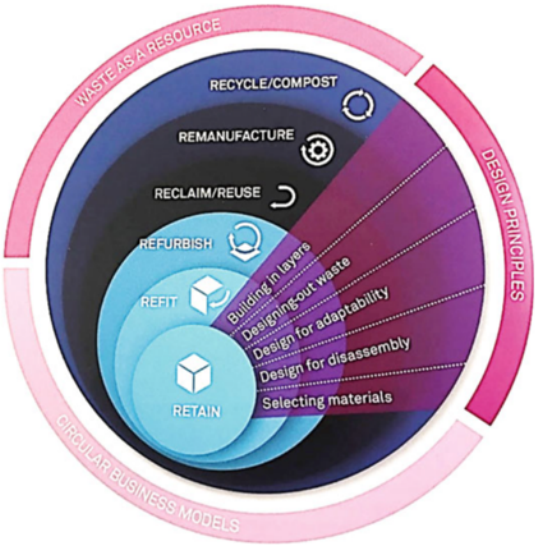


Figure 34 Principles of CE applied in the construction industry (Cheshire, 2016)

Common to these circles, there are five segments that represent the design principles to follow in each type of intervention, these are: building in layers, designing-out waste, designing for adaptability, design for disassembly, and selecting materials.

In addition, Cheshire (2016) conceptualizes the economic benefits of his circular model applied to the construction industry, as shown in Figure 34.

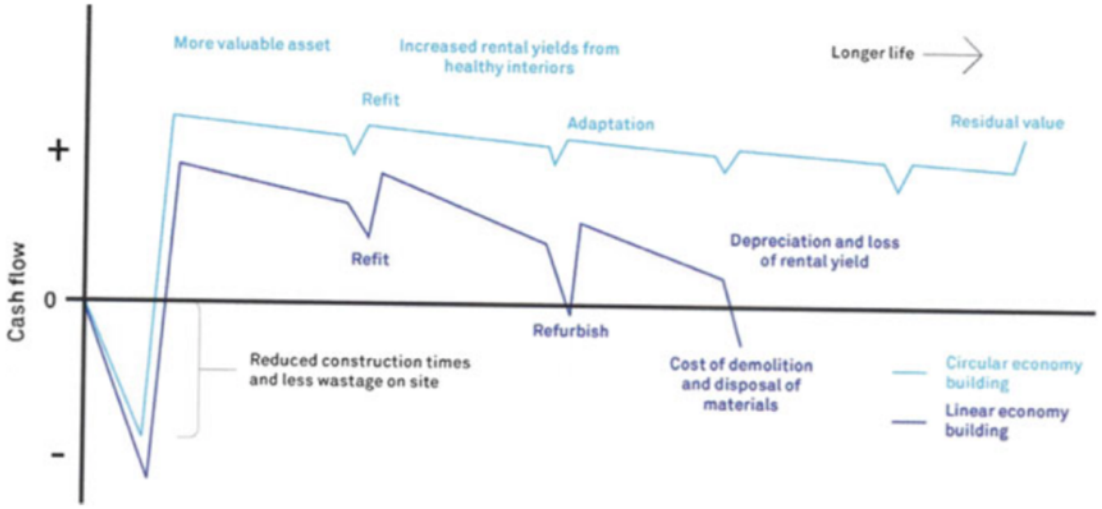


Figure 35 Economic benefits of linear and CE buildings (Cheshire, 2016)

Here the linear and CE approach to build are compared in terms of revenue and costs, in a long-term view, starting from the design to the end-of-life of the building. The feasibility conditions of the circular model of Cheshire are linked to the economic efficiency of the processes (Mangialardo & Micelli, 2018). As a conclusion of the study of Mangialardo & Micelli (2018), they clearly state that "*it is important to understand if CE is able to generate new value and in which way this value is created*".

In buildings designed according to traditional techniques, components and systems are intimately connected, and separation as part of demolition activities, is extremely difficult. Instead, an easy separation of the materials, involves an easy isolation and, consequently, a greater amount of material to be sent to recovery operations, not to mention that, "design for disassembly" means improving the maintenance operations, repairs, and replacement, as well as makes it easier to remove harmful toxic components used in the construction system. (Ghisellini et al., 2018).

However, buildings are complex systems and introducing CE principles is not an easy task. Following a systems thinking, buildings are seen from the perspective of a meso-level, where the macro-level refers to urban agglomerate and the micro-level as buildings components (Winans et al., 2017).Within this system, layers (or subsystems) exists and have different lifespans,

behavior, and value (see Figure 36). Brand (1994) introduced a hierarchy for the components of a building, defined each layer and explained that the problem is that buildings are not designed for change; they combine components with long technical or social lifespan along components with a much shorter lifespan.

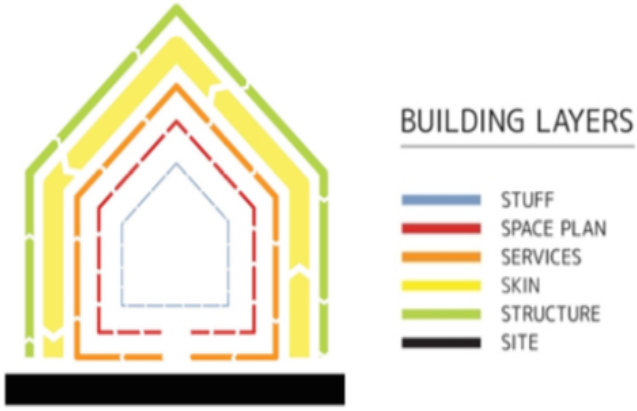


Figure 36 Building Layers by Steward Brand (taken from (Geldermans & Jacobson, 2015)

As it can be seen, research relating CE to the built environment, even when just starting, is already showing some of the barriers and opportunities inherent to this new area of knowledge. Aiming to structure the way in which research is done in this recent field Pomponi & Moncaster (2017) propose a framework to help focus the efforts of scholars (see Figure 36). What is most interesting is how they end their paper, mentioning that further research should focus on the economic viability of solutions for successful and sustainable transition to a 'circular built environment' (Pomponi & Moncaster, 2017). This seems to be in line with the recommendations of Mangialardo & Micelli (2018).

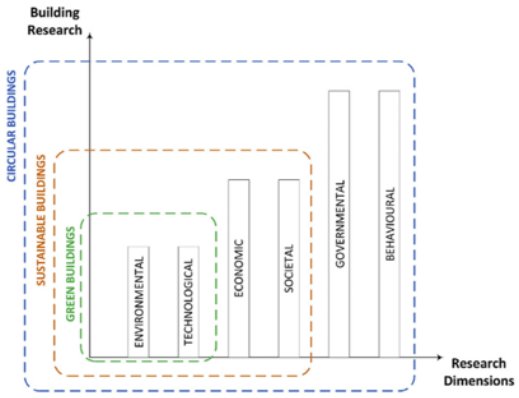


Figure 37 Evolution and research dimensions of building research (Pomponi & Moncaster, 2017)

Finally, Adams et al (2017) make a study on the challenges and enablers of CE for the building industry in the UK. From this research, it is concluded that the most significant challenges were a *"lack of incentives to design for end-of-life issues, followed by the lack of market mechanism to aid greater recovery and an unclear financial case"*. On the contrary, the most important enabler is proposed to be a clear business case, followed by "*greater recovery of materials through viable take-back schemes and higher value markets, assurance schemes for reused materials, best practice exemplar case studies and an awareness scheme"*.

Appendix 2 Business Model Canvas

As mention previously, this tool was developed by (Osterwalder & Pigneur, 2010). It was developed to describe, analyze and design business models. It presents, in a visual format, how a company creates, deliver and captures value. This is done through nine building blocks. In Figure 38 it can be seen how these blocks are represented visually.

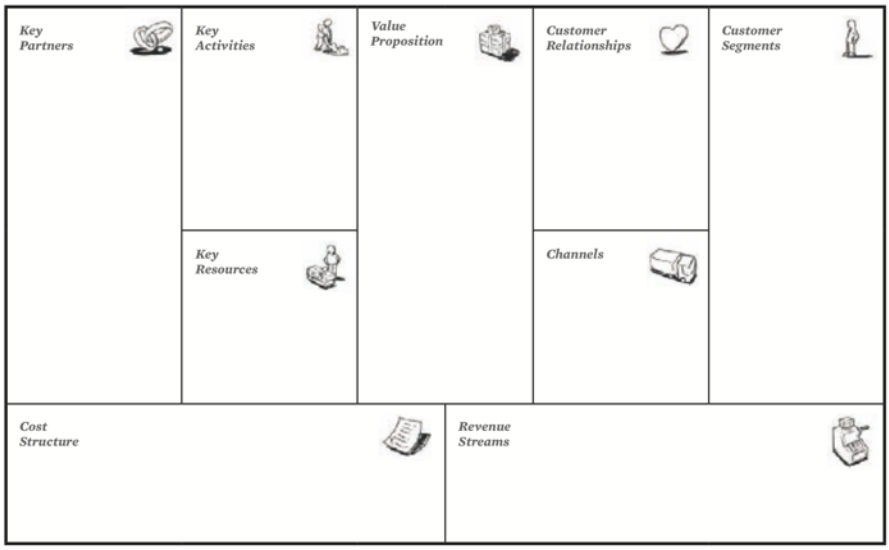


FIGURE 38 BUSINESS MODEL CANVAS (OSTERWALDER, 2010)

1. Customer segments: This block defines a specific need that requires a distinct offer
2. Value propositions: This block describes an important or fundamental problem in each situation for the costumer.
3. Channels: Here it is described how a company communicates with the costumer segment.
4. Customer relationships: refers to how costumers are taken care of by the company.
5. Revenue streams: describes how the company gets the money.
6. Key resources: They can be physical, intellectual, human, and financial, and they allow the company to develop its value propositions
7. Key Activities: these are the most important actions a company must take to operate successfully.
8. Key Partnerships: essential relations to optimize the business, reduce risk or acquire resources.

9. Cost structures: describe all cost important to keep the business going.

This tool can be divided in three segments; left, right and bottom. The components of the left side, i.e., key partners, key activities and key resources, represent how a company creates value. The components of the right side, i.e., costumer relationships, costumer segments, and channels, represent how a company delivers this created value. Finally, the components of the bottom, i.e., cost structures and revenue streams, represent how a company captures value. This shows how the business model canvas illustrate the three value dimensions inherent to every business model.

The business model canvas became popular because of its simplicity of use while providing a holistic overview of a business model. Not only is used to describe current business models but allows to implement business model innovation. For this reason, it is a complementary tool to a lot of different frameworks related to business model innovation (Haaker, Bouwman, Janssen, & de Reuver, 2017). An example of its application can be seen in Figure 39.

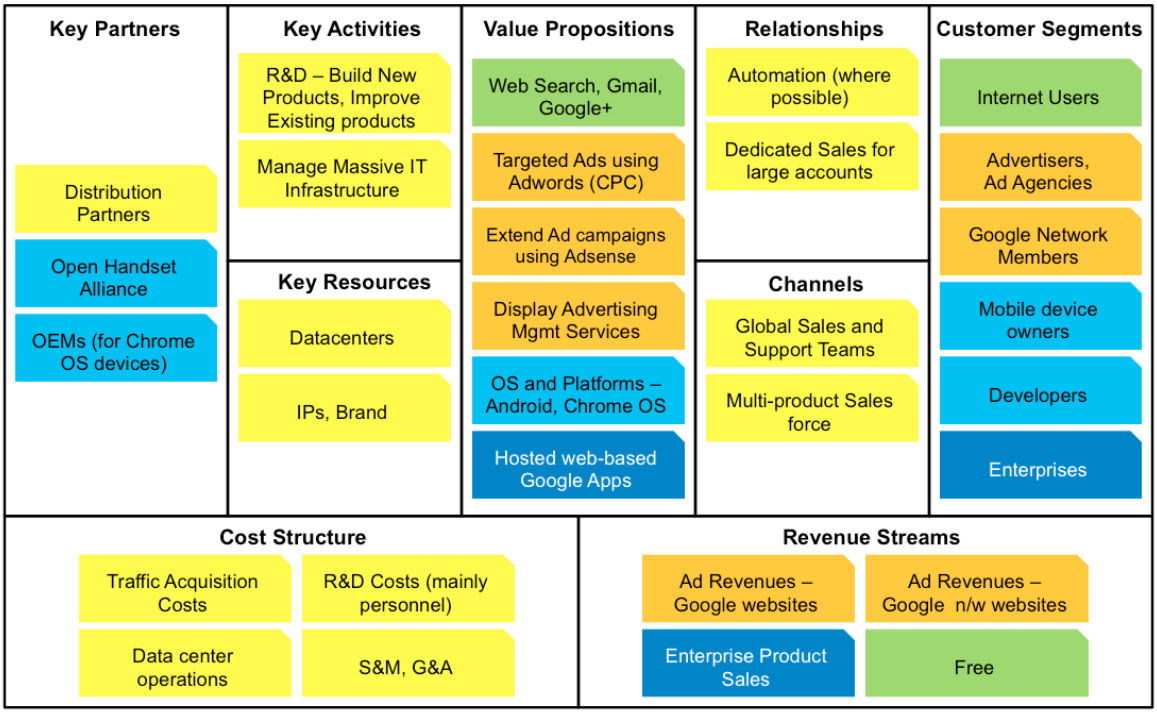


Figure 39 Google Business Model by (www.businessmodelgeneration.com)

According to this literature review, it seems like the business model canvas still will be the point of departure for future developments regarding business model innovation. The current popularity that it has makes it known between practitioners and scholars, thus easier to implement.

Appendix 3 Purpose Built Student Accommodation

A trend born in the Anglo-Saxon countries is gaining grounds, i.e. Purpose Built Student Accommodation (PBSA). According to (Emerging_Property, n.d.) PBSA are "*developments specially design to meet the needs of the post-modern student*". These buildings provide a living environment where study and socializing go hand in hand. This includes different amenities like gyms, game rooms, and professional onsite management. They are located in prime close-to-campus locations and can offer different types of rooms.

Because of the success of PBSA in more established markets such as the USA and UK, this type of developments is being introduced in the European market where the same demand factors are growing. These factors are: an increasing number of higher education students, globalization of higher education incrementing the number of English Taught Programs (ETPs), growing number of international student, and ranking improvement of European universities (JLL, 2017).

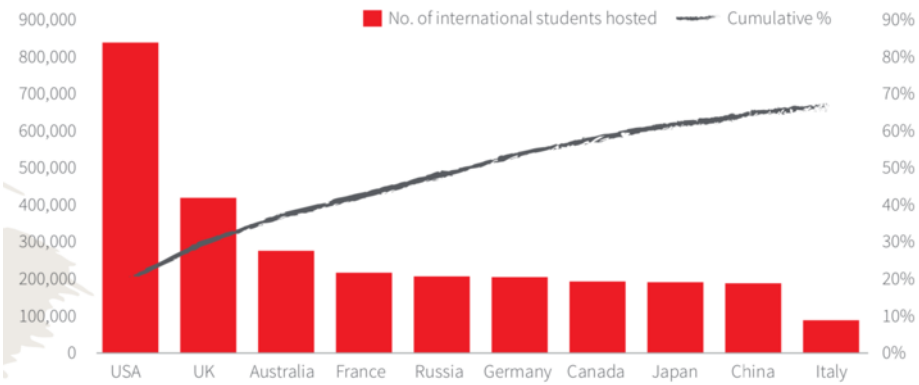


FIGURE 40 TOP 10 DESTINATIONS COUNTRIES (JLL, 2017)

As it can be seeing in Figure 40 the market is still mostly influenced by the USA and UK, but the infant market in European countries is attracting a lot of attention.

In relation to the Dutch market (SAVILLS, 2017) reported that the market is growing strongly. An increment in the enrolment at research universities of the 2.4% was observed in the 2016/2017 academic year. Moreover, the number of new enrollments at universities of applied sciences also increased by 8.7% compared to the previous year.

Similarly, the number of international students also grew by 8.2% above the previous year. One important feature that is well noticed is the number of ETPs in the Netherlands, having over 2068 programs is the European country with the greatest number of ETPs in Europe (excluding the UK and Ireland).

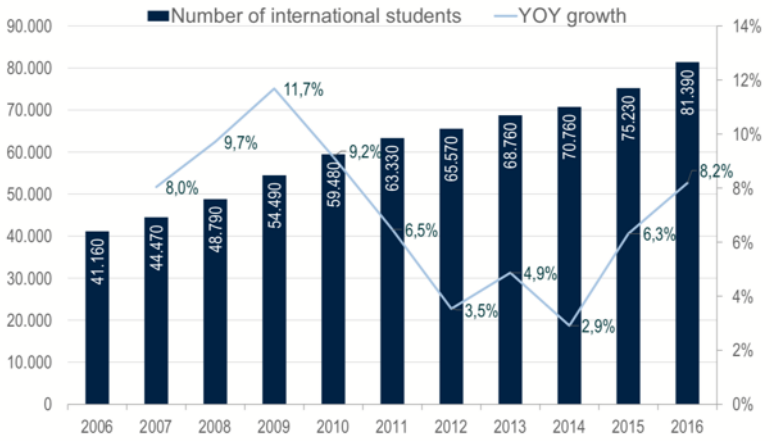
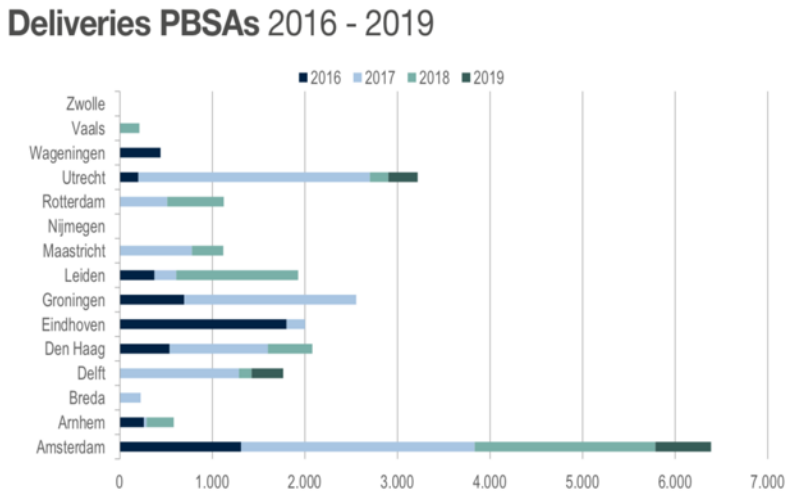


Figure 41 Growth international students in higher education (SAVILLS, 2017a)

Another important feature in the Dutch market is that the Netherlands has the most universities in the world's top 200 after the UK. Due to these reasons it is projected that there is still a demand from 21, 600 self-contained rooms and 50,400 fully independent student units (SAVILLS, 2017)

In relation to the supply, Savills (2017a) also calculates a surplus of 11, 600 rooms with shared facilities but these numbers are not so trustworthy due to the method of evaluation.



According to another study made by Savills (2017b) the number of forecasted PBSA units will reach 21, 400 in the 2017-2019 period. Amsterdam, Utrecht, Groningen and Maastricht being the cities with more opportunities.

Figure 42 Deliveries PBSAs 2016 – 2019 (SAVILLS, 2017a)

Consequently, investment volumes have grown rapidly over the past years. JLL (2017) has calculated that since the start of 2015, there has been over $714 millions of PBSA transactions.

Appendix 4 Circular Strategies by FinanCE

The following description of the strategies is taken from the report *Circular Economy Finance Guidelines* (AMRO_ING_RABOBANK, 2018).

Circular inputs

This strategy refers to companies or projects that substitute virgin raw materials with secondary (recycled) materials originating from materials and resources recovery. Examples of this strategy can be the use of recycled bricks and building blocks, use of bamboo wall panels, or insulation made from recycled cotton.

Circular Design

This strategy is described as companies or projects that eliminate or reduce input from hazardous/toxic materials and design for modularity, easy disassemble and repair to facilitate recycling, reuse, and life time extension. Examples of this strategy is the design and use of prefabricated detachable elements or the construction of modular buildings.

Sharing business model

This strategy is described as companies or projects that increase the capacity utilization of a product or asset during its useful life through activities like predictive maintenance. Sharing is stated to be circular when optimizes the utilization of the asset. Examples of this strategy are sharing parking areas and coworking spaces.

Life Time Extension

This strategy is described as companies or projects that increase the reuse, refurbishment or remanufacturing to extend the useful life of products and assets. Examples of this strategy are the use of state-of-the-art products like self-healing concrete or the use of new technologies like the Internet of Things (IoT) to monitor construction assets.

Product-as-a-service

This strategy is described as companies or projects that improve the circularity of the whole supply chain through product-as-a-service offering. It implies the change of ownership structures, improved collaboration between partners in a supply chain, and improved traceability of products and materials. Examples of this strategy are the propositions of lifts, lighting, facades, washing machines, etc., as a service.

Material/Resource Recovery

This strategy is described as companies or projects utilizing reverse logistics to harvest value from wastes; be it materials, heat, bio-wastes or waste waters. Examples of this strategy are seen buildings as material banks and turning into a supplier of recycled materials.

Circular Facilitator and Enablers

This strategy is described as companies that establish networks between other actors (consultors, engineering firms, accounting firms, etc.) to collaborate for a circular economy. These facilitators include their role in their business strategy. Examples of this strategy can be consultancy firms that design measures or tools for a circular economy, companies that set up operating marketplaces for used materials, etc.

Appendix 5 Interviews' Guide

Introduction

Overview of the study (Explain research)

My name is Henoc and I'm doing a master in CME at TU Delft. Currently, I'm working on my master thesis. My project regards the introduction of Circular Economy (CE) in the (re)development of commercial real estate, specifically student accommodation.

I asked you for this interview because of your expertise. With your background and current position, I think we can have a productive discussion about the current business model for real estate redevelopers focused on student accommodation, how innovation is or can be implemented in the business model, and how innovative ideas (like CBM) are managed within your company.

This interview is going to be audio recorded because it allows me to focus on what you say and not on taking notes. After the interview, I'm going to transcribe it and make my notes.

Your interview's transcript will not be published in the public document of the thesis, and no comments will be linked to the responded so you can feel free to talk. The only people that will have access to the transcripts are my committee members.

Business Models

1. Interviewee short introduction

In a few words, can you introduce yourself; name, occupation, a little bit about your background, etc.

Have you been involved in the development of Business Models?

2. Business Model

How would you define a Business Model?

What is the purpose of a business model from your perspective?

How would you describe the current BM of your department? (value proposition, value creation & delivery, and value capture)

Who decides/defines the BM?

How often do you review the BM?

What is the process to modify the BM?

How is it managed?

Do you use a tool to develop the BM?

3. BM Innovation

If you would innovate the BM, how would you do it?

Who will be involved?

How will it be managed?

How will you evaluate the innovation?

Circular Economy

Do you have experience with Circular Economy?

With your own words, how would you define Circular Economy?

From your perspective, how can Circular Economy be implemented at the development of student accommodation?

What are the biggest challenges?

Circular Business Strategies

What is your perception on Circular Business Strategies?

How would you describe the difference between your current business model and a circular business mode?

From the set of circular strategies presented, which one would you think is the best for the development of student accommodation?

How will you rank them?

Do you have any other comment?

Appendix 6 Circular Strategies Cardboards

Circular Inputs

Companies/projects that substitute virgin raw materials with secondary (recycled) materials originating from materials and resources recovery.

Example
Recycled bricks and buildings blocks
Bamboo wall panels
Insulation made from recycled cotton

Circular Design

Companies/projects that eliminate/reduce input of hazardous/toxic materials and design for modularity, easy disassemble and repair to facilitate recycling, reuse, life time extension.

Examples
Prefab detachable elements
Modular buildings

Sharing Business Model

Companies/projects that increase the capacity utilization of a product or asset during its useful (e.g. through sharing and/or predictive maintenance). Sharing is circular when optimizes the utilization of the product or asset.

Examples
Sharing parking areas
Coworking

Life time Extension

Companies/projects that increase Reuse/Refurbishment/Remanufacturing to extend the useful life of products and assets.

Example
Self-healing concrete
IoT monitoring of construction assets

Product-as-service

Improve the circularity of the whole supply chain through product-as-service offering based on:
- A changed ownership structure, where the ownership of an asset remains with the supplier;
- Improved collaboration and alignment of interests between partners in the value chain (e.g. sharing of costs and benefits);
- Improved traceability of products and materials.

Example
Mitsubishi Lift. The lift supplier is selling a service – vertical mobility – rather than a product.
Lighting
Facades
Washing machines

Material/Resource Recovery

Companies/projects dealing value recovery from wastes, be it materials, heat, bio-wastes or waste waters.

Example
Supplier of recycled materials
Building as material bank

Circular Facilitator and Enablers

Establish networks and collaborate with facilitators in the circular economy such as consultancy, engineering, knowledge and data providers or accounting firms, facilitating the shift to a circular economy. These facilitators include their role in the circular economy in their business purpose or strategy.

Examples
Development of key enabling technology with circular economy applications (e.g. 3D printing)
Knowledge gathering and sharing on organizing the circular economy
Designing (measurement) tools for the circular economy
Setting up and/or operating marketplaces for used materials
Setting up and/or managing data repositories for material passports.

Appendix 7 Interviews Transcripts

T**his appendix contains confidential information**
For more information, please contact:

Henoc Balderas
H.BalderasZavala@student.tudelft.nl

Appendix 8 Open Codes

Table 5 Open Codes

	Codes	Times mentioned
1	Lead by example	21
2	Top management	6
3	Buy in	12
4	Investor	8
5	Innovation	14
6	Disruptors	6
7	CSR	4
8	Entrepreneurial Spirit	6
9	Leader	31
10	True believer	28
11	CE perception	9
12	CE motivation	14
13	CE expertise	12
14	CE in place	17
15	Overperforming	4
16	Payback	6
17	ROI	4
18	Status quo	21
19	Knowledge	28

20	Traditional	23
21	Real Estate	29
22	Vision	22
23	North star	14
24	Strategy	18
25	Circular Strategy	13
26	CBM	16
27	Preferred choice	9
28	Measurement	18
29	Benefits	28
30	Impacts	19
31	Costs	18
32	Team composition	12
33	Decision-makers	20
34	Supply chain	14
35	Suppliers	12
36	Contractors	10
37	Outsider	8
38	Consultant	6
39	Guide	5
40	Workshop	14
41	Tools	19

42	Business Model Canvas	8
43	Sustainable Business Model Canvas	4
44	Full-day	8
45	Company	20
46	Communication	14
47	Feedback	17
48	Inclusive	11
49	Flat organization	8
50	Challenges	26
51	Bottlenecks	28
52	Law	14
53	Government	12
54	Traditional	28
55	Location	11
56	Organization structure	8
57	Hierarchy	15
58	Short-term	22
59	Revenues	31
60	Long-term	31
61	Cash flow	11
62	Investment	8
63	Traditional	14

64	Technology	12
65	Iterative	6
66	"low hanging fruit"	21
67	Resilience	8
68	Future	13
69	Better equipped	8

Appendix 9 Axial Codes

Table 6 Axial Codes and its relationship to Open Codes

Open Coding	Axial Coding
Lead by example	Buy in from executive board
Top management	
Buy in	
Investor	
Innovation	Company Philosophy
Disruptors	
CSR	
Entrepreneurial Spirit	
Leader	Champion/Ambassador
Lead by example	
True believer	
CE perception	Clear CE definition
CE motivation	
CE expertise	
CE in place	
Overperforming	Good performance
Payback	
ROI	
status quo	

Knowledge	Acknowledge current BM (status quo)
Traditional	
Real Estate	
Vision	Define Vision
North star	
Strategy	
Circular Strategy	Define Circular Strategy
CBM	
Preferred choice	
Measurement	KPIs
Benefits	
Impacts	
Costs	
Team composition	Set up team
Decision-makers	
Supply chain	Collaboration with supply chain
Suppliers	
Investor	
Lender	
Contractors	
Outsider	Engage external expert
Consultant	

Guide	
Workshop	Develop workshops
Tools	
Business Model Canvas	
Sustainable Business Model Canvas	
Full-day	
Company	Communicate plans
Communication	
Feedback	
Inclusive	
Flat organization	
Challenges	Legislation
Bottlenecks	
Law	
Government	
Traditional	
Location	
Organization structure	Organizational Governance
Flat organization	
Hierarchy	
Short-term	
Knowledge	

CE perception	Social Awareness
CE motivation	
Bottlenecks	
Challenges	
Revenues	Financial feasibility
ROI	
Payback	
Long-term	
Short-term	
Investor	
Lender	
Cash flow	
Investment	
Traditional	
Technology	Technical feasibility
Long-term	
Short-term	
Iterative	
Innovation	
Knowledge	Know-how
CE perception	
CE expertise	

"low hanging fruit"	Quick wings
CE in place	
Knowledge	
Resilience	Future-proof buildings
Future	
Better equipped	
Benefits	
Long-term	Long-term vision
Benefits	

Appendix 10 Legal Challenge in CBMs Implementation

As seen in Chapter 4 'Context Bottlenecks', when asked about the challenges to implement Circular Business Models (CBMs) in the real estate industry, participants identified the current (Dutch) legal framework and its implications for the introduction of such new business models. When this study was performed, no particular CBMs had been designed or implemented within the selected organization (The Student Hotel, TSH). Therefore, specific obstacles could not be identified by the participants, however, general concerns about the legal implications were mentioned. It is assumed that these concerns are shared by another economic operators, therefore, the importance of looking into this matter.

One of these concerns was derived from the implementation of a 'product-as-service' CBM in goods that are part of a real estate asset. Most of the interviewed participants referred to this type of CBM as "the most challenging" to implement due to perceived legal implications. These implications were not described in detail and only discussed in relation to what the participants had read or heard about, or to preliminary conversations between suppliers of these types of products and TSH.

For this reason, in this section, a specific case is considered and elaborated upon based on a literature review and some of the comments mentioned by the participants about the way in which TSH develops its real estate assets. Some of the products that run on a 'product-as-service' business model considered by the participants were the introduction of leased facades, lifts, washing machines, furniture, and lighting. For this research, the case of the leased facades are further explored, because a façade lease would have more legal issues than other products due to its long-lasting and intrinsic place within a building. The following paragraphs first describe the 'product-as-service' business model according to the literature. Then, the current legal framework that shapes real estate products in the Dutch system is delineated. Finally, the proposed solutions to overcome the inherent challenges that the current legal framework raises are discussed.

Product-as-service definition

According to the literature, a 'product-as-service' offering is regarded by some scholars and practitioners as a type of circular business model where the goods offered have a changed ownership structure, where the ownership of the good remains with the supplier (AMRO_ING_RABOBANK, 2018, p. 3; H. D. Ploeger et al., 2017, p.3); this type of CBM is also referred as Product-Service System [PSS] by Azcarate-Aguerre, Den Heijer, & Klein (2017, p.46).

Different types of arrangements can encompass a 'product-as-service' business model, e.g., 'sale-and-leaseback', 'pay-per-use' and 'operational lease'. 'Sale-and-leaseback' is a financing technique that allows products to be sold but leased back for its use(Ling, 2012, p. 502). This type of agreement is common in real estate assets because it allows clients to gain access to properties without owning them (Ibid.). 'Pay-per-use' arrangements refer to any payment structure in which customer only pays for what they actually use, so they benefit from using and accessing the product without having to own it (Cusumano et al., 2015, p.560). Finally, 'operational lease' refers to any agreement where the supplier keeps the ownership of the product and the client pays for the services provided, including use, management, maintenance, and others (H. D. Ploeger et al., 2017, p.3). The facade example is only explored in this section under conditions of an operational lease because of its popularity among recent circular products and its more encompassing nature (H. D. Ploeger, Prins, Straub, & van den Brink, 2017; van Loon, Delagarde, & Van Wassenhove, 2018).

The benefits that some scholars and practitioners think a 'product-as-service' CBM will bring are improved collaboration and alignment of interests between partners in the value chain (e. g., sharing of cost and benefits), and better traceability of products and materials (Leasing et al., 2017; AMRO_ING_RABOBANK, 2018, p.3).

However, different scholars argue that the major problem that this type of CBM faces is the legal ownership status of the products offered (Blok, 2018; Michael, 2018; H. D. Ploeger et al., 2017; van den Brink, Prins, Straub, & Ploeger, 2017). Therefore, in the next section the focus is given to describe such ownership challenges in the case of leased façades.

Description of ownership models

In most of traditional contracts, the goods are agreed to be developed by a supplier and then sold to clients in one-off transactions where by the client becomes the owner of the good involved (van Loon et al., 2018), implicating that all the risk and opportunities inherent to the product are transferred from the producer to the client after the goods are sold, unless otherwise stated. On the contrary, in a 'product-as-service' agreement the goods' ownership can remain with the supplier, as well as most of the risk and opportunities, in exchange for a recurring fee paid by the clients (H. D. Ploeger et al., 2017). The differences between a traditional ownership model and one based on a 'product-as-service' can be illustrated by the example of leased facades following the arguments presented by Azcarate-Aguerre et al. (2017, p.47-48).

In a traditional model, different components or functions (e.g., lighting, ventilation) are assembled by the supplier to form a façade that can be installed on a specific building; this work is typically financed by an external party or the client itself. Then, as soon as the façade is attached to the building structure the supplier transfers the ownership of the façade to the client (due to the current legislation in the Netherlands); this implies that all the responsibilities towards the façade are now mainly on the client, if nothing else is stated in the contract. Therefore, the maintenance or other services related to the façade are now responsibility of the client, even when the supplier could perform such tasks. Finally, the client expects that the product delivers agreed levels of performance but the responsibility to keep such levels stays with the client. This traditional model is represented on the left side of Figure 43.

On the other hand, in a 'product-as-service' model, different responsibilities stay with the supplier. Since the ideas is that the ownership of the façade stays with the supplier, the product does not need to be financed by the client, thus other financial instruments need to be applied. Moreover, the responsibility to keep the agreed levels of performance remains with the supplier, thus, the maintenance and management of the façade are his responsibility. Therefore, the supplier retains a part of the building (the façade) as its own and only provides a service in exchange for a fee. The 'product-as-service' model is illustrated on the right side of Figure 43.

Therefore, the particular difference between these two ownership models is that in a traditional model the façade becomes part of a whole "ownership's unity" of the building while in a 'product-as-service' model the proposition is to "breakdown" this conceptual unity. However, this situation creates complex legal and financial circumstances since "the financing of real estate products has been conventionally collateralized by the product itself and the value of such real estate asset can only be estimated if all the functional components remain part of it" (H. D.

Ploeger et al., 2017; H. Ploeger, Prins, Straub, & Van den Brink, 2019).

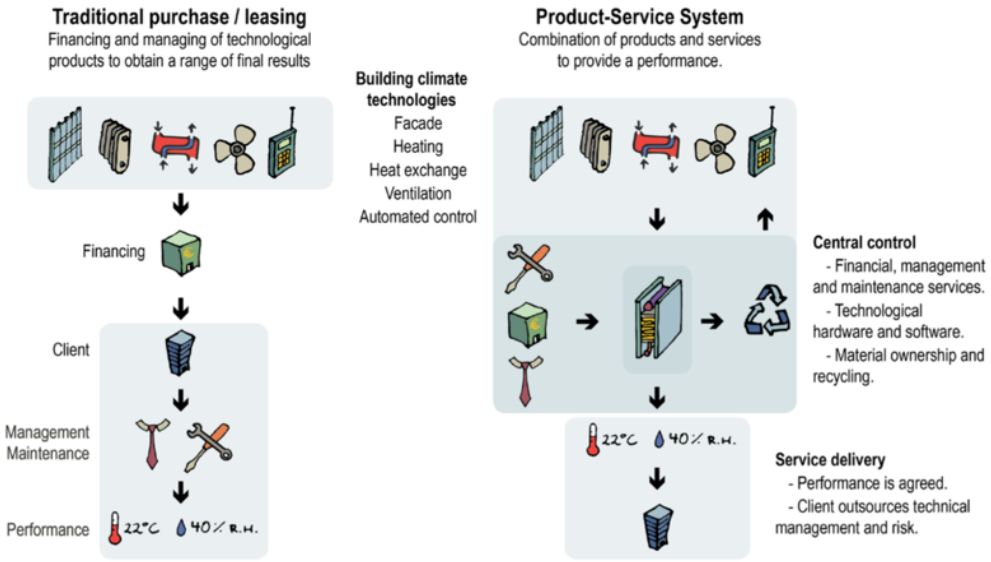


Figure 43 Schematic shift from traditional Product-System to a circular Product-Service System for integrated facades (Azcarate-Aguerre et al., 2017)

Then, if the ownership of a building as a whole, changes the value of such a building and the rights that can be derived from that ownership might be affected. Consequently, it is important to firstly define what ownership means within the traditional legal system.

Definition of Ownership in the legal system

As implied by Ploeger et al. (2019), any legal solution proposed to sort out the legal ownership challenges derived from the introduction of CBMs in the building industry are bound to specific rules within the national context. Therefore, it is important to specify that all the arguments presented next are specific to the Dutch property law.

Then, according to Article 5:1 of the Dutch Civil Code (DCC), "*ownership is the most comprehensive property right that a person, the 'owner', can have to(in) a thing".* Furthermore, in Article 5:1,3 it is stated that "*as far as the law does not provide otherwise, the owner of a thing is the owner of all its components".* From these two articles, it can be already seen that a right of ownership defines the idea of unity (a 'thing) and that even when that 'thing' has different parts (components), if the law does not provide otherwise, the owner of the thing also becomes the owner of the components.

Moreover, Article 3:4 explains that a component is *"all that, according to general accepted views (common opinion), forms a part of that thing"* and "*a thing that is attached to another principal thing in such a way that it cannot be separated from it without causing meaningful damage to one of the things, becomes a component of the principle thing".* Therefore, two more

characteristics can be derived from the law: common opinion defines what a component is and if a thing causes meaningful damage to a principal thing when separated, then this thing is also considered a component.

Consequently, in itself the definition of ownership in the legal system present problems to the separation of ownership in buildings, thus to the introduction of leased facades. First, because until now façades are seen as part of buildings, thus are not provided as a separated component of buildings. Second, because the law still does not provide any specific clarification to this situation. Consequently, the owner of the real estate asset still holds the rights to any component within the building by definition.

Given this situation, different studies have specified the need to define three essential concepts that complement the definition of ownership, i.e., distinction between movable and immovable components, accession, and mortgage law (Michael, 2018; H. D. Ploeger et al., 2017; H. Ploeger et al., 2019), to help clarify the challenges imposed by the definition of ownership. Hence, each of the concepts is defined next.

a) *Movable and immovable*. Dutch property law differentiates between movable and immovable components. According to Article 3:3 of the DCC *"Immovable are the land, the not yet mined minerals, the plants connected with the land,* ***and the buildings and constructions permanently attached to the land*** *[emphasis added], either directly or through a connection with other buildings or constructions".* On the contrary, movable components are all those that are not immovable. This definition of immovable components raises the question if all the components within a building are defined as immovable; specially in the case where a product such a detachable façade is built. However, according to different studies, the answer to this question can also be taken from the law and depends on two arguments: can the component be easily moved or is it destined to remain on its location permanently, and will the removal of the component decrease the value of the asset as a whole because it would be seen as an incomplete product (Michael, 2018; H. D. Ploeger et al., 2017; H. Ploeger et al., 2019)? Finally, according to Vliet (2002), in Dutch law, the intentions of the builder are not considered in the analysis of movable vs immovable components since it is deemed to be subjective. Therefore, even if the supplier of the façade built this element with the intention of it being a movable object within a building, his intentions will not hold in legal matters.
b) *Accession*. The understanding of accession is derived from Articles 3:4, 5:14 and 5:20 of the DCC. From these articles it can be state that accession is *"a term that defines that the owner of the land is the legal owner of immovable components built in or on it"* (H. D. Ploeger et al., 2017). For the example of the leased façade, this means that when two independent objects, i.e., the building envelope and the façade, are joined together in such a way that both of them lose their independence becoming one interdependent product, from that moment onwards they are considered as one single object (Michael, 2018; Vliet, 2002). Moreover, it is important to mention that according to Article 5:14 of

the DCC there is a distinction between the principal object and the additional objects. This situation is established to determine the owner of the final object, since the owner of the principal object becomes the owner of all other additional objects. Then, a principal object is defined as *"the thing of which the value exceeds the value of the other things considerably or the thing that is regarded by generally accepted views (common opinion) as the principal thing"* (Book 5, Article 14 Dutch Civil Code). From this definition of principal object, between the building envelope and the façade, the building envelope would be considered as the principal thing, thus, the owner of the building envelope will also have the right of ownership to the facade. Finally, it is important to mentioned that fixtures are also considered to be part of a building (H. Ploeger et al., 2019). Ploeger et al. (2017) argue that the decision to identify a fixture of a building lays within the Dutch civil law and it is based on two criteria: the extent to which removing a component from a building will cause damage and if the component is a fixture according to general opinion.

c) *Mortgage law*. Derived from the rule of accession it is stated that the mortgagee can hold as security everything which is part of a property, such as the building on the land or any fixture of the building (H. D. Ploeger et al., 2017; H. Ploeger et al., 2019). Therefore, *"in the case of an interest payment or repayment default of the debtor, the mortgagee is entitled to sell the mortgaged property in public by auction and to recover the secured debt-claim from the sale proceeds"* (H. Ploeger et al., 2019, p.6). For the example of the leased façade, this means that if the owner of the building where the façade has been installed fails with its financial obligations, the debtor (bank or investor) is entitled to sell the whole property (including the leased façade), being the rightful owner.

In summary, the current legal system binds the ownership of most of the objects within a building to the owner of the land. Moreover, due to the interdependent nature of the majority of the objects that make a building it is complicated to legally define them as separate and independent entities. Then, the ownership of a leased façade would be transferred to the owner of the building as soon as this object is attached to the building, without any regards to the agreement reached between the parties, e.g., client, contractor, supplier, etc. This situation is mainly based on the fact that a building without a façade cannot be seen as the final functional product and due to technical challenges, that make it difficult to detach facades from buildings without damages on a general scale. Nevertheless, some ideas are already being presented to overcome the legal challenges present in the current Dutch legal system. The next final section focuses on these propositions.

Alternatives for ownership

To start proposing possibilities to overcomes the constraints placed on the introduction of PSS by Dutch property law, different authors argue that, first, it is important to understand the motives for the rule of accession (Michael, 2018; H. D. Ploeger et al., 2017; H. Ploeger et al., 2019). According to Ploeger et al. (2019, p.9) two motives for this rule can be extracted from the

literature: legal security and preservation of value. Legal security is considered because it is argued to be complicated to determine if a product is separated in parts (H. Ploeger et al., 2019). While the preservation of value implies that the sum of all the parts together is worth more that the individual value of each of the parts, meaning that once different parts are put together the value of this unity should be preserved (*Ibid.*).

Considering the legal security of products, different studies argue that the solution to this issue lays within the introduction and improvement of technologies like Building Information Modeling (BIM), blockchain technologies and other standardized interfaces, e.g., building passports (H. Ploeger et al., 2019). These types of technologies could allow to easily identify and document individual products within buildings, link them to their producer or owner, make records of their use and register individual components, among other things, hence, securing the legal rights of ownership for all the parties involved. As argued by Chao-Duivis (2017, p. 1038) *"legal certainty can also be served by registration"*, therefore, the integration of these technologies in 'product-as-service" business models seem to be the most suitable enabler to overcome the first of the mentioned motives.

On the other hand, the concept of preservation of value could be more challenging since it seems to be rooted on the core basis of the traditional linear economy (H. D. Ploeger et al., 2017; H. Ploeger et al., 2019). Stating that each of the parts that make a product are less valuable than the whole product hinders the idea of detachment or independence. Considering the example of the leased façade, if it is known that a building without an owned façade is less valuable than a building with an owned façade, and that an independent façade could be worthless, why would the option of independent facades be considered? However, there are cases in which independence of parts in a product allow upgrades to the product, thereby often increasing the value. Many examples of this situation can be seen in the automotive industry. Consequently, it seems that to overcome the motive of preservation of value in the building industry, there is the need to reexamine the principle of unity, allowing real estate assets to introduce new values by the independence of its components. Nevertheless, deeply rooted principles like the principle of unity are not easy to change, thus, some scholars do not expect changes in the Dutch property laws in the coming decades (H. D. Ploeger et al., 2017; H. Ploeger et al., 2019).

Two exceptions to the rule of accession were found in the literature. This means that even when certain components could be considered a fixture of the land, the ownership of land and fixture could be separated. The first exception can be found as a building lease or right of superficies ['opstalrecht' in Dutch] (Michael, 2018; H. D. Ploeger et al., 2017; H. Ploeger et al., 2019). This is a limited property right (a right in rem), which according to Book 5 Article 101 of the DCC enables the lease to have or acquire the ownership of buildings or constructions in, on or above an immovable thing (e.g., land) by someone else. However, in Article 102 of the same book, the DCC

endows limits to the right of superficies. Basically, it limits the rights of ownership to buildings or "constructions"; but the latter concept is rather ambiguous. Ploeger et al. (2009), describe that from literature and case law the right of superficies seems to be constrained only to components which have "sufficient economic independence", e.g., radio towers or wind turbines. Therefore, it is still not knowing the extent of application of this right of superficies. Currently, only one case of split ownership that takes advantage of this right of superficies is known in the Dutch real estate industry, i.e., Mitsubishi Elevators Europe with "M-use".

The second exception to the rule of accession is derived from the 1979 case of the Dutch Supreme Court against Radio Holland. From this case, it was established that even when a component might be appreciated as a fixture, if the lessor has enough market power the component can remain in the ownership of the producer. Then, as put by Ploeger et al. (2019), "the common opinion can be influenced by contractual standards". Consequently, from this case it can be derived that even when an object might be functionally incomplete without a certain component this does not automatically establish such component as a fixture; nevertheless, certain market pressure needs to be in place.

Additionally, other alternatives to the right of superficies have been proposed by scholars. One alternative is economic ownership. This concepts translates in the contractual use of an object (including financial risks and responsibilities) without the legal ownership of the object (Michael, 2018; H. D. Ploeger et al., 2017). The economic ownership concept is mostly used in Dutch tax law, but it has no legal meaning in real estate law, meaning that it cannot be treated as a legal entity yet. Therefore, it is still too early to say if it can be used under CE principles.

In conclusion, it seems that it is still too early to define true alternatives for the case of leased products under 'product-as-services' business models. As shown, some studies already describe propositions to tackle, mostly, the challenge of ownership; however, no real case study has been properly conducted to see all the real legal challenges that arise from the change of a linear consumption system and how to overcome them. Specifically related to the used of leased facades it can be mentioned that already a pilot at Delft University of Technology is being performed but its results are still not known (Azcarate-Aguerre et al., 2017). With the development of new technologies, like the better implementation of BIM, it might seem that some legal issues could be tackled but this is also still left for future studies. All in all, during this example, it was shown that the legal challenges that arise from the implementation of CBMs can be more difficult than expected, thus the importance of placing this concept in the proposed framework.

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