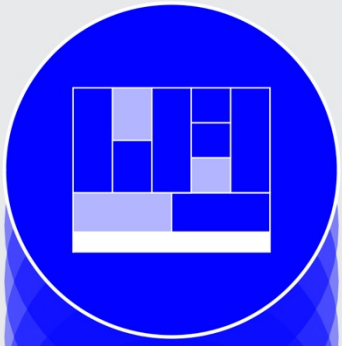

CIRCULARITY AS A GAME CHANGER

An exploration into dynamic capabilities' microfoundations as mechanisms for business model transformation in architectural firms

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Version: P5 Report
Date: 14.06.2022

ABSTRACT

Economies, society, and organizations are operating on borrowed time (Lacy & Rutqvist, 2015).

As a response to urgent planetary and societal needs, a critical shift is required on every aspect of how organizations in the construction sector, one of the most resource intensive and pollutant industries, propose, create, and capture value (Bocken & Antikainen, 2019). The circular economy (CE) has been embraced in the architectural discourse as one of the most powerful, innovative, and viable business strategies to achieve sustainability in the built environment. However, architectural firms are still struggling to translate the concept into their business models (BMs) (Urbinati et al., 2017; Accenture, 2014; Khan et al., 2020).

Scholars argue that in order for firms to reorganize their strategies, resources, and structures to those that are free from linear constraints, new dynamic organizational capabilities (particular kills, processes, and organizational activities) are required (Lacy & Rutqvist, 2015; Khan et al., 2020; Bauwens et al., 2020). However, most research on the subject has been developed from a practice-oriented perspective and/or has been primarily focused on large profit-driven organizations, rather than smaller creative firms driven by strategic goals beyond financial revenues (Lu & Sexton, 2006; Bos-de Vos et al., 2017).

Through semi-structured interviews and qualitative data collection with stakeholders in four architectural firms operating in the Netherlands; the research addresses the limited academical research on this field by exploring the Dynamic Capability Approach of the firm as a BM transformation know-how strategy in favor of CE.

The findings indicate that the dynamic capabilities approach is undeniably beneficial for CE implementation among architectural firms. In this regard, the research identifies 15 microfoundations of sense, seize, and reconfigure dynamic capabilities that architects and entrepreneurs can implement to transform the way they create, deliver and capture value. Furthermore, this thesis concludes that architectural firms operate on the basis of a BM portfolio with CE embedded at the project-based level. Finally, the findings suggest that CE has had limited impact in the value proposition of architects but has increased the complexity of their value creations and delivery components, ultimately leading to trade-offs and creative strategies to capture value and ensure the firms survival in still transitionary markets.

Keywords: circular economy, architectural firms, business models, sustainability in the built environment, microfoundations, dynamic capability approach,

PREFACE

This master's thesis presents a one-year research project, part of the Management in the Built Environment masters' track. The current report marks the completition of the Master of Science in Architecture, Urbanism and Building Sciences at TU Delft. The analysis and ideas collected in this research are intended to provide knowledge about business model transformation in the context of the circular economy for architects and other organizations in the creative industry. Furthermore, it sheds light on the changing role of architects to deliver sustainability in the built environment.

The research is a demanding individual effort supported by the contributions of people who believed in the value of this research and my work as master student, researcher, and architect. I would like to extend my gratitude to my supervisors Hans Wamelink and Hilde Remøy for their guidance, trust, and constant inspiration on this journey. Equally, I would like to extend my appreciation to my tutor Tuuli Jylhä who accompanied me at the beginning of the process and together set the basis of the study.

Additionally, I would like to thank the interviewees for their valuable insights and the effort of their team and organization to achieve a sustainable built environment, while also believing in the valuable contribution of this research to the cause. I would like to thank my classmates and friends, in a similar academical journey, for making this an incredible experience.

And above all, I would like to thank my family for their unconditional love and support and for always encouragement to follow my goals.

Para ustedes Judith, Mario, Alex y Jaime.

Pedro,
Delft, June 2022

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EXECUTIVE SUMMARY

INTRODUCTION

Society, economies, and organizations are operating on borrowed time (Lacy & Rutqvist, 2015). The construction industry, one of the major players in the global economy, is responsible for 50% of the total use of raw materials, 39% of energy and process-related emissions, and up to a third of the total waste generated in the EU (Norouzi et al., 2021). Due to the threatening consumption and production processes associated with this industry, there is an urgent need for the construction sector and its contributors to transform the way they propose, create and capture value, embracing sustainability strategies like the CE in their BMs (Nuñez-Cacho et al., 2018). The CE has emerged as one of the most powerful, innovative, and viable business strategies that can radically address planetary threats and tackle sustainability challenges by improving resource productivity (Ellen MacArthur Foundation, 2013; Lewandowski, 2016). Specifically, architectural firms are also experiencing substantial changes in the business climate where they operate. Together with other creative professional service firms (CPSFs) in the construction industry, they are actively contributing to the sustainability problem (Duffy & Rabeneck, 2013). In this respect, a vital shift is required in the purpose and every aspect of how architects conduct the operations favoring the CE and responding to major societal, technological, and industry-level changes (Bocken & Antikainen, 2019).

Problem Statement: The architectural discourse has widely adopted the ideas underpinning the CE as a straight forwards strategy to achieve sustainability in the built environment , yet most firms are unable to translate the concept of CE into their BMs and operations. Innovation in CE and BMs requires new dynamic organizational capabilities that allow firms to reorganize their strategies, resources, and structures to those that are free from linear economy thinking. However, there is little discussion and paucity in academic research about how firms can develop such capabilities and associated CE micro-foundations. The majority of research on BM transformation has been developed from a practice-oriented perspective and/or has been primarily focused on large profit-driven organizations, rather than smaller creative firms that pursue a variety of objectives under the value umbrella.

Research aims and objectives: The purpose of this research is to address the knowledge gap between CE implementation and BM transformation know-how for creative professional services firms, specifically architectural firms. The main research objectives are, explore and understand BM theory concerning CPSFs in the context of CE; identify the barriers that architectural companies experience while integrating CE in their BMs; understand how the Dynamic Capability Approach (DCA) of the firm enables BM transformation to overcome identified barriers; and finally define a dynamic capability toolbox for architectural firms to approach CE on their journey toward a sustainable built environment

Research questions: Three research questions provide the structure necessary to answer the main research question:

MRQ: Which organizational processes enable architectural firms to transform their business models in favor of the Circular Economy?

RQ1: How is the CE embedded in BMs for architecture firms?
RQ2: How can BMs be transformed through the Dynamic Capability Approach?
RQ3: How are architectural firms currently addressing the circular economy?

METHODOLOGY

Theoretical research : This section provides the language and theoretical knowledge necessary to define, differentiate and discuss the three key study concepts: circular economy, business model theory, and the dynamic capability approach. The secondary data was collected from academic publications via academic search engines such as Scopus, Google Scholar, and the digital platform of the TU Delft Library. This section's output includes background information that justifies the existence of the problem to be investigated, as well as previous research on the subject of business models for CPSFs and CE. More importantly, it delves deeper into the Dynamic Capability Approach of the firm, which guides the data collection in the empirical part of the research.

Empirical research: This section exploits the multiple case-study approach, collecting primary data from architectural firms that have embraced circularity as part of their organization. The output of this section is the identification of microfoundations of Sense, Seize and Reconfigure dynamic capabilities necessary for CE implementation. Furthermore, it provides insights into the development path of these capabilities, CE challenges encountered by the case studies, and the overall impact of CE on their value proposition, creation, and capture. Semi-structured in-depth interviews with stakeholders in strategic positions of the firms are used. Stakeholders include partners involved with business development tasks, but also architects that have actively participated in CE initiatives and projects were circularity played a big role.

- **Case Firm A:** They describe their approach as a practical idealism that pushes architecture and design towards the maximalization of flexibility, circularity, and future innovation. Active for more than eighty years with a current team of around 70 people.

- **Case Firm B:** Medium-sized architectural firm operating nationally for over sixty-five years. Their portfolio consists of social and commercial projects with tasks involving interiors, new construction, and especially real estate transformations. They present an analytical and integral design approach that emphasizes on (re)develop functional, future-oriented, and expressive buildings.

- **Case Firm C:** Firm operating in the Netherlands and abroad. The focus on new build projects, but specially their experts in the field of adaptive re-use of architectural heritage and urban development strategies. They are operating for 25 years under five core values context, community, new aesthetics, flexibility, and new values.

- **Case Firm D:** Active in the Dutch market for thirty years, and currently operating under an international team of forty people. Their approach is described as a realistic idealism that aims for a sustainable future with people-centered design and livable cities. They are characterized by their data-driven design. In the last decade, they have expanded

FINDINGS

Figure 20 reflects the main findings of the study. Accordingly, the findings are presented in relation to the main research objectives, which are connected to the core topics of the research: the CE paradigm, BM for CPSFs, and the Dynamic Capability Approach.

CE paradigm on BMs for CPSFs

The first objective of this research was to **explore and understand the BM concept in relation to CPSFs in the context of CE.** The concept of BMs applied to CPSFs represents the development of a BM portfolio comprised of two levels (Figure 5), the firm level and the project-based level. In this sense, this research suggests that CE is embedded at the project-level BM of architectural firms. The results from the empirical research show, that CE is not applied consistently across all architectural products by the case studies. Furthermore, this study finds that CE and its principles are marketed as a distinctive solution available to clients, yet not as the only one.

This research concludes that the lack of market receptivity and awareness of the CE concept among clients, obstructs the possibility of CE being placed at the firm-level BM. In this regard, the research argues that the firm-level BM is composed by the offer of specialized architectural services (project assistance, product design, product development and business case development) centered around the overarching concept of sustainability, to which most clients and organizations can relate by establishing similar goals. The positioning of CE at the project-level BM enables architectural firms to navigate different paths to meet client and planetary needs while also creating value for the company, its partners, and society.

Furthermore, it may be argued that architects are heavily reliant on clients', contractors', and end users' objectives to shift their operations toward more sustainable practices. In this regard, based on the data collected through the cases study analysis, we conclude that there are two options to embed the CE paradigm on BM's for CPSFs like architectural organizations. On the one hand, architects can develop the necessary managerial and organizational processes to become their own clients and contractors, extending their operations along other stages of the building's lifecycle; on the other hand, architects can develop the processes and systems required to influence the clients' behavior as well as the behavior of other actors along the construction industry.

Finally, the research determines that the concept of "Circular BMs" applied to architectural firms, refers to projects where the value creation logic has been designed to generate shared value, meaning economic value that not only benefits shareholders, but also aligns with broader public values benefiting the environment and society in general. Furthermore, this value creation logic closes and narrows and slows down material loops, parting away from traditional resource-intensive AEC processes that are contributing to climate change.

Value Proposition: The mains findings indicate that architectural firms are moving away from conventional economically and customer-centric value propositions, but rather considering other stakeholders, like nature and future generations. In this regard they aim to provide economic value that not only benefits direct shareholders, but also value that impacts society in general and the environment.

However, the research argues that although they aim for value propositions with greater impact, and that their architectural products can be differentiated between CE projects and traditional projects; they strive to provide it through the same specialized services namely, project assistance, product design, product development, and business case development. Hence, the research concludes that there is a lack of further innovation from the case studies on this area of the business model canvas.

Furthermore, the research distinguishes a strong relationship between building lifespan stages and value propostion (specialized services and products) for architects. Hence, in order for these organizationa to expand the type of services that they offer, they need to scale up their scope into other stages of the building lifecycle (Design, Manufacturing of components, Construction, Use, and End of Life). This could detonate a new type of architectural and none architectural products that have yet to be explored by professionals in the architectural domain.

Value Creation and Delivery: Although the value proposition of architectural firms has not change significantly in relation to CE, the architecture by which they create value has become more complex. The findings depict a strong dependency on a wider group of stakeholders in the creation of value, especially when it comes to deliver sustainability in the built environment through CE. The findings show that collaboration has become a pivotal stone among the case studies and their value network.

The research concludes that the increase dependency on other actors for CE, intensifies the key partners component of the circular business model canvas. In addition, the research argues that although none of the firms provided an exact definition of CE, the principles that it represents are embedded in the firms either in the form of a vision statement core values or project briefs. In this regard based on the qualitative data collected, this study dares to say that architects are the front of understanding of the CE concept in comparison to suppliers, contractors, and clients.

The intensification of key partners means the expansion of key resources and key activities. This research finds an intensification of activities related to knowledge creation and management, market monitoring and networking, client incentive activities, and software analysis. It was also observed that the new bundle of resources and activities are mostly related to turn the concept of CE and its outputs more transparent, measurable, and more tangible for other stakeholders.

On the value delivery side , the findings show that the take-back system components of the circular business model canvas is largely neglected by architectural firms. The findings indicate that most of their initiatives on take back systems suggest a long-term nature with modest impact in the short term. Customer segments were characterized by an emphasizes on entrepreneurial clients looking for architectural products that mirror their aims for a sustainable lifestyle. The social market sector was also mentioned as niche for CE implementation as public regulations favor sustainability measures among these entities. Finally, Online platforms, academical and supplier events, but also informal interactions have become important channels to increase awareness of the distinctive architectural products and services that the firms offer.

Value Capture: The findings suggest a conflict between cost structure and revenue streams as one of the biggest challenges that architectural firms face for implementing CE. The conflict can ultimately lead to top managers hesitating to allocate not only financial but also other tangible and intangible resources in favor of CE.
This study claims that more research is needed to validate this scenarios, as the case study focused on middle size architectural firms and not bigger firms which may have stronger financial resources to allocate for CE.

On the other side, The findings show a disbalance between client's ambitions and budget, which ends up affecting the fees of architects, leading to monetary loses but more importantly hindering the profession and enjoyment of the work. The findings show discrepancies on interviewees' response to professional value conflicts, result of clients' restrictive budgets and high expectations. Interviewees expressed that is the architect's responsibility to create enough space for innovation that matches clients' uninformed ambitions; even if this means sacrificing enjoyment of the work, as this is responsibility is embedded in the profession. Other interviewees claimed that is the client's responsibility to have a budget that matches their ambitions, and architects innovation should go toward disincentivizing a normalized culture of doing more for less.

Finally, the findings suggest a connection between the maximization of societal, exchange and use value and the capture of monetary value. The research suggests that architects can develop business models and subsequent organizational mechanisms that support the maximization use value for clients. As showed by the case studies, this could be done through the implementation of CE strategies like flexibility, adaptability and dismantlability. The maximization of use value can then potentially lead to higher exchange value in project with strong CE ambitions. Finally, the study argues that higher use and exchange value become a source of adequate financial stability for the firm supporting its survival in the market.

Barriers of CE implementations among CPSFs

Table 17 and Table 18 link theory and practice by displaying the main findings concerning internal and external barriers faced by architectural firms when integrating CE in their BMs.

Concerning internal cultural barriers, this research finds that architectural firms have integrated CE into their BM either through their mission statement, core values, or the indicators used in their projects. All interviewees acknowledge the urgency to change current practices and have not detected any opposition among their team. However, they are still facing a lack of holistic understanding of how CE can be applied along the different stages of the building's lifecycle.

More importantly, there is a lack of reverse supply chain as there is a hesitation among architects to take responsibility for these tasks. Financial internal barriers appear as one of the most prominent among the case studies. CE implementation in projects can lead to financial risks by the firm, as they might invest capital in resources and capabilities to improve their CE delivery, yet this is often not recognized by clients and occasionally the investment is not recovered.

At the same time, the research argues that CE is compromised by architectural firms in order to survive in a transitionary market. If the firm needs short term return on their investments, then they are willing to reduce their CE implementation ambitions to close a deal ensuring an injection of capital to stay operating. The field of collaboration presented less barriers, as the findings show that collaboration among architectural firms has increased.

Barriers associated with lack of resources are still present. Time plays a big role as CE projects take longer periods of time to detail and execute, but also in terms of client approval. Lack of knowledge was unanimous recognize as the main internal barrier for CE. However, the findings argue that architects are leading the closure of the knowledge gap as they are actively and extensively investing in knowledge generation and integration for CE. Lack of financial resources was also mentioned as a barrier, especially regarding budget appointment for CE tool development

Although all of the interviewees recognized that they are designing architectural products that aim for longevity, easy maintenance, future disassembly, and reuse of materials; there is still some barriers in term of the measurement of the effectivity of the design to achieve CE. Most of the implemented design strategies focus on long-term effects rather than short-term results. Hence, the benefits of CE design strategies are not directly contributing to immediate planetary needs.

Finally, the findings show that architectural firms need to increase their capabilities to overcome the lack of communication among departments specially in relation to business models. The results show that his is kept among top management, however the research argues that if this type of knowledge is better distributed among the employees, they have the opportunity to contribute to business model innovation for CE. A BM holistic awareness inside the firms, could also contribute to better distribution of tasks among departments.

In terms of external barriers, there is a lack of awareness among clients about the CE concept. On one hand, the architect's tasks have then intensified to promote and foster awareness and interest among clients. On the other hand, the lack of market interest can foster initiator capabilities among architects to become their own client assuring delivery of CE products. In regard to legislative and economic regulations, the empirical results show that public institutions are keenly working with architects and that public circular procurement is not limited but rather increasing.

However, these institutions often present a disbalanced between ambitions and budget hindering the architect's job. Lack of consensus on how to approach sustainability by legislative bodies has caused architect to waste their resources on initiatives that were later overturned by changes in legislation and construction regulations. To conclude this section, the findigns indicate that the above-described challenges are present among all the participats dispite their longevity. However, the emprical research showed that case studies established thirty years ago managed to be at the same compettive level as firms who were born more than sixty years ago. Based on the qualitative data and on the overview of firms' documents , the reseach dares to say that younger firms have had a smoother path towards CE than firms who have been established years before.

Dynamic Capability Path

The third objective was to understand how the Dynamic Capability Approach (DCA) enables BM transformation for architectural firm overcoming CE barriers.

In this regard, the main findings of this research show that the DCA enables BM transformation by becoming the internal adoption factors that dictate the extent to which CE is embedded in the operations of architectural firms. Hence, dynamic capabilities and their microfoundations describe the organizational capabilities or intangible processes associated with organizational change, strategic renewal of the firm and adaptation within firms and industries in ever changing markets. DCs enable BM transformation by supporting organizations in the development of three specific types of capabilities namely Sense, Seize and Reconfigure (Figure 20).

First, the empirical analysis and the later workshops for findings validation with architects and students, suggest that the development of these three types of skills is not always a linear process as illustrated in Figure 11. Instead, sense, seize and reconfigure processes or microfoundations can be developed in a distinctive order that the one describe in theory where sense capabilities are developed first, followed by seize microfoundations and finally by reconfigure processes. The study suggest that the development of capabilities of different nature depends on the market perception of the participants. Hence, the transformation of their business models is heavily dependent on their clients approach to the built environment.

Second, in terms of the microfoundations' applicability, the participants observed distinct linkages between game cards. In this manner, each of them devised a unique implementation path or method of playing the game. Nevertheless, some similarities were identified in the multiple approaches. The initial approach is to prioritize specific skills, differentiating between microfoundations with a central role and others under a supportive position. Furthermore, based on the workshops, the research suggests that the applicability path of microfoundations for business model transformation can be in clusters. The study indicate that the clusters can be divided into time periods and applied to different stages of an architectural project life's cycle.

Third, the research proposes that the dimension of competitiveness does not come only from developing new skills, possessing specific resources, or from a particular strategic view to the built environment; but rather competitiveness occurs from the careful orchestration of the relations between these elements. In that logic, this research concludes that DCs and strategy guide organizational transformation by combining to create and refine a defensible BM.

15 Dynamic Capabilities microfoundations

This research identified 15 microfoundations of DCs that constitute the DCA toolbox. According to the framework developed by Teece (2007), micro-foundations represent the organizational and managerial skills, processes, systems, and structures that undergird each of the three higher order dynamic capabilities of Sense, Seize and Reconfigure.

SENSE

01 ARCHITECTURAL MARKETING

Actively pursue opportunities through differential business development, communications, and strategic processes.

- Exploit media landscape
- Speak-out skills
- Statement development
- Find pioneering clients

SENSE

SENSE

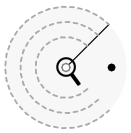
02 THE SIDE DOOR

New opportunities do not always present themselves through the front door, but can arise from differential access to existing information

- Office as a business card
- Locate the firm in an innovation cluster

SENSE

SENSE



03 MARKET SURVEILLANCE

Opportunities that arise from processes related to monitoring:

- Unsatisfied markets
- Past and present market needs
- Architectural competitions as market reflectors
- International emerging markets

SENSE

SENSE

04 QUESTION BEHIND THE QUESTION

Processes to sense and influence existing and old clients, by monitoring their openness and ambition to change.

- Early client involvement
- Ambition brainstorm skills
- Workshops with pioneering clients

SENSE

SENSE

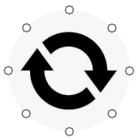
05 KNOWLEDGE GENERATION

Opportunities can arise from generating and acquire new information and technology inside and outside the firm

- Participating in material districts
- Knowledge networking
- Retrospective project learning
- Employee specialization

SENSE

SEIZE



06 CONTINUOUS MOTIVATION

Processes delineate customer relationships by building trust and commitment with new/old clients

- Long-term motivation schemes
- Buildings' characteristics as a motivation base
- Providing information as a stimulus

SEIZE

SEIZE

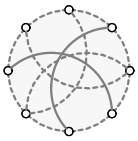
07 INITIATOR CAPACITY

Processes that delineate new key activities and distinctive value propositions in favor of a circular economy

- Architect as real estate developers
- Architect as project initiator

SEIZE

SEIZE



08 COLLABORATION

Processes that delineate new key partners, beyond traditional collaborators, to introduce CE into the services and operations of the firm.

- Expert supply circle
- Supplier selection by architects
- Involvement of Software Developers
- Partnerships with academic institutions
- Universities as knowledge suppliers

SEIZE

SEIZE

09 CIRCULAR TOOL DEVELOPMENT

Processes that delineate new key resources to introduce CE into the services and operations of the firm.

- Material Passport
- Circularity toolbox development
- BIM software
- CE booklets

SEIZE

SEIZE

10 GUARANTEE SYSTEMS

Fostering long-term trust and commitment with public and private partners, combating ephemeral efforts and misleading narratives of sustainability.

- Confidentiality agreements
- Guarantees from policymakers

SEIZE

RECONFIGURE

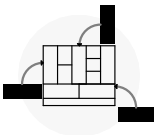
11 KNOWLEDGE INTEGRATION

Processes directly linked to knowledge management and information spreading inside architectural firms

- Knowledge Academy
- Knowledge sharing platforms and catalogs
- One on one sharing
- Generational knowledge integration

RECONFIGURE

RECONFIGURE



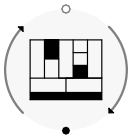
12 BUSINESS MODEL DESIGN SKILLS

Processes needed for new business model generation and decompose of obsolete business models

- Business Model design knowledge
- Clients' business model awareness

RECONFIGURE

RECONFIGURE



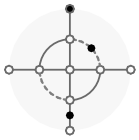
13 NEW BUSINESS PARADIGMS

New governance models that result in various reconfigurations of the components of the business model

- New workload protocols
- New business practices
- Distinctive ways to see the architectural role

RECONFIGURE

RECONFIGURE



14 ORGANIZATIONAL RESTRUCTURE

Processes associated with strategic management in a way that the combination of resources enhances value for the firm

- Succinct and flexible teams
- Specialised professionals addition
- Multi background team
- Circular economy team establishment

RECONFIGURE

RECONFIGURE

15 ORGANISE THE NARRATIVE

Processes associated with the internal and external governance over the narrative towards sustainability in the built environment

- Circular economy ambition
- Internal core value establishment
- Organise the external storyline

RECONFIGURE

CONCLUSION

As presented through the findings of this study, the introduction of CE has become a game changer not only for actors shaping the built environment through spatial design, but also for entire economies, cities, and societies. If architects want to become part of global efforts for sustainability and change the way they propose, create, and deliver value, they first need to understand the business model game and the position of their organizations as players in an everchanging market.

Understanding the game means, acknowledging the BMs concept beyond a mere endowment of bundles of specific resources, but rather advocate for a far-reaching rationale that contemplates the mechanisms that put these tangible and intangible resources together making a BM work and compete in dynamic markets. These mechanisms refer to the internal organizational and managerial processes and skills by which firms can identify, adapt, and reconfigure new opportunities and threats for CE.

The research concludes that the 15 microfoundations or game cards (Figure 24) represent the organizational processes needed for BM transformations in favor of CE. Furthermore, the study indicates that the game cards developed in this research, are undeniable beneficial for CE implementation, yet not exclusive to this subject. The findings and the validations suggest that the 15 microfoundations can be used for more purposes that CE, including different approaches in the search for sustainability in the built environment.

In this regard, architectural firms may apply five micro-foundations to sense CE business opportunities in the market specifically: (1) Architectural Marketing, (2) The Side Door, (3) Market Surveillance, (4) The Question behind the Question, and (5) Knowledge Generation. Once, CE business opportunities have been sensed, firms may address those opportunity through five seize microfoundations that will impact each of the BM components, namely (6) Continues Motivation Schemes, (7) Initiator Capacity, (8) Collaboration, (9) CE tool Development, and (10) Guarantee Systems. Finally, the last organizational processes that enable architecture firms to transform their BM are five reconfiguring microfoundations namely (11) Internal Knowledge Integration, (12) BM design skills, (13) New Business Paradigms, (14) Organization Restructure, and finally (15) Organize the Narrative.

To finalize, BM transformation and CE, demands for motivated professionals in the creative industry that believe that a deeper change is needed in the essence of the profession and the construction industry. The game cards should support professionals to constantly reevaluate their approach to the built environment allowing to respond and enhance social, economic, and environmental sustainability.

CONTRIBUTIONS OF THE RESEARCH

This thesis contributes to the fields of corporate real estate management and design and construction management by providing knowledge about BM transformation processes in favor of CE and its supporting organizational mechanisms. The main contribution of this research relates to the identification of fifteen microfoundations of dynamic capabilities that architectural firms and other creative firms can pursue to incorporate CE into the way they propose, create, and deliver value for the firm, society and a broader group of stakeholders that include nature and future generations.

In this line, the research provides a toolbox or gamecards that explain how BMs can be transformed depending on three core capabilities, namely sense, seize and reconfigure dynamic capabilities. Additionally, the study has revealed different internal and external challenges that architectural firms in the Dutch context have experienced when implementing CE principles as part of their BM portfolio.

This information is particularly relevant not only for top managers or senior architects, but also for every member of architectural organizations or entrepreneurs aiming to enter this field, as it gives insight into the BM dynamic of this part of the construction industry. This research contributes to the exiting body of knowledge and closes a gap in literature regarding BM transformation in the context of CPSFs. The research provides a more comprehensive view of the topic, as previous studies have focused only on large profit driven organizations or have been developed in single unit of analysis methodology.

RECOMMENDATIONS FOR FUTURE RESEARCH

The findings of this research are subject to certain limitations of context, timing, methodology, and scope, which provide opportunities for future research paths.

First, the empirical research of this study is based on data collected form architectural firms based in the Netherlands. In this regard the findings are influenced by the social, political an economical context in which the case studies operate. Thus, future studies may conduct a similar study in other geographical contexts or provide insights into the influence of different national regulations on the practices of architectural firms in different countries on their efforts to achieve CE.

Second, the subject of study for this research are architectural firms; future research can explore the dynamical capability approach on other sectors and actors of the creative industry that is yet to be observed in the current study. Additional research focusing on the demand side of CE projects could be highly beneficial in order to better understand clients' perceptions of CE and the conflict between cost structure and revenue streams. This type of research could gather information on what is required to motivate clients to allocate financial resources for CE. These insights might then be used to reinforce the organizational processes highlighted in this study, giving architectural firms a competitive advantage or CE premium influencing client's preferences for organizations with higher CE capabilities for sustainability goals.

Third, in relation to methodology, this research is based on qualitative data exploiting the case-study approach. However, the empirical study evidenced that an increased number of interviews per case study could be very fruitful and provided greater details about the organization. Hence, a longitudinal study for research on the evolution of a firm's dynamic capabilities for CE implementation is not discarded. The longitudinal study can also be performed with one of the organizations that were part of this study yielding insightful information about the evolution of the firm

Moreover, quantitative data collection could improve the comparability between case studies and the use of the game cards, regarding the impact of CE on architects' business models, costs expenditures, investment of time, increase of fees, hiring of new stuff, among others. In the same line, the methodology could be adjusted to use the game cards and acquire insight from a business model perspective by comparing two specific projects from the same firm. This is suggested as literature showed that creative firms have the capacity to develop specific business models on a project base. All these suggestions can be accomplished by modifying approach and adding adjustments to match the specific goals and conditions of future studies.

RECOMMENDATIONS FOR PRACTICE

Recommendations for Architects

- The study found a strong relationship between the dimension of value proposition and the stages of a building's lifecycle. In this regard, the empirical research concluded that most of the case studies' business models focus on the concept and design phase. Hence, architectural firms aiming to expand the services and the type of products that they provide need to expand their operations a long a building's lifecycle.

- The take back systems component of the BM canvas is a niche that remains unexplored by architectural firms as seen in the empirical research. Hence, architects or entrepreneurs that aiming for strategic change toward sustainability through CE implementation can expand their business model to this area, as it represents the ultimate element that permits material loops to happen recirculating, recycling, remanufacturing and refurbishing products, parts, and components.

- The information collected from the case studies, shows that architectural firms in their approach to CE are mostly focusing on short-loops that have long term results. Hence, this study recommend that architects aiming for change should expand and strengthen their focus into longer loops that bring materials and components back into the loop, including remining and recovering strategies.

- The participants answers on the questionaries showed that, although they motivate their clients to manage and implement energy efficiency strategies on their projects; energy efficiency innovation inside the firm is not being managed. In this regard, the implementation of intelligent systems or the hiring of a trained individual in this field could accelerate the accomplishment of CE and sustainability goals by architects not only externally but also inside their organizations.

- The above-described initiatives can be combined with the Side Door game card, where the architect's office is used as their business card, attracting new opportunities. Furthermore, these changes can be maximized by implementing the Architectural Marketing game card, being outspoken about their internal initiates for CE. These two cards where often combined by the participants during the workshop, as a way to potentialize their value.

Recommendations for actors in the construction industry

- The interviews revealed that although collaboration barriers for CE implementation have decreased; there is a lack of consensus on how to apply CE initiatives into the built environment by not well-informed developers, contractors, and suppliers. Hence, there is a call for other actors to also innovate the way they create, deliver, and capture value sharing the responsibility with architects.

- The study showed that the principle of the CE are still too abstract for clients in the construction industry. As a result, this study recommends that any tool developed by developers, contractors, suppliers, and consultants to encourage CE should make the concept as tangible, quantifiable, and clear as possible for clients and people outside the construction industry.

Recommendations for clients

- According to empirical study, clients frequently place high expectations on architects to accomplish a high level of innovation and creativity with a limited budget. This dynamic not only reduces architects' opportunities for monetary value but also their enjoyment of their work. As a result, the study advises clients to have a detailed and well-informed brief for their architectural projects based on current sustainability criteria.

Recommendations for policy-makers

- The interviewees sustained that there is a lack of governmental systems that guarantee the legitimacy of architects' efforts to achieve suitability in the built environment through CE implementation. Hence, policy makers should focus on developing legislation and building codes that part away from fragile and transitionary regulations.

1 INTRODUCTION

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1.1 INTRODUCTION

Society, economies, and organizations are operating on borrowed time (Lacy & Rutqvist, 2015). Rapid urbanization, rising global population, and industrial expansion have placed enormous pressure on the environment. Among the various consequences, these planetary menaces have generated resource scarcity, inflation in prices, and ultimately accelerated a process of global ecological degradation.

"We are a tipping point in history. Never before have we face so many major changes in such a short period of time.... architectural practices should be driving the transition rather than adapting to it " (A+287, 2020)

The construction industry, one of the major players in the global economy, is responsible for 50% of the total use of raw materials, 39% of energy and process-related emissions, and up to a third of the total waste generated in the EU (Norouzi et al., 2021). Due to the threatening consumption and production processes associated with this industry, there is an urgent need for the construction sector and its contributors to transform the way they propose, create and capture value, embracing sustainability strategies like the CE in their BMs (Nuñez-Cacho et al., 2018). The CE has emerged as one of the most powerful, innovative, and viable business strategies that can radically address planetary threats and tackle sustainability challenges by improving resource productivity (Ellen MacArthur Foundation, 2013; Lewandowski, 2016).

Specifically, architectural firms are also experiencing substantial changes in the business climate where they operate. Together with other creative professional service firms (CPSFs) in the construction industry, they are actively contributing to the sustainability problem (Duffy & Rabeneck, 2013). In this respect, a vital shift is required in the purpose and every aspect of how architects conduct the operations favoring the CE and responding to major societal, technological, and industry-level changes (Bocken & Antikainen, 2019).

1.1.1 Problem Statement

The architectural discourse has widely adopted the ideas underpinning the CE as a straight forwards strategy to achieve sustainability in the built environment (Haas, Krausmann, Wiedenhofer, & Heinz, 2015), yet most firms are unable to translate the concept of CE into their BMs and operations (Urbinati et al., 2017; Accenture, 2014; Khan et al., 2020). In this regard, CE shift requires stakeholders in strategic positions to replace the firm's current approach to the built environment and transform their BMs generating value for society and the planet (Hughes & Hughes, 2013, Bos-de Vos, Lieftink, & Futura, 2018). In addition, the shift can be more challenging for architectural organizations born in linear tradition, as they have further established resources, procedures, and organizational competencies to re-engineer (Teece, 2018).

Innovation in CE and BMs requires new dynamic organizational capabilities that allow firms to reorganize their strategies, resources, and structures to those that are free from linear economy thinking (Lacy & Rutqvist, 2015). However, there is little discussion and paucity in academic research about how firms can develop such capabilities and associated CE micro-foundations (Khan et al, 2020; Brilinger A.-S., 2018; Bauwens et al, 2020). The majority of research on BM transformation has been developed from a practice-oriented perspective and/or has been primarily focused on large profit-driven organizations; rather than smaller creative firms that pursue a variety of objectives under the value umbrella beyond financial revenues (Lu & Sexton, 2006; (Bos-de Vos et al.,, 2017).

1.1.2 Research aims and objectives

The purpose of this research is to address the knowledge gap between CE implementation and BM transformation know-how for creative professional services firms, specifically architectural firms. The research explores the Dynamic Capability Approach of the firm as a theoretical base and collects qualitative data from practice that provides insights into its soundness as BM transformation strategy in favor of CE. To achieve this goal, four objectives have been established. They represent the main findings of the research and will be addressed in Chapter 5.

- Explore and understand BM theory concerning CPSFs in the context of CE.
- Through academic and empirical research, identify the barriers that architectural companies experience while integrating CE in their BMs.
- Understand how the Dynamic Capability Approach (DCA) of the firm enables BM transformation to overcome identified barriers.
- Through the collection of empirical data, define a dynamic capability toolbox for architectural firms to approach CE on their journey toward a sustainable built environment

1.1.3 Societal and Scientific Relevance

Scientifical Relevance: Firstly, although the CE has become a well-known driver for sustainability, its definition and implementation differs across industries. The research aims to contribute to literature by operationalizing CE among architects informing about progress and development of the concept and its state of art.

Secondly, this research advances the Dynamic Capability theory by collecting data from practice that contributes to its better understanding as mechanism for BM transformation. The findings provide insights into the intricacies among the microfoundations of dynamic capabilities and its development order. Thirdly, the outcome of this research may contribute to answering several research gaps in BM theory, such as BM and business strategy differentiation, the dimension of competitivity, and finally, insights into the impact of CE on the three value dimensions.

Societal Relevance: This research aims to develop valuable information for stakeholders in a strategic position within creative organizations, who want to become leaders in the industry and secure their relevance in the new economy.

This research addresses the challenges that architectural firms face when adopting CE in their practice, and which particular skills, processes and systems are necessary to tackle them. This research can be valuable for architectural companies, investors, and entrepreneurs aiming to futureproof their BMs by reacting to environmental market changes. Similarly, the research could be beneficial for companies that are still relying on scarce natural resources as part of their activities or that are struggling to adapt to market changes and exploit CE opportunities.

Finally, this research is part of the growing global effort to promote sustainability among cities, businesses, and society addressing the planet's deterioration.

1.1.4 Research Questions

The main research question addresses the study's three core concepts: (1) The circular economy paradigm, (2) Business model theory , and (3) The dynamic capability approach of the firm. The question seeks to identify the know-how or the organizational and managerial mechanisms that stimulate architectural firms' adoption of the CE in their BMs. Hence, it has been defined as follows:

MRQ: Which organizational processes enable architectural firms to transform their business models in favor of the Circular Economy?

Three research questions will provide the structure necessary to answer the main research question:

RQ1: How is the CE embedded in BMs for architectural firms?	Qa: What are Business Models in the CE? Qb: What is the contribution of CE to sustainability? Qc: What are the barriers for CE adoption in Business Models?

This question aims to generate an understanding of the BM Concept under the CE paradigm by digging into the conceptualization of circular BMs and the main barriers that organizations must anticipate and tackle when aligning their strategies to sustainability in the built environment. This question is answered by three sub-questions (Qa, Qb, Qc).

RQ2: How can BMs be transformed through the Dynamic Capability Approach?	Qd: What is the Dynamic Capability Approach? Qe: What is the development path of Dynamic Capabilities? Qf: What are the main dynamic capabilities needed for CE?

The second research question explores the role of the DCA as a theoretical base for business model transformation. Furthermore, it aims at comprehending the relationship between the different components of an organization including its resource base, competencies, and current capabilities.

RQ3: How are architectural firms currently addressing the circular economy ?	Qg: What is architects' response to changes in the market ? Qh: What processes have they developed to tackle sustainability challenges? Qi: What processes have they developed to embrace the CE?

Finally, the third question creates an overview of the current situation in practice by exploring the state of the art in terms of architects' response to changes in the market environment such as the CE.

1.1.5 Conceptual Model

The problem statement, the research boundaries and the presumed relationships amongst the main research topics have been translated into a conceptual model (Figure 1). The sustainability challenges generating societal and planetary pressure have been located in the top of the figure and directly influence the architectural firms' strategical response to the built environment. Consequently, in order to respond to planetary and societal demands for sustainability, organizations are pressured to change their BM, replacing current operations and an obsolete resource base with new organizational and managerial skills, processes, and systems. The research intends to clarify these relationships and identify these processes by exploring the Dynamic Capability Approach of the firm as the ultimate strategy for BM transformation.

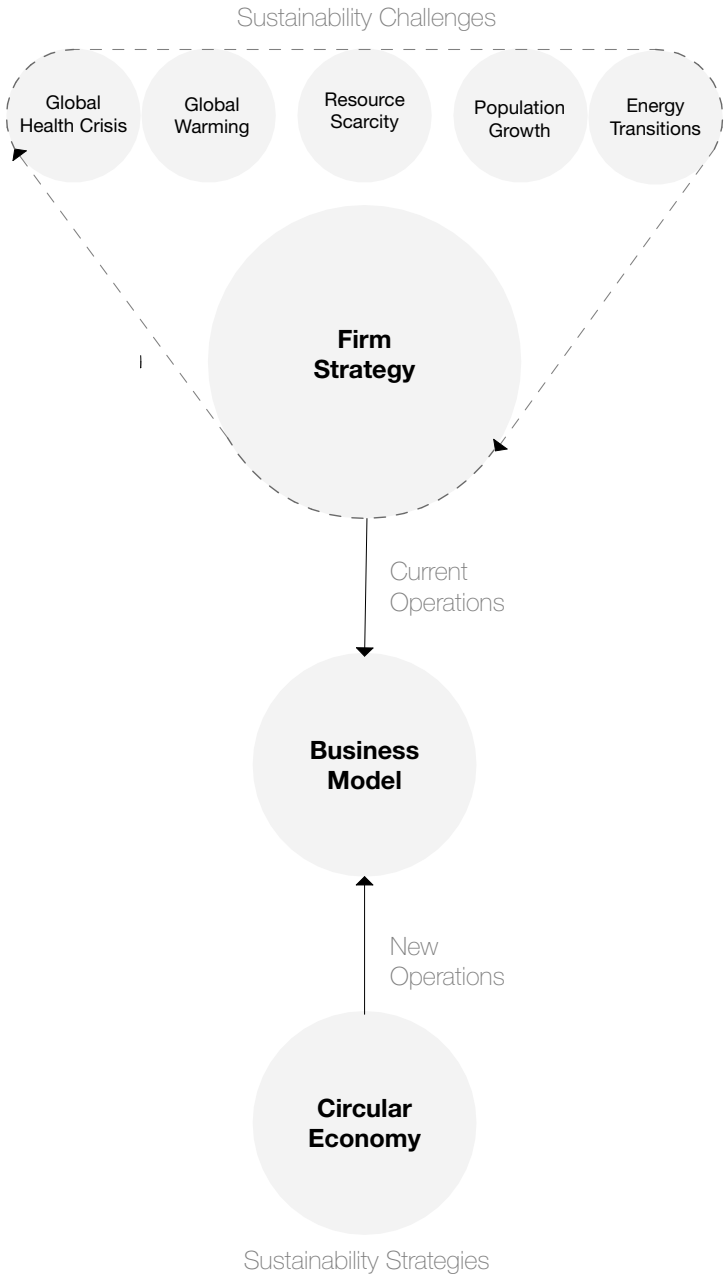

Figure 1: Research conceptual model, Source: Own elaboration

1.2 RESEARCH METHODOLOGY

This chapter discusses the methodology employed at various stages of the research. The next subsections will go deeper into the research approach, design, and output.

1.2.1 Research Approach

The proposed "applied research" intends to be change-oriented, creating not only knowledge for understanding, but also knowledge for action (Blaikie & Priest, 2019). Drawing on the framework from Teece (2007), the research explores the role of sense, seize, and reconfigure dynamic capabilities as the ultimate mechanisms for BM transformation.

Due to the exploratory nature of the study, the research approach is divided into three sections theoretical research, empirical research, and main findings. Firstly, the research creates a theoretical base under the collection of secondary data through literature review. Then, using a multiple-case study approach, qualitative primary data is collected from architectural firms, concerning the particular skills, processes, and organizational activities that facilitated CE implementation in their BMs. Finally, inductive logic will be used to generate the main findings of the study answering the sub and main research questions. These three parts will be further elaborated on in the next section.

1.2.2 Research Design

The Research Design provides a framework for the collection and analysis of data (Bryman, 2012). As Table 1 illustrates, the study has been structured in three sections.

Theoretical: This section addresses RQ1 and RQ2 by providing the language and theoretical knowledge necessary to define, differentiate and discuss the three key study concepts: circularity economy, business model theory, and the dynamic capability approach. The secondary data was collected from academic publications via academic search engines such as Scopus, Google Scholar, and the digital platform of the TU Delft Library. This section's output includes background information that justifies the existence of the problem to be investigated, as well as previous research on the subject of business models for CPSFs and CE. More importantly, it delves deeper into the Dynamic Capability Approach of the firm, which guides the data collection in the empirical part of the research.

Empirical: the empirical study, through a multiple case-study approach focuses on RQ3. The aim is to collect primary data from architectural firms that have embraced circularity as part of their organization. The output of this section will be a state of art of CE in the architectural realms and the identification of specific skills necessary for CE implementation. Furthermore, this section provides insights into the development path of these processes, CE challenges encountered by the case studies, and the overall impact of CE on their value proposition, creation, and capture. Semi-structured in-depth interviews with stakeholders in strategic positions of the firms are used. They include partners involved with business development tasks, but also architects that have actively participated in the CE initiative and projects were circularity played a big role. Chapter 03 provides greater insight into the empirical research methodology.

Findings: Inductive logic will be used to develop the main findings of the research and a following workshop will be implemented for validations of the results. The results from the theoretical and empirical research will be presented answering the main research questions. Finally, this research builds upon current knowledge on the topics of creative professional service firms, circular economy, and business model transformation mechanisms.

1.2.3 Research Output

The outcome of this study addresses the knowledge gap between CE implementation and BM transformation know-how for architectural firms. The outputs of this research include conclusions regarding the impact of the CE on the value dimensions of architectural firms' BMs, CE barriers identified through academic and empirical research, Dynamic Capabilities Approach understanding, and the documentation of microfoundations needed for CE implementation in the shape of gamecards. Table 1 presents the extended research design, where the research questions, research methods, data sources, and outputs can be found.

Part	01 Theoretical Research	02 Empirical Research	03 Findings
Method	Literature Study	Case Study Approach Questionnaire and in-depth interviews	Synthesis and Interpretation Workshop
Data Source	Academic Journals, Books Repotts	Partners Business Development Managers, Senior Architects.	Theoretical & Empirical Research
Research Questions	What Questions RQ1: **How is the CE embedded in BMs for architecture firms?** Qa: What are Business Models in the CE? Qb: What is the contribution of CE to sustainability? Qc: What are the barriers for CE adoption in Business Models RQ2: **How can architect's BMs be transformed through the Dynamic Capability Approach?** Qd: What is the Dynamic Capability Approach? Qe: What is the development path of Dynamic Capabilities? Qf: What are the main dynamic capabilities needed for CE?	How/Which Questions RQ3: **How are architectural firms currently addressing the circular economy ?** Qg: What is architects' response to changes in the market ? Qh: What processes have they developed to tackle sustainability challenges? Qi: What processes have they developed to embrace the CE?	Main Question MRQ: **Which organizational processes enable architectural firms to transform their business models in favor of the Circular Economy?**
Output	1.Taxonomy of CE in Business Models 2. Barriers of CE Implementation 3. Theory-based DCA framework	4. CE approaches from practice 5. Firm specific transformation processes 6. Dynamic capabilities paths	7. DCs game cards for CE

Table 1: Extended Research Design, Source: Own Elaboration

1.2.4 Disseminations & Audiences

This study is intended for two types of audiences: academics and practitioners. On the academic front, the core audience consists of construction and design management, circularity, and business development researchers. Similarly, students in the fields of architecture, management, and real estate make up another audience in this group. The goal is to bridge theory and practice by gaining a deeper knowledge of how circular economy principles can be embedded into business models for architectural firms and the necessary organizational and managerial mechanisms. In addition, the research provides key insights and references for future studies.

On a practical level, the audience consists of business development and design managers, architects, real estate investors, and entrepreneurs in the construction and design industries. The information produced may be used strategically by practitioners to back up their decision-making process on the transformation of their BMs. Furthermore, the study provides information on the development of dynamic capabilities needed to respond to ever changing markets, useful for organizations who are considering the expansion of sustainability in the firm strategy and the adoption of CE in their BM.

1.2.5 Personal Study Targets

The author's goal with this thesis is to increase understanding of how professionals in architecture and design industry can contribute in the transition to a more sustainable built environment. Architects have the responsibility to accelerate and actively contribute to the evolution from linear and polluting consumption and production models to better practices that create value for a broader number of stakeholders including nature and future generations. Often, these two stakeholders are silenced from the decision-making processes regarding the future of our cities and buildings, and more broadly in the lifestyle that humanity carries on this planet.

The topic is of considerable societal and scientific importance since architects play a pivotal role in shaping our built environment, from cities to buildings, to components that can influence our behavior as a society.

The topic is of considerable societal and scientific importance since architects play a pivotal role in shaping our built environment, from cities to buildings, to components that can influence our behavior as a society. As a result, managers and stakeholders in important positions have a social obligation to shift current linear business models and develop knowledge that can help the earth and society by constructing more sustainable and livable cities. Similarly, a personal goal is to learn how different firms have responded to the transition and what remains to be done by future generations of architects and designers seeking a better, livable, and sustainable built environment where satisfaction in their profession transcends generational boundaries.

2 THEORETICAL RESEARCH

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2.3 LITERATURE CONCLUSION 60

This chapter is structured in three parts.

The first section, Circular Business Models, is organized to provide an initial approach to the RQ1: *How is the CE embedded in BMs for architecture firms?* . It starts by providing an overview of the CE concept, its core principles, and its relation to the building's lifecycle. Then it delves into BM theory starting with the general understanding of the concept to later focus on BM theory applied to architectural firms in CPSFs context. Finally, the last parts of this section put together the two research topics: (1) CE paradigm and (2) BM theory, as a way of synthesis. In this regard the last sections explain how CE and BMs connect by presenting the Circular Business Model Canvas, CE barriers and innovations areas for this sector.

The second section, Dynamic Capability Approach Theory, advances RQ2: *How can architect's BMs be transformed through the Dynamic Capability Approach?* . Hence, it starts with the fundamental concept of organizational capabilities, then moving forwards to the DCA itself , followed by a hierarchical distinction of organizational capabilities, to finally concentrate on the ultimate organizational capabilities defined as the sense, seize, and reconfigure dynamic capabilities. Finally, the third section is dedicated to a general conclusion and the introduction of the adjusted conceptual model of the research that reflects the findings of the theoretical framework.

2.1 CIRCULAR BUSINESS MODELS

2.1.1 The Circular Economy

The CE has emerged as one of the most powerful and innovative paths in the urgent race toward sustainability in the built environment (Lewandowski, 2016). It has gained momentum among policymakers, academia, and businesses as a means of addressing socioeconomic and environmental challenges simultaneously (Bocken & Antikainen, 2019).

Specifically, the building industry accounts for the use of up to 40% of worldwide material production and around 35% of global waste (Guldager & Sommer, 2019). In this regard, the CE has been framed as a business opportunity able to address threatening consumption and production processes associated with this industry (Ellen MacArthur Foundation, 2012). In this regard, the CE supports organizations to part away from linear consumption and production practices delivering environmental quality, economic prosperity, and social equity for current and future generations (Kirchherr et al., 2017).

"Building a circular future means redesigning industry logic from building scale to business scale"
Kasper Guldager Jensen

At its core, the CE represents a new economic system aiming to make the concept of waste obsolete by closing and narrowing open production systems built on linear consumption models (Mentink, 2014; Gerding, Wamelink, & Leclercq, 2021). Linear models refer to the take-make-waste dynamic, where raw materials are taken, processed into completed products, and then discarded after consumption building waste (Urbinati & Chiaroni, 2017). This linear model means that the value of the material and the subsequent product loses the value generated during extraction and production processes (Figure 2). Hence, the CE seeks to optimize and manage the use of finite stocks of resources enabling the reduction of waste while generating the highest utility and value at all times (Ellen Macarthur Foundation, 2015). It's important to mention that the concept of waste goes beyond physical waste, but also includes wasted resources, waste processes, wasted embedded values, and wasted capacity (Lacy & Rutqvist, 2015).

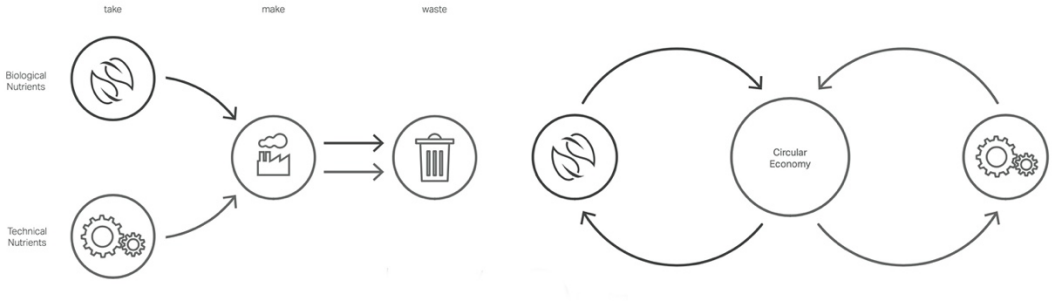

Figure 2: Diagrams illustrating the flow of biological and technical resources in the linear vs. the circular economy, Source: Guldager & Sommer (2019) reinterpreted from the Ellen MacArthur Foundation

As illustrated in Figure 2, the CE and the zero-waste industrial economy that it describes, profit from two types of resource inputs. On the one hand, biological resources are those that can be reintroduced back into the biosphere in a restorative manner without harm or waste. On the other hand, technical materials can be continuously re-used without harm or waste. The butterfly graphic (Figure 3), elaborated by the Ellen Macarthur Foundation (2015) serves to illustrate the theory behind CE and the flow cycles of biological and technical in more detail.

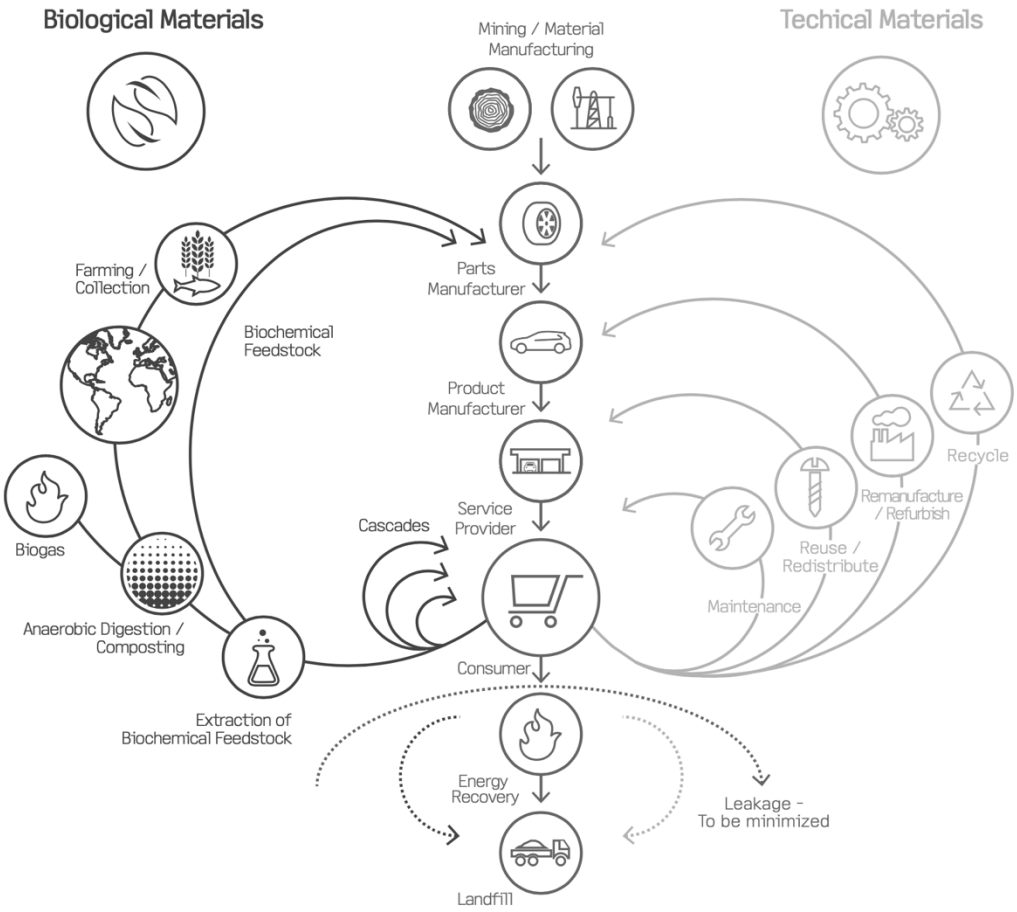

Figure 3: CE is a system that is restorative and regenerative by design, aiming to close and narrow resource loops, keeping all kinds of material inputs, products, and components in a constant loop of production and usage, Source: Ellen Macarthur Foundation (2015)

On one side of the biocycle, natural processes regenerate resources whether or not humans are involved, encouraging flows of biological resources to be managed so as not to exceed the carrying capacity of natural systems. On the other side, on the technical cycle resources are recovered and repaired by implementing circular economy technologies and business models. As explained before, the aim of CE is to optimize and maximize the value derived from finite stocks of technical resources, addressing systematic waste in industrial sectors (Ellen Macarthur Foundation, 2015). The distinction between biological and technical cycles is critical to understand where the notion of BMs and CE intersect.

Main Principles of the Circular Economy:

The CE presents a new way of creating opportunities for value creation based on three key principles. According to Lewandowski (2016), these three principles present the fundamental constructs and constituent elements to generate circular business models.

- Preservation and enhancement of natural capital: Finite stocks and renewable resources should be carefully managed and obtained from renewable sources.

- Optimize resource yields: by always keeping materials, parts, and components in a constant loop of production and consumption, keeping them at the highest utility at all times in both technical and biological cycles. This requires design principles that enable recycling, refurbishing, and remanufacturing.

  Figure 3 shows some of the design principles (Rs) necessary for the optimization of finite resources. In the figure, Recycling, the largest loop, is when a product is broken down and converted into raw material ready to be reused. Remanufacturing, the second-largest loop, is when a product is disassembled and is reconstructed using a mix of new and reused parts and components. Reuse and redistribute materials and products. Maintain and prolong, the second-smallest loop, which happens when the product is restored to working condition by repairing, replacing components, or cosmetic updates. Finally, the smallest loop is about creating sharing mechanisms.

- Foster system effectiveness: reducing damage to outside systems by designing out negative externalities such as toxic substances, climate change, land use, or pollution to water and air.

Circular Economy and Building Lifecycles:

Vermeulen et al (2019) on their research on CE, unravel the previously described 5R's into a total of 10R's, which are distributed in three types of loops (short, medium, and long). The R's can also be distinguished in the butterfly figure. They go from short to long depending on their proximity to the center of the figure. More importantly, the 10R's or circularity strategies allow organizations to achieve the tree principles of the CE.

In the case of design practitioners in the architecture and construction industry, the 10 Rs have become design principles applied along all stages of the building's lifecycle. (Design, Manufacturing of components, Construction, Use, and End of Life).

In addition, previous research finds that role of design practitioners in the CE is restricted to implementing the 10R's to develop services and embedded BMs, that merely focus on the "product concept and design" stage, rather than other stages in a building's lifecycle like manufacture and supply, construction, actions during product use, or the end its life. Similarly, Adams et al (2019) acknowledge that actors in the construction supply chain, employ CE principles in isolation, frequently within a specific project or expertise, not considering their roles across the entire building's lifecylelifecycle.

The 10 Rs include short loops: refuse, reduce, reuse, repairs ; medium loops: refurbish, remanufacture, repurpose ; and long loops: recycle materials, recover energy and remine.

2.1.2 Business Model Concept: General Overview

"A business model describes the rationale of how an organization creates, delivers and captures value" Osterwalder & Pigneur, 2010

Through the years, BMs have evolved from being portrayed as a static notion to a conception that emphasizes on their dynamic nature (Zott et all., 2011). In essence, a BM describes the rationale or architecture that firms employ to create, deliver, and capture value in a network of actors (Osterwalder & Pigneur, 2010; Teece, 2010; Teece, 2018). The overall objective of a firm's BM is to exploit its business opportunities (such as the circular economy) in a way that creates value for all the parties involved, fulfilling customers' needs while also generating value for the firm, its partners, and society (Amit & Zott, 2001; Bos-de Vos et al, 2017).

The framework developed by Osterwalder and Pigneur (2010), the business model canvas (BMC), can be described as a blueprint for the implementation of a firm's strategy. It conceptualizes the notion of BMs in a very practical way, by distinguishing between nine components or blocks that explain how a company operates and generates value (Figure 4). The nine blocks cover the main dimensions of BMs: Offer or Value Proposition, Customers and Infrastructure or Value Creation and Delivery, and Financial Viability or Value Capture (Bos-de Vos et al., 2018). According to Teece (2010), a good business model delivers attractive value propositions to customers, is clearly structured to deliver that value, and has a profitable revenue model that allows the firm to capture a portion of the value created.

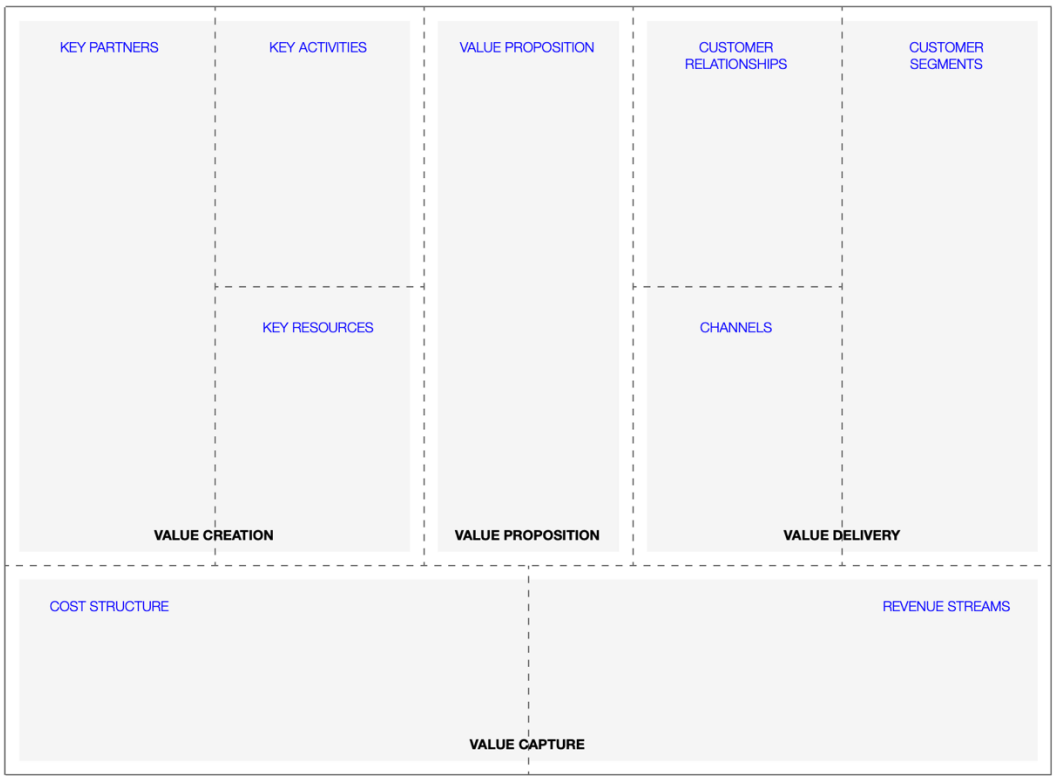

Figure 4: Business Model Canvas, Source: Own Elaboration based on Osterwalder and Pigneur, 2010.

As described above, value is at the core of the business model concept. The three value dimensions that explain a firm's business model construct be described as follows:

- **Value Proposition:** represents the solutions or bundle of products and services that firms offer to their customers or end-users to fulfill their needs (Osterwalder & Pigneur, 2010). In other words what value is created and for whom.

- **Value Creation and Delivery** refers to the infrastructure, meaning how and by what means firms and other parties involved collectively create value for themselves, the end-user, society in general, and other stakeholders (Bos-de Vos, Lieftink, & Futura, 2018).

- **Value Capture:** explains how the firm successfully claims revenue and other forms of value from their propositions (Osterwalder & Pigneur, 2010; Bos-de Vos et al.,, 2018).

In order to satisfy all three dimensions, companies need to identify customer needs, specify the technology and organization that will address them, and lastly, capture value from the activities that they perform to satisfy said market needs (Teece, 2018). Moreover, Ritter (2014) explains that the right balance between proposition, creation and capture of value is vital if companies want their BMs to succeed and stay competitive in the long term. However, BMs are rarely successful right away and require continuous refinement (Teece, 2010). As a result, most scholars have begun to acknowledge the dynamic nature of the BM concept beyond past static definitions (Amit & Zott, 2014).

Advocates for the far-reaching definition argue that the "rationale" behind value proposition, creation, and capture, goes beyond having the correct bundle of components and resources needed to design and operate a BM, but rather BM also encompasses the intangible mechanisms and the overarching dynamics that make it work and compete in the market (Afuah & Tucci, 2001; Shafer et al, 2005). The emphasis on the dynamic competences or capabilities as organizational mechanisms for BM change and renewal, calls for stakeholders in strategic positions to adopt different approaches to continuously innovate their organizations' response to market changes (Teece, 2010). As Amit & Zott (2014) explain, every entrepreneur, CEO, or senior executive in a firm will eventually need to design or adopt new BMs that deliver different products and service mixes, craft a new market strategy, and so on.

The Role of Strategy:

As previously stated, definitions of BMs include the term strategy in their explanation, or link BMs to the firm's strategic analysis (Teece, 2010). According to Osterwalder and Pigneur (2010), a BM is a framework or blueprint that a firm uses to implement a strategy to remain competitive in the market. However, business model and business strategy refer to two distinct concepts (Chesbrough & Rosenbloom, 2002). This section aims to dissipate the common misconception between them as equivalent terms, as researchers and practitioners use them interchangeably (Magretta, 2002).

In essence, the role of a business strategy is to map out how the company will compete in the long term (Teece, 2018).

It includes actions like, setting the boundaries of the BM, where the business is going over a given time period, how it intends to use its resources to compete in the market and its plan for constant environmental scanning as well as to ensure stakeholder's satisfaction (Haynes, Nunnington, & Eccles, 2017). Furthermore, strategy can also lead to abandoning an old BM for a new one. Johnson et al. (2008), state that even if every organization is built on a BM (the logic to which it operates), is not itself, but rather the business strategy that deals with the dimension of competition (Pekuri, 2015). Finally, strategy exists at several junctures. Bellow a brief explanation of the different types of strategy at the firm level, according to Haynes et al (2017).

- **Corporate Strategy:** concerned with the overall purpose, direction, and scope of the business. This is the most significant level as it is heavily influenced by stakeholders and guides strategic decision-making throughout the whole spectrum of business operations.

- **Business Unit Strategy:** is about how a business competes successfully in a particular market. It concerns strategic decisions about the choice of products, meeting the needs of customers, gaining an advantage over competitors, exploiting, or creating new opportunities, etc.

- **Operational Strategy:** is concerned with how each part of the business is organized to deliver the corporate and business-unit level an understanding of corporate strategy.

Therefore, the distinction between both is that BM addresses the fundamental structure or the logic to which a firm operates, while business strategy refers directly to how an organization would interact with its competitors and maintain its competitiveness in the market (the bigger picture). However, academics call for further empirical research that confirms the above statement, as business models may also be a source of competitive advantage (Casadesus-Masanell and Ricart, 2011). According to the authors, once in place, a BM shapes strategy in as much as it constrains some actions and facilitates others.

2.1.3 Business Models for Creative Professional Service Firms (CPSFs)

There has been limited research on the various BMs employed in architectural service delivery, and how they support or hinder a firm's ability to produce and provide multiple types of value in an ever-changing market (Bos-de Vos et al, 2016). This section aims to provide a better understanding of the subject of study and explain their business typology, activities, and the values that drive their business operations.

Architectural firms as Creative Professional Service Firms:

Architectural firms are part of the knowledge-intensive and creative industry, where little research from a BM perspective has been performed (Bos-de Vos et al, 2016). Within these industries, architectural firms are categorized as Creative Professional Service Firms (CPSFs) a subset of Professional Service Firms (PSFs).

On the one hand, PSFs are companies whose primary delivery to customers are specialized services in the hands of professionals, who have been recognized by society as leaders in the field due to their education, experience, and performance (Brejaart, 2018). PSFs are characterized by two main aspects that separate them from other firms. According to Maister (1993), PSFs have a high degree of customization in their work, and they present a strong face-to-face interaction factor with the client. Both characteristics mean that they must anticipate and respond to client requirements, which strongly influence the firm's decision-making process (Blindenbach-Driessen & Van den Ende, 2006). On the other, Creative PSFs, like architectural firms, go beyond the offer of specialized services, but also deliver a product to their customers (Bos-de Vos et al., 2016). In their research, Bos-de Vos et al. (2017) identified four types of value propositions specific to architectural firms:

- **Project Assistance:** consists of a broad range of process-related services that are delivered to facilitate the start or further development of an urban area or real estate development. Examples: location scouting, connecting potential partners, gaining project funding, project management services, etc.

- **Product Design:** refers to a variety of product-oriented services that are delivered to come up with a design of a product, such as an urban plan, building, or interior.

- **Product Development:** goes further than product design and also includes process-oriented services that are needed to realize the designed product. Example: real estate development services, design, and realizations of existing buildings transformation.

- **Business Case Development:** consisting of the services that are necessary to design and realize a marketable product, which has its revenue stream, Examples: business plan set-up for investments or refurbishments, energy scans for renovations investments from inhabitants.

According to Bos-de Vos et al. (2017), CPSFs go beyond profit as the main driver and rather chase a variety of goals with a distinctive nature under the value umbrella. Particularly, the goals of CPSFs include the traditional financial or monetary ambitions (Monetary Value), by delivering high-quality services and products that satisfy customer needs (Use Value), where costumers/users are willing to pay a price for its exchange (Exchange Value). However, researchers have found that CPSFs ambitions surpass these three types of value by also aiming for greater Societal Value as one of their priorities, and Professional Value goals involving status and reputation, knowledge development, and work pleasure (Bos-de Vos et al., 2016; Brejaart, 2018).

Based on the furthered developed concept of what value represents for CPSF, the value capture dimension described in the first section of this chapter can be extended to representing the capture of monetary value (i.e., firm revenues and profits), exchange value, user value, societal value, and professional value. The last one includes all the non-monetary elements that are important for the firm’s existence and survival such as reputation, development, work pleasure (Bos-de Vos et al., 2016).

CPSFs as Project-Based Professional Organizations

As a result of the complex and customized nature of their operations, CPSFs organize their tasks on a project-basis (Brejaart, 2018). As a result, the term Project-Based Professional Service Firms englobes a deeper layer of understanding of CPSFs and how they organize their strategies and BMs.

According to Bos-de Vos (2017), research on project-based professional service organizations is very limited. Most research focuses on large companies that are primarily profit-oriented rather than smaller creative service organizations. These smaller organizations need new or improved strategies to survive in increasingly dynamic and competitive environments (Bos-de Vos M. et al, 2017).

The organization of their tasks on a project-basis means that these organizations develop slightly different BMs for each type of project. As a result, project-based firms develop a business model portfolio consisting of two levels, the firm level, and the individual project level (Kujala et al., 2010). The BM's portfolio implies that architectural firms rely on a constellation of interactions with different stakeholders to create and deliver their services and products. Authors explain that project-level BMs are often derived from the firm-level BM (Mutka & Aaltonen, 2013). However, they also state that CPSF can create autonomous BMs that may also influence firm-level BMs.

To conclude, this research aims to explore the relationship between CE and dynamic capabilities and the BM portfolio of Architectural Firms. The empirical research will shed some light on the internal relationships between both levels and CE. Finally, Figure 5 illustrates the theory behind architectural firms as CPSFs emphasizing the type of values that they aim to create, deliver, and capture.

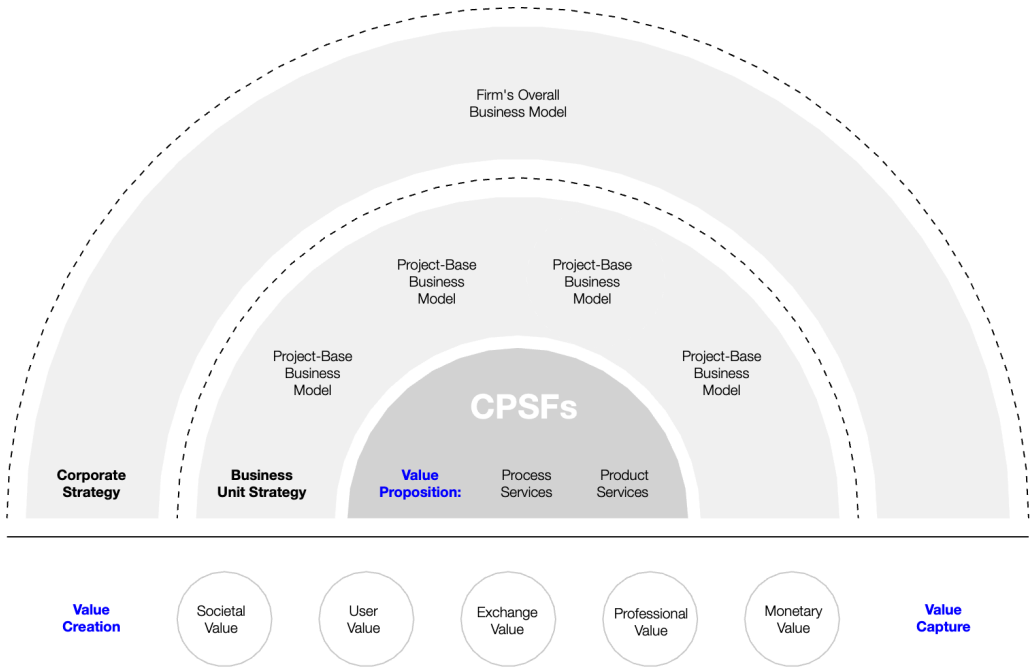

Figure 5: Business Model Portfolio for CPSFs, Source: Own elaboration based on the theoretical framework developed by Bos-de Vos et al., 2017

2.1.4 Business Models a Circularity Approach

This section synthesizes the link between CE and BM theory for architectural firms as part of CPSFs. Despite the increased interest in CE and BM, no commonly established definition of the concept of circular BMs exists (Nußholz, 2017). Table 2 shows different concepts of circular BMs developed in the last years.

Roos. (2014, p. 257)	A circular value chain business model (or green business model) is one in which all intermediary outputs that have no further use in the value creating activities of the firms are monetized in the form of either cost reduction or revenue streams"
Linder and Williander (2015, p.2-3)	"(...) a business model in which the conceptual logic for value creation is based on utilizing the economic value retained in products after use in the production of new offerings. Thus, a circular business model implies a return flow to the produce from users, through there can be intermediaries between the two parties (...and) always involving recycling remanufacturing, reuse or of their sibling activities (e.g., refurbishment, renovation, repair)."
Den Hollander and Bakker (2016, p. 60)	"A circular business model describes how an organization creates, delivers and captures value in a circular economy system, whereby the business rationale needs to be designed in such a way that it prevents, postpones or reverses obsolesce minimizes leakage and favors the use of "presources" over the use of resources in the process of creating, delivering, and capturing value."

Table 2: Circular Business Model Concept, Source: Own Elaboration

"The circular economy represents a huge opportunity for companies to disrupt the way we produce and consume through innovative business models (...) and the enabling capacities that support these systems"
(Lacy & Rutqvist, 2015)

As stated in previous sections, the CE creates new business opportunities by offering an alternative to linear production and consumption models. Hence, circular BMs can be said to be BMs, which are based on the main principles of the CE (Lewandowski, 2016). In this regard, they combine the nine building blocks of the BM canvas in innovative ways to create, capture, and deliver value with the value creation logic designed to reduce environmental impacts, improve resource efficiency, and deliver superior customer value by closing, narrowing, and slowing material loops (Nußholz, 2017; Bocken et al., 2018; Bocken & Antikainen, 2019; Gerding, Wamelink, & Leclercq, 2021).

The concept described above is aligned with the creation and maintenance of the value of products and parts for as long as possible. This can be achieved by adopting resource efficiency strategies (Nußholz, 2017). These strategies in the case of architectural firms refer to the implementation of the 10Rs in the way they propose, create, and deliver value. According to Bocken & Antikainen (2019), these strategies enable the design of products that last, supporting product life extension (slowing); strategies to close material loops through recycling (closing), and strategies to use less material and energy per product (narrowing loops).

Circular Business Model Canvas

In order to fully incorporate the CE principles into BMs, Lewandowski (2016) extended the original BMC developed by Osterwalder and Pigneur (2010), and later by Bocken (2015), to develop the Circular Business Model Canvas (CBMC) (Figure 6).

Bocken contribution to the canvas was an evolutionary step toward Laskowski's framework. She added the "shared value" concept to the canvas as sustainable BMs in contrast to conventional economically and customer-centric BMs, consider a wider group of stakeholders than just customers and shareholders. In this regard, the value proposition explicitly considers society and the environment as stakeholders by creating economic value in such a way that it also has societal and environmental benefits (Porter & Kramer, 2011; Bocken., 2015).

The business model canvas developed by Osterwalder and Pigneur (2010) and the one developed by Bocken (2015) were used as the base to design the CBMC (Lewandowski, 2016). The circular business model canvas (CMBC) developed by Lewandowski (2016) explains how the CE principles are embedded into each component of BMs

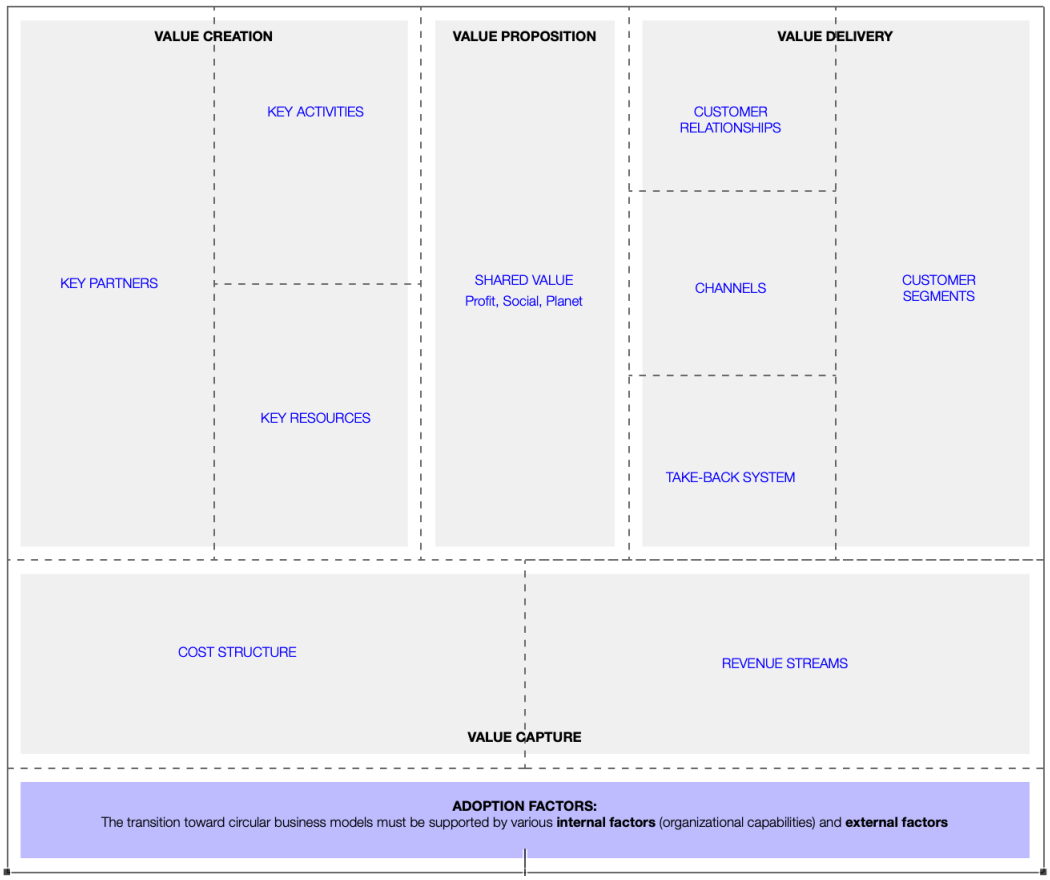

Figure 6: Circular Business Model Canvas Source: Own Elaboration based on Lewandowski (2016)

The CBMC has some advantages as compared to the original canvas. Firstly, The CBMC points out the ways of applying circularity to each component of the business model canvas. Firstly, in order to alter a BM to fit with CE, It provides entrepreneurs and managers with the chance to transform one, several, or all of the BM components. This can be done at different speeds of change from radical to incremental.

Secondly, and the most important for this research, is the identification of two additional components that allow the design of circular practices, namely the take-back system and the adoption factors (Figure 6). Thirdly, the CMBC indicates the three main challenges in the transition from a linear to a circular BM, which the original canvas did not include. Fourthly, it combines the original components of the canvas with CE principles in one framework, which as a practical tool is easier and more user-friendly than other methodologies. However, there are also a few disadvantages. Due to its focus on CE principles, it is less useful in designing linear BMs. The new framework is also more complex, and thus more difficult to apply than the original one. Moreover, the authors explain that it's real usability in designing processes has yet to be empirically verified.

Adoption Factors & Take-Back System

The most important contribution from the CBMC for this study is the identification of two additional components, take-back systems, and adoption factors, that allow the design of circular BMs and provide a general overview of how CBMs can be conceptualized.

- **Take back system:** this component added under the value delivery section, is what enables the core idea of "material loops" to happen. It allows products to be circulated and reused, remanufactured, refurbished, or recycled in the case of finite resources and technical components; and cascaded in case of biological nutrients (Lewandowski, 2016). It refers to the mechanisms to collect back products, parts, and resources from the consumer, including take-back management, incentivizing return and reuse, and collection of used products. This component specially encompasses reversed logistics that may require different partners, channels, and customer relations; furthermore, it makes a distinction between forwards and reverse logistics (Lewandowski, 2016).

- **Adoption factors:** This component was added to the canvas due to the multiple challenges that affect the extent to which a BM may be adapted to the CE. This component enables companies to anticipate and counteract CE challenges and is divided into internal and external factors (Lewandowski, 2016).

  On one side, Internal factor represent the organizational capabilities that are required to transition to a CBM (Ingelsson & Mellgren, 2020), which are often dependent on intangible resources. These components are based on developing human resources and team building, and the application of change management instruments using business models' design methods, tools, and evaluation models

  On the other side, external factors concern political, sociocultural, technological, and economic issues that may affect circularity adoption in a business model. For example, the possibilities to use adequate IT and data management technologies to support material tracking, monitoring legislation and political incentives to accelerate CE, customer habits and public opinion, and economic forces like predictable demand for future products or previous difficulties of business entities in the adoption of CE principles

2.1.5 Circular Business Models Barriers

In order to unlock the potential of the CE and implement circular strategies, organizations must rethink their BM, meaning what value is proposed, how value is created and delivered, and how value is captured (Nußholz, 2017). Linder and Williander (2017), sustain that despite the business potential of CBMs, widespread adoption is yet to happen.

This can be attributed to the fact that transformation toward CE sets challenges for established companies that might hamper the usefulness of their existing capabilities, networks, and current BMs (Antikainen & Valkokari, 2016; Bocken & Antikainen, 2019). In this regard, the transition can be highly problematic for mature organizations than new firms, as it requires impactful changes in their core business processes (Eikelenboom & de Jong, 2021), such as the value proposition, linkages, and sequencing of supply chain activities, governance model interaction with external supplier, etc. (Urbinati & Chiaroni, 2017; Nußholz, 2017).

Research has investigated and consequently tried to categorize the various barriers and challenges that organizations face regarding CE implementation. According to Kirchherr et al. (2018), who developed a large study on CE barriers across businesses in the EU; cultural barriers, particularly a lack of consumer interest and awareness as well as a hesitant company culture, are considered the main barriers faced by businesses and policymakers (Kirchherr et al., 2018). Consequently, these barriers are driven by market barriers which, in turn, are induced by regulatory barriers meaning a lack of synergistic governmental interventions to accelerate the transition towards a CE (Rios et al., 2016; Kirchherr et al., 2018; Ormazabal et al., 2018).

Parallelly, technological barriers are present in the ranking, however, not as highlighted as cultural or regulatory challenges. Barriers may for instance hamper the development of circular products and services by organizations, prevent circular products from competing with their linear equivalents and complicate the adoption of recycled materials (Kirchherr et al., 2018). As a result, immediate efforts need to be undertaken for the concept to maintain its momentum among firms and industries. Similarly, other categories for circularity barriers have appeared in literature such as policy-related barriers consumer-related barriers, design-related barriers, and social practices.

However, for this research, barriers will be classified into internal and external barriers, as it is one of the most widespread and useful approaches in the existing studies to understand CE Implementation in BM (Hinaa, Chauhanb, Kaur, Krause, & Dhird, 2022). This distinction serves to further stress the relevance of the Circular Business Model Canvas developed by Lewandowski (2016), specifically in the “adoption factors” component. This component also distinguishes between internal and external factors enabling or diminishing CE adoption into BMs. The tables below, illustrate the barriers found in the literature.

Specifically, the tables present barriers found in the literature regarding the construction and design industry, which have been found relevant for this research. Finally, The different barriers may lead businesses to implement circularity in the form of add-on short-term practices, instead of completely and permanently integrating circularity in their practices (Kirchherr et al., 2018; Pheifer, 2017).

Internal Barriers: Refer to the limitations that emerge within an organization attempting to implement a business model (Vermunt et al., 2019).

Companies' culture, policies, and strategies	- Hesitant company culture: no sense of urgency, company culture and people opposed of changing current way of working - Not integrated in the strategy, mission, vision, goals & key performance indicators - Not fully understanding the holistic approach of the circular economy - Current operating linear system: Processes and quality management systems are organized in a linear way - Strong hierarchical organization prevents awareness & recognition CE-opportunities at C-level - No reverse supply-chain in place
Financial Barriers	-Higher Financial risks -Focus on short term Return on Investment (ROI) and costs reduction -Investment in technological and employee training for new operations and the production and sale of circular products
Technological Barriers	-Absence of organizations technological capacity and knowledge -Inadequate information management systems (IMS)
Lack of other resources	-Time as resource for caring circularity ambitions -Lack of information and knowledge -Lack of organizational, financial, etc.
Collaborations	-Limited willingness to collaborate in the value chain -Lack of interorganizational collaboration among firms
Product Design	-Incorrect design of products, not designed for longevity, easy maintenance, disassembly, and reuse -Lacking standardization - Low virgin material prices -Low quality perception of circular products -Lacking ability to deliver high quality remanufactured products
Internal stakeholders	-Lack of communication among departments -Unclear departmental responsibilities towards an organization circular practice -lack of trained personal -absence of influence and participation among stakeholders

Table 3: Internal Circular Business Model Barriers Source: Own Elaboration based on (Hinaa, Chauhanb, Kaur, Krause, & Dhird, 2022; Kirchherr et all, 2018; Pheifer, 2017 Ormazabal & al, 2018; Ingelsson & Mellgren, 2020; Adams, Osmani, Thorpe, & Thornback, 2019.

External Barriers: Refer to hindrances in the implementation of CEBM that arise outside the firm (Vermunt et al., 2019).

Consumer related barriers	-Lacking consumer awareness and interest -Consumers price priority when choosing a product, consumers may regard CE practices as costly -Consumers' reactions are difficult to anticipate because they depend upon external conditions and social norms.
Legislative and Economic Barriers	-Limited circular procurement -Obstructing laws and regulations - Lacking global consensus - Lack of financial incentives for circularity, while there is for linearity - Low virgin material prices -High upfront investment costs -Limited funding for circular business models
Supply Chain related Barriers	-Absence of supply chain alliances -Lack of trust and transparency in the supply chain -Lacking standardization and reverse logistics
Social, Cultural and Environmental barriers	-Absence of people involvement in environmental issues

Table 4: External Circular Business Model Barriers Source: Own Elaboration based on (Hinaa, Chauhanb, Kaur, Krause, & Dhird, 2022; Kirchherr et all, 2018; Pheifer, 2017 Ormazabal & al, 2018; Ingelsson & Mellgren, 2020; Adams, Osmani, Thorpe, & Thornback, 2019.

2.1.6 Innovations for circular economy

Although transitioning to the CE can benefit many organizations, it is still a difficult process. Lowik (2020), developed a model that describes different areas where organizations can innovate to embed CE in their operations. In this regard, he defines circular innovation, as a continuous and systematic approach to design, develop, and commercialize sustainable products, services, and processes that contribute to the transition from a linear economy and society.

Moreover, innovation for CE must be developed and maintained over time and can be deployed repeatedly. The ultimate goal is to support the firm with a viable and sustainable business case where a product, service, or process is commercialized; and ultimately contributes to the transition to a sustainable built environment.

According to Lowik (2020), there are six areas where business can innovate to embed CE in their organizations:

- Technological Innovation: Organizations can revolutionize from the application of technological Innovation to allow design for circular flow and responsible material use.
- Business Model Innovation: Circularity calls for new and different business models, and hence changes to the "business as usual" of firms are fundamental.
- Organizational Innovation: Organizations can innovate from no strategy, system, and culture in place to continuous and systematic strategy, systems, and culture toward the circular economy.
- Value Network Innovation: Firms can transform from no insight into a value network and limited collaboration to full insight, full collaboration, and a leading position in the circular innovation network.
- Renewable energy process Innovation: In the CE, energy efficiency is key. Organizations can innovate by complying with minimal requirements to proactively increase energy efficiency as a key driver inside the firm but also outside the firm through its design process.
- Social Innovation: When firms strive for the earth's well-being, they also strive for the well-being of people and society. This means that organizations can go from minimal regulatory requirements to full societal responsibility and stewardship.

Based on the six area of Circular Innovation, Lowik (2020) explains that the change toward circularity requires a transformation and not a transition. A transition refers to a stage-chain process, where the subject goes from one state to another, but the essence remains unchanged. According to the author organizations aiming for sustainability and using the CE as a means, need a holistic approach that requires a deeper change, a transformation. Furthermore, innovation for CE is a gradual process, as changing all business components at once is not an ideal option. Table 5, depicts the areas of innovation with specific characteristics that organizations can use to evaluate their operations.

	L1: UNFORMED	L2: BASIC	L3: IMPROVING	L4: ENGAGED	L5: ADVANCED
Technological Innovation	Recycling and recovering Insight into harmfulness of materials and applicable norms and regulations	Recycling and recovering Minimal use of harmful materials and additives	Recycle & Repair, Remanufacturing, and Refurbishment. No use of harmful materials and limited insight in source of supply and accompanying environmental damage	Long lasting use and reuse Full insight in source of supply and accompanying environmental damage	Focus on full range from rethink to Recovering No use of any environmentally harmful materials on the whole supply chain.
Business Model Innovation	Based on ownership	Based on ownership: promoting careful use of products and sustainability	Based on ownership: besides durability, services such as repair and maintenance	Based on use: revenues come from lease and subscriptions	Based on results: revenues come from providing added value
Organizational Innovation	Ad hoc innovation processes	Focus on internal processes, efficiency improvement and incremental innovation	Systematic approach for internal and external innovation processes	Integrated system that is aligned with strategy	Integrated system that is flexible and adaptative to change
Value Chain Innovations	No strategic partnership for Circular Economy	A few strategic partners to orchestrate recycling and recovering	Some value chain processes are managed with strategic partners	All value chain processes are managed with strategic partners	All processes in the whole value chain are actively managed and monitored regarding, raw material use, transport, and re-use
Renewable Energy Proceses Innovation	Complies to minimal regulatory requirements of energy saving Insight into major energy flows	Complies to regulatory requirements and use of renewable energy Insight into own energy use and intention to save energy	More energy saving than regulatory requirements s Partly own renewable energy production Insight into emissions	CO2 emission awareness and reduction in the value chain Insight into emissions	Value chain partners actively involved in reducing co2 emissions in the whole value chain
Social Innovation	Actions are geared towards minimal regulatory requirements like human right and environmental protection	Improved knowledge and understanding of direct and indirect environmental and social impact	Corporate social responsibility is incorporated in the firm strategy, related to direct stakeholders (clients, suppliers, citizens)	CSR is related to direct and indirect stakeholders in the whole value chain	The UN Development goals are leading principles in strategy, operations, and value chain

Table 5: Circular Innovation Maturity Level, Source: Lowik (2020) extended framework from Potting et al (2017)

2.2 DYNAMIC CAPABILITY APPROACH THEORY

In the previous section the research presented the Circular Business Model Canvas developed by Lewandowski (2016). As explained before, its biggest contribution was the identification of two extra components that enable CE to be embedded in BMs, the "take-back system" and the "adoption factors". Specifically, the adoption factors component, divided in internal and external, aims to support organizations to anticipate and counteract CE barriers as the ones displayed in Table 3 and Table 4.

This section of the literature review delves deeper into the understanding of the internal adoption factors. They represent the organizational capabilities that companies require in order to transform their operations in favor of CE (Ingelsson & Mellgren, 2020). The section starts by defining the concept of "organizational capabilities" as the core notion behind the internal adoption factors depicted in the CBMC. Then the chapter will explore the Dynamic Capability Approach, where organizational capabilities are embedded, emphasizing the role of dynamic capabilities as the ultimate drivers for BMs transformation.

2.2.1 Organizational Capabilities

Capabilities can be defined as the managerial competences needed in a firm to appropriately adapt, integrate, and reconfigure internal and external organizational skills, resources, and functional competencies matching the requirements of a changing environment (Teece, Pisano, & Shuen, 1997). They are not defined as resources, as resources don't refer to processes but rather to the tangible and intangible assets owned and controlled by the firm that enable efficient and effective production of market offering (Amit & Schoemaker, 1993; Hunt S., 2000).

To further distinguished between resources and capabilities, which are sometimes used in literature as synonyms; resources are the assets that a firm has accumulated while capabilities are the glue that binds these assets together, and enables them to be advantageously deployed (Day, 1994; Penrose, 1959). Thus, capabilities are defined as intangible processes or routines that are firm-specific and developed over time through complex interactions among the firm's resources (Dosi et al., 2008). Due to the deep specificity of capabilities within the fabric of a firm, it's very difficult for competitors to identify and replicate these intangible processes in their firm (Jiang, 2014).

The use of the term "organizational" next to capabilities, emphasizes the type of processes used to maximize the performance and deployment of a firm's resources. According to Teece, Pisano, & Shuen (1997), organizational capabilities are the abilities of an enterprise to organize, manage, coordinate, or undertake specific sets of activities (Jiang, 2014). Finally, organizational capabilities are a driving force for gaining competitive advantage, adapt to change, and drive business performance. The right mix of organizational capabilities helps businesses to operate effectively and deliver excellent service while satisfying customer needs.

2.2.2 Dynamic Capability Approach of the Firm (DCA)

This research has detected a direct link between the DCA, and the Circular Business Model Canvas (CMBC) developed by Lewandowski (2016) (Figure 6) . Specifically, into the internal adoption factors. Both frameworks, the DCA and the CBMC explain a firm's path to counteract and anticipate CE barriers, through the development of particular organizational capabilities. They represent the game changers in terms of to what extent a firm can adapt its BM to CE.

"The capacity an organization has to create, adjust, hone, and, if necessary, replace business models is foundational to dynamic capabilities..." Teece, 2007

The DCA is concerned with the evolutionary path of organizational capabilities, which as stated in the previous section, refers to the capabilities, and organizational processes, needed inside an organization to effectively deploy its tangible and intangible resources to achieve its goals (Hunt & Madhavaram, 2008). At its core, the DCA is associated with organizational change, strategic renewal, and adaptation within firms and industries in changing environments (Jiang, 2014).

This approach to the firm is considered an extension of the Resource-Based View (Eisenhardt & Martin, 2000; Jiang, 2014), which is a theoretical framework that analyzes the competitive performance among firms based on the disparity in the endowment of unique and strategic resources among them (Amit & Schoemaker, 1993; Kraaijenbrink et al., 2010). However, the RBV has been largely criticized for having a vague definition and differentiation between its terminology, i.e., resources, processes, capabilities, and core capabilities. Second, it has been considered static and lacking consideration of market dynamics; and thirdly, it has been attacked for its focus on the endowment of resources itself, but the failure to define mechanisms that explain how resources are transformed to competitive advantage giving little practical use to the management practice (Eisenhardt & Martin, 2000; Zahra & George, 2002).

In this regard, the DCA goes beyond the RBV, as it regards the "how" question of BM transformation. It enables the identification of firm-specific processes that are critical to firm evolution (Wang & Ahmed, 2007). The approach recognizes that is not just the mere endowment of bundles of specific resources that achieves higher performance and sustains a competitive advantage in situations involving rapid and unpredictable market changes (Jiang, 2014); but rather the internal organizational mechanisms by which firms identify, adapt and reconfigure new opportunities, threats, resources, and markets, as well as the forces that limit the speed and direction of this process (Shuen, Teece, & Pisano, 1990).

2.2.3 Organizational Capabilities Hierarchy

In order to understand the evolutionary nature (the "how" question) of capabilities and their influence on the firm's response to BM transformation, this research has developed the framework present in Figure 7.

The graphic illustrates an organization's overall portfolio of capabilities based on the "hierarchical" order of organizational capabilities established by Wang & Ahmed (2007). It helps to distinguish and conceptualize different levels, locating dynamic capabilities at the top of the pyramid as the "ultimate" organizational capabilities conducting to long-term performance and business model transformation in rapidly changing environments.

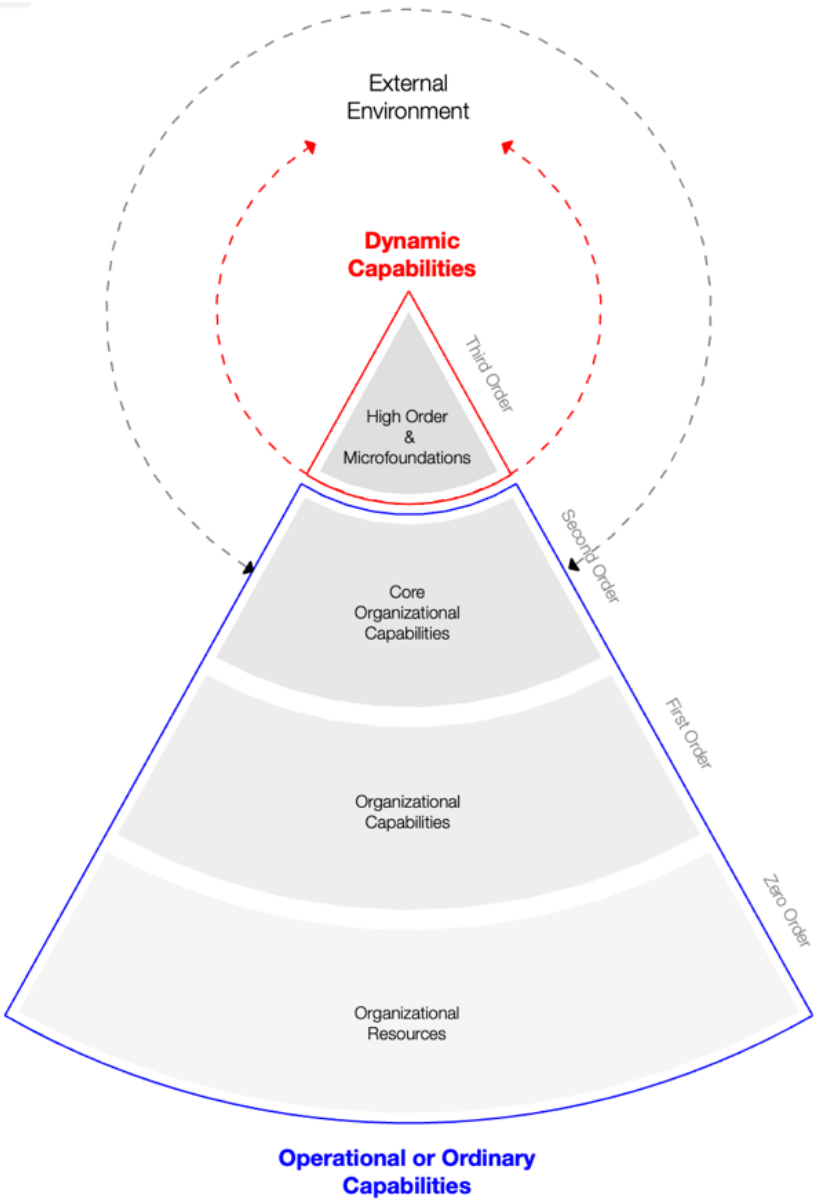

Figure 7: Hierarchical order of resources, capabilities, core capabilities, and dynamic capabilities Source: Own Elaboration based on Wang & Ahmed, 2007; Hunt & Madhavaram, 2008; Jiang, 2014

As illustrated, the capability portfolio operates on two levels. First, at the most fundamental level, there are operational or ordinary capabilities (zero, first & second-order). They represent the current operations, administration, and fundamental governance that enable an organization to follow a certain ambition or production program with their up-to-date resources base.

- **Zero Order Organizational resources:** are the foundation of a firm and the basis for firm capabilities. Once these resources acquire VRIN attributes (valuable, rare, inimitable, and non-substitutable) they become the source of competitive advantage (Wang 2007). However, VRIN resources become obsolete over time in dynamic market environments, and hence cannot be a source of sustainable competitive advantage.

- **First-order organizational capabilities**: lead to improved performance when resources are deployed to attain the desired goal (Jiang, 2014). These organizational capabilities refer to the most fundamental action or the ability of a firm to deploy resources to achieve its goals.

- **Second- order organizational capabilities:** , refer to Core Organizational Capabilities that are strategically important for the firm to obtain a competitive advantage at a certain point in time. These capabilities go further than just the mere deployment of VRIN resources, and they are also known as Strategic Capabilities. They are aligned with the strategic direction of the firm. However, Core Organizational Capabilities can become irrelevant and turn rigid when the environment changes. Hence, even if they are strategically important to firms' competitive advantage, this is only at a certain point of time (Wang & Ahmed, 2007). This is when dynamic capabilities (top of the pyramid) become extremely important.

- Dynamic capabilities or 'third-order' organizational capabilities: refers to the new operations critical for renewal, reconfiguration, and re-creation of resources, capabilities, and core capabilities that have become rigid (Jiang, 2014). The alteration can be in any form as long as they modify the firm's previous set of capabilities, such as obtaining new resources through acquisitions and partnerships, innovation and entrepreneurial activities, growth in an ongoing business, or a change of a new business model. In other words, dynamic capabilities focus on how well or to what extent a company adapts to a changing business environment by building, integrating, and reconfiguring its current competencies (operational capabilities). Finally, dynamic capabilities can be divided into "micro-foundations" and "higher-order capabilities". Section 2.2.4 and 2.2.5 will explain this distinction in greater detail.

To conclude this section, operational and dynamic capabilities have different purposes. The purpose of operational routines is to minimize the need for human governance by providing order and stability. Whereas dynamic capabilities represent the deliberate and conscious human action of transforming existing routines and even disrupting order and stability (Katkalo et al., 2010). Finally, the embodiment of dynamic capabilities in the BM of a firm might even be able to influence the surrounding business ecosystem to its advantage, creating market opportunities that often lead to a higher level of efficiency and effectiveness (Eisenhardt & Martin, 2000, Schoemaker, Heaton, & Teece, 2018).

2.2.4 Dynamic Capabilities

Dynamic capabilities represent the core the Dynamic Capability Approach. In the last two decades, research on dynamic capabilities has been one of the most prominent and active research streams in management studies (Khan, Daddi, & Iraldo, 2020). However, there are still multiple definitions of the subject which was born and developed from strategic management perspective (Albort-Moranta et al., 2018). Table 6 gathers the most widely recognized definitions of dynamic capabilities.

Teece et al. (1997, p. 516)¡	The firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments.
Eisenhardt and Martin (2000, p. 1006)	The firm's processes that use resources-specifically the processes to integrate, reconfigure, gain, and release resources-to match and even create market change; dynamic capabilities thus are the organizational and strategic routines by which firms achieve new resource configurations as markets emerge, collide, split, evolve and die.
Griffith and Harvey (2001, p. 597)	Dynamic Capabilities is a combination of resources that are difficult-to-imitate, including effective coordination of inter-organizational relationships, on a global basis that can provide a firm competitive advantage.
Zollo and Winter (2002, p. 340)	A dynamic capability is a learned and stable pattern of collective activity through which the organization systematically generates and modifies its operating routines in pursuit of improved effectiveness.
Adner and Helfat (2003, p. 1012)	The capabilities with which managers build, integrate, and reconfigure organizational resources and competences.
Winter (2003, p. 991)	Those (capabilities) that operate to extend, modify, or create ordinary capabilities.
Zahra et al. (2006, p. 918)	The abilities to reconfigure a firm's resources and routines in the manner envisioned and deemed appropriate by its principal decision-maker(s).
Helfat et al. (2009, p. 4)	The ability to perform a task in least minimally acceptable manner.
Teece (2007, p. 1319)	Dynamic capabilities can be disaggregated in the capacity (a) to sense and shape opportunities and threats, (b) to seize opportunities, and (c) to maintain competitiveness through enhancing, combining, protecting, and, when necessary, reconfiguring the business enterprise's intangible and tangible assets.
Pavlou and El Sawy (2011, p. 239)	Dynamic capabilities have been proposed as a means for addressing turbulent environments by helping managers extend, modify, and reconfigure existing operational capabilities into new ones that better match the environment.
Helfat and Martin (2015, p. 1)	The capabilities with which managers create, extend, and modify the ways in which firms make a living-helps to explain the relationship between the quality of managerial decisions, strategic change, and organizational performance.
Wang and Ahmed (2007, p. 35)	A firm's behavioral orientation to constantly integrate, reconfigure, renew, and recreate its resources and capabilities and, most importantly, upgrade and reconstruct its core capabilities in response to changing environment.

Table 6: Dynamic capabilities definitions, Source: Own Elaboration based on Albert-Morat et al., 2018

The work of Teece, Pisano, and Shuen (1997) and their definition, where dynamic capabilities (DCs) are defined as: the capacity that enables a firm to integrate, build and reconfigure internal and external competencies to address rapidly changing environments, has been recognized as the most influential study on the matter (Albort-Morant et al., 2018). Together with the framework of dynamic capabilities (Figure 11) developed by Teece in 2007 and later refined in 2014, both become the theoretical foundation for this research. According to Teece (2007), DCs are especially important for organizations operating in a business environment that present four main characteristics.

- They are exposed to the opportunities and threats associated with technological change.
- These organizations are influenced by changing customer needs and the systematic technical change needed to create interrelated products and services to address them.
- The existence of global markets is needed for the exchange of components, goods, and services

- They are vital for firms that operate in business environments characterized by the lack of a highly developed market for technological and managerial know-how exchange (Teece, 2007).

These four characteristics can especially be found in the high-technological and manufacturing sectors. However, they also apply to architectural organizations where firm performance does not depend on textbook recipes, but rather on the discovery and development of opportunities, the protection of intellectual property, the upgrading of best practices, the invention of new BMs, new ways to connect the dots, market perception, protection against imitation and other forms of replication by rivals, their reputation and other characteristics associated with professional value. DCs are disseminated into three high-order capabilities:

- Capacity to Sense and shape opportunities and threads,
- Capacity to Seize these opportunities
- Capacity to Reconfigure enhance, combine, protect, the organization's intangible and tangible assets maintaining competitiveness.

Organizations with strong DCs have the power to adapt to change and shape their business ecosystem through entrepreneurship and innovation based on the opportunities hidden in ever-changing customers' demands, new technological developments, and new sustainability requirements, among others. Similarly, organizations that develop robust DCs have the freedom to develop new BMs that involve radical reconfigurations in their resource base and activities (Teece, 2007). This advance gives them a competitive advantage over firms with weaker capabilities that will be more likely to adopt BMs that lean on past investments and already existing organizational processes along with the industry.

The nature of the three dynamic capabilities is sustained by microfoundations. They represent the particular organizational and managerial processes, procedures, systems, and structures that undergird each of them. Microfoundations are unique processes that emerge from each individual firm. As Bowman & Ambrosini (2003) explain, they are built rather than bought in the market and are embedded in the organization. However, the authors explain, although they are firm-specific and hard to replicate and tailored to the setting in which they function including different industries, technologies, functional areas, and organizations (Dosi, Faillo, & Marengo, 2008); they also present commonalities in key features that are associated and can be generalized with effective processes across firms (Eisenhardt & Martin, 2000). Researchers recognize that for dynamic capabilities to be a source of sustained competitive advantage, they need to be applied 'sooner, more astutely, and more fortuitously' than competition (Eisenhardt & Martin, 2000). This ability according to Wang & Ahmed (2007) is at the heart of dynamic capabilities.

To conclude, academics state that the development and application of DC's are critical for organizations aiming to successfully change of their BMs to cope with sustainability and circularity barriers (Bansal, 2005; Ritzén & Sandström, 2017; Strauss et al., 2017; Wu et al., 2013). Strauss et al. (2017) suggest that practice can benefit from future research that identifies the micro-foundations of dynamic capabilities necessary for CE implementation guiding organizations to transition and mature in their approach towards circularity.

2.2.5 Sense, Seize and Reconfigure

Dynamic Capabilities are divided into three High Order Dynamic Capabilities (Sense, Seize and Reconfigure) and their correspondent micro-foundations. Micro-foundations are the distinct skills, processes, and organizational activities that undergird the Sense, Seize and Reconfigure Capabilities (Teece, 2007). Together they enable organizations to orchestrate their assets adapting to changes in their environment (Ambrosini, Bowman, & Collier, 2009). This section explains the three main capabilities and the micro-foundations that sustain them.

Sense (and shape): Sensing and shaping new opportunities refer to the adaptive capacity of a firm to effectively search for new exploitation strategies (Wang & Ahmed, 2007). Especially in markets where consumer needs, technological opportunities, and activity among competitors are always changing. This can be done by constantly scanning, creating, searching, learning, and interpreting new opportunities across technologies and markets (Teece D., 2007).

Opportunities get detected depending on two factors. (1) Differential access to existing information or (2) Opportunities can arise from new information and new technology. In addition, Teece (2007) suggests that organizations need to foster an entrepreneurial mindset to be able to recognize any disequilibrium in the market and take advantage of it. This means that managers in strategic positions need to overcome narrow search horizons and get away from established routines that once were great but now have turned into straitjackets. Once opportunities have been glimpsed, managers or entrepreneurs must deduce how to interpret new developments, which market sectors to target and which technological development to pursue, and how will competitors and suppliers react (Teece, 2007). All these factors can change the nature of the opportunity and how it will unfold for the firm. Equally important is to detect the barriers that may limit the exploitation of said opportunity. Processes such as investment in research and development activity, tap into new technologies, probing and re-probing of customer needs and, internal discussion, understanding latent demand and the structural evolution of industries and markets, and the search for new collaborators make part of this group's micro-foundations (Teece, 2007). Figure 8 shows the nature of the SENSE dynamic capability and its accompanying micro-foundations.

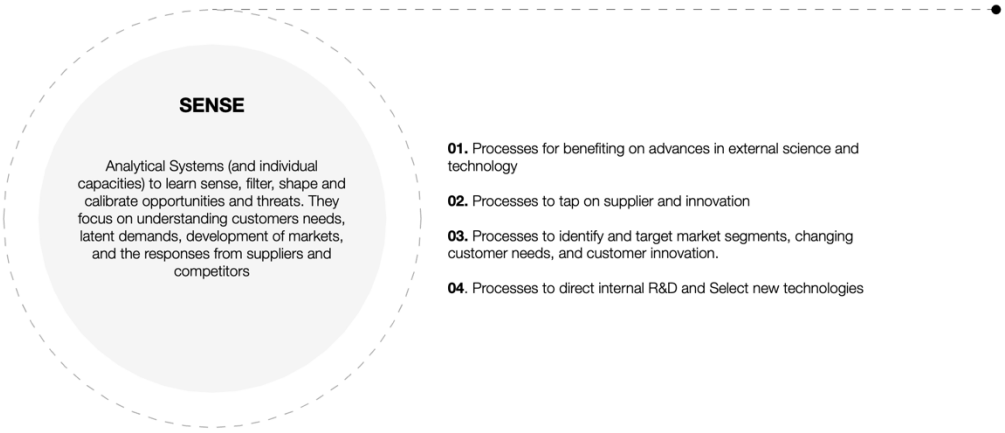

Figure 8: Sense Capability ecosystem of micro-foundations for sensing market and technological opportunities, Source: Own elaboration based on Teece (2007)

Seize : Once opportunities and barriers are identified, organizations must act quickly to benefit from them. This process is known as seizing and refers to strategic execution or strategic decision skills. It denotates making the right decisions at the right moment and executing them into new products, processes, or services (Teece 2007). Seize means having the absorbent capacity to recognize the value of opportunities and apply it to the benefit of the organization (Wang & Ahmed, 2007). This capability strongly trusts investment decisions to improve the existing technological competencies and other complementary assets that the firm presents at the time.

Hence, the micro-foundations for seizing capability refer to four segments. Firstly, selecting product/project architectures this included which technologies and services are embedded in the product and service, how the revenue and cost structure of a business is to be designed and if necessary redesigned to meet customer needs, how technologies are to be assembled, the identity of market segments to be targeted and the mechanisms by which value is to be captured. In short, it refers to the BM itself, it defines how the organization "goes to the market", meaning establishing a commercialization strategy and investment priorities that result in profit for the firm (Jiang, 2014).

The other three groups of seize microfoundations refer to selecting the enterprise boundaries to ensure that innovation benefits the firm; selecting Decision-Making Protocols refers to avoiding decision errors and inflection points by having an established decision-making process. Finally, Building loyalty and Commitment in cases of collaboration. Figure 9 shows the nature of the SEIZE dynamic capability and its accompanying micro-foundations.

Figure 9: Seizing Capability- Ecosystem of micro-foundations for strategic decisions skills/execution, Source: Own Elaboration based on Teece (2007)

Reconfigure: Even if firm growth and higher profits can be achieved when new opportunities are sensed and effectively seized; firms must develop the ability to continuously recombine and reconfigure organizational assets and current structures under constantly changing markets. Reconfiguration capability is closely linked to product, process, and knowledge innovation to develop new practices (Jiang, 2014). Reconfiguration microfoundations creates continuous innovation in dynamically competitive environments, revitalizing core capabilities that have turned rigid, aligning them again with the new strategic direction of the firm. Ultimately transforming the BM and the current resource base of the firm. The micro-foundations in this group involve decentralization and near decomposability inside the organization structure, governance skills, co-specialization, and knowledge management. Figure 10, shows the nature of the SEIZE dynamic capability and its accompanying micro-foundations.

Figure 10: Reconfiguring Capability- Ecosystem of micro-foundations for combination, reconfiguration, and asset protection skills

Figure 11 illustrates the linear Dynamic Capability Framework, proposed by Teece (2007) which in his words *"endeavors the key variables and relationships that need to be manipulated to create, protect and leverage intangible assets to achieve superior enterprise performance"*.

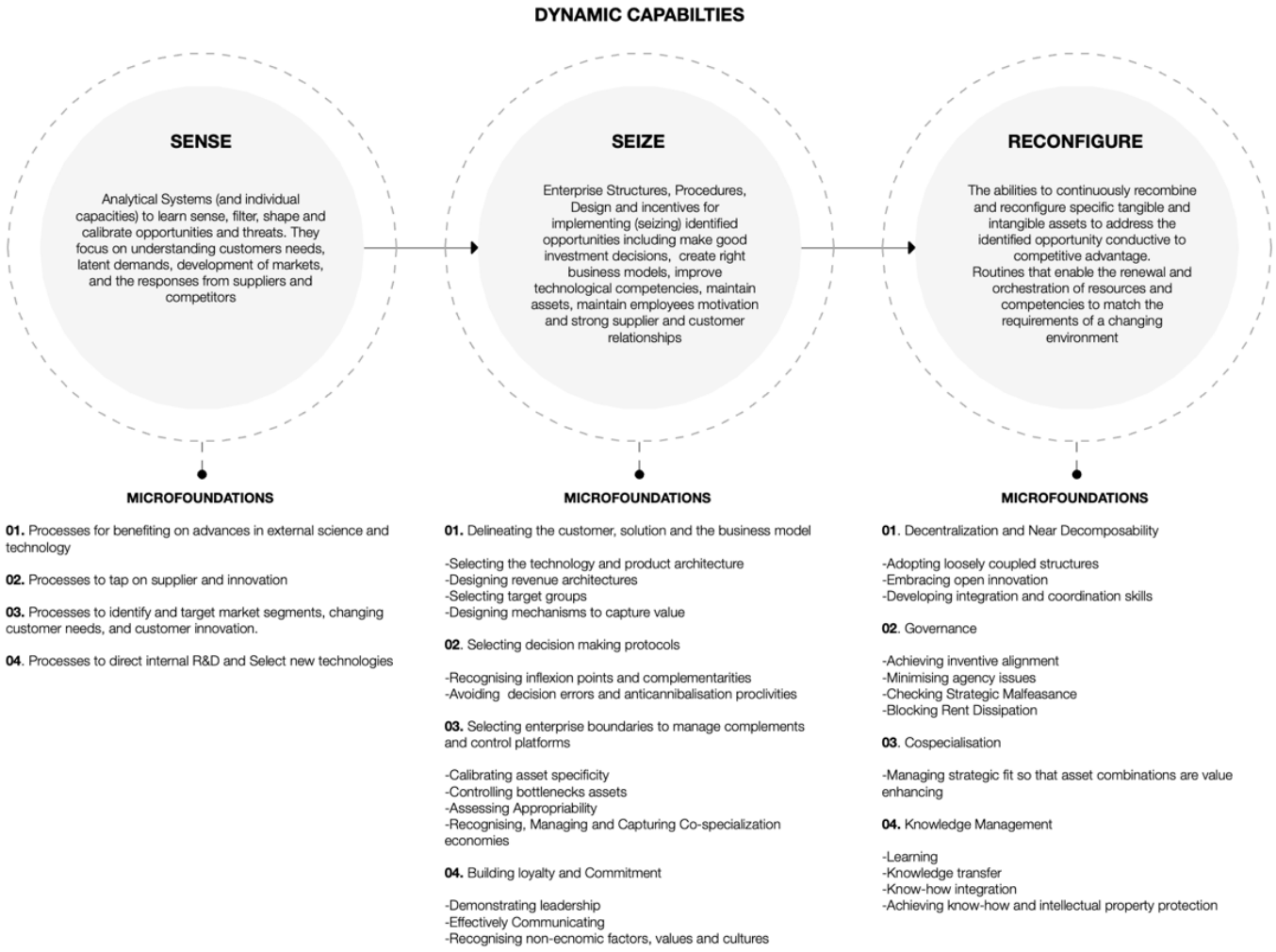

Figure 11: Foundations of Dynamic Capabilities & Micro foundations, Source: Own elaboration based on Teece (2007) and Jiang (2014)

2.3 LITERATURE CONCLUSION

Based on the findings of the literature review, the conceptual model presented in the first chapter (Figure 1) has been further developed. Recent advancements on the BM concept emphasize on its dynamic nature, defining it as the architecture by which firms propose , create, and capture different types of value; but also, as a system comprised of components, linkages, and capabilities that require constant transformation to respond to changing market environments.

Architectural firms, as part of CPSFs, are characterized by having a high degree of customization in their work and presenting a strong interaction factor with clients. These characteristics have led to the development of a BM portfolio composed by the firm-level BM and project-level BM. In addition, architects value propositions include four types of products and process service. Finally, research specifies that architects chase five types of values including namely use, monetary, exchange, social, and professional value. The BM portfolio and the five typed of values are place at the center of Figure 12. Research states that although the CE concept has been widely embraced in the architectural discourse, in practice architects are still struggling to translate the concept into their BMs, due to many internal and external barriers as illustrated in Table 3 and Table 4. Furthermore, research shows that architects in their approach to CE act in isolation, limiting themselves and the BMs to mostly focusing on the concept and design stage of a buildings. Hence, in order to cope with these barreirs and embed CE into their BM portfolio, archtiect need new capabilities that transform current strategies, structures, ultimately their BMs. The CEBM canvas (Lewasdowski, 2016) embeds these organizational processes into the internal adoption factors of the canvas. They represent the link to the Dynamic Capbility Approach of the firm as they both focus on managerial and organziation processes that enable BM tranformation for CE. However, even if scholars and practitioners are aware of the need for a CE shift , there is still a lack of deeper academic research on BM transformations know-how for smaller CPSFs, that chase value beyond revenues (Bos-de Vos et al., 2017).

In this regard, the DCA is concerned with organizational change, strategic renewal, and adaptation within firms and industries to changing environments (Jiang, 2014). It is composed of sense, seize, and reconfigure DCs, which are supported by microfoundations. The three categories, and the characteristics of their microfoundations have been placed at the bottom of Figure 12. As explained by Teece (2018), BMs, DCs, and strategy are interdependent. The figure shows this interdependency by distinguishing the two types of organizational capabilities, Core Organizational Capabilities that have tuned rigid due to changes in the business environment; and Dynamic Capabilities needed to embed CE into the BM.

The new capabilities will also impact the previous capabilities aligning BM and strategy again, while ideally reversing sustainability challenges. Teece (2018) makes a call for further research that expands on the relationship between strategy and BM, as the normal assumption says that corporate strategy dictates BM ; yet BM can also impact the very feasibility of a strategy. Finally, literature suggests that practice can benefit from future research that identifies the micro-foundations of DCs necessary for CE. The empirical research will focus on identifying the above-described relationships and the specific processes developed from practice to embed CE into the BM.

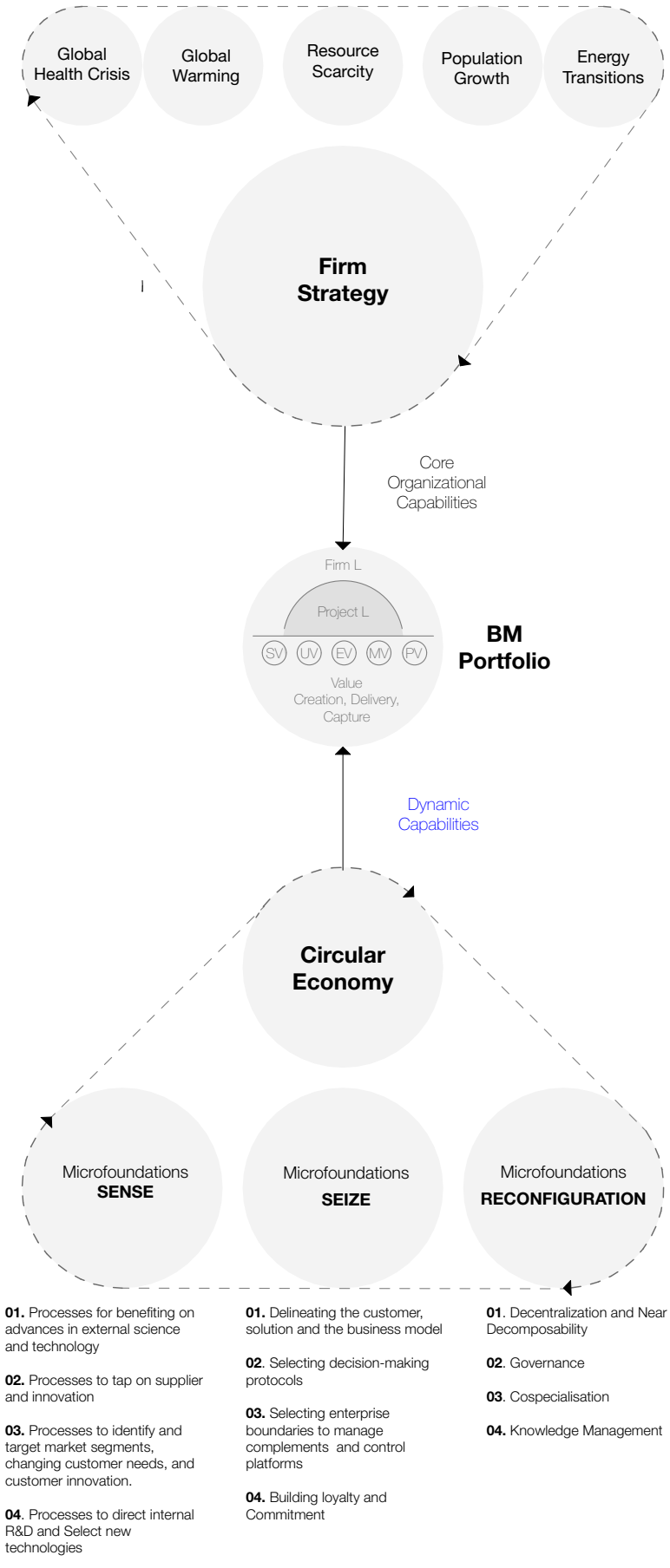

Figure 12: Conceptual Model adjusted to illustrate the theoretical framework of the research, Source: Own elaboration

3 EMPIRICAL RESEARCH METHODOLOGY

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3.5 DATA PLAN 71

This chapter outlines the empirical research methodology and is structured in five main parts. Accordingly, first, empirical research design; second, introduction to case studies; third, data collection method; fourth, data analysis technique; and fifth, data plan.

3.1 EMPIRICAL RESEARCH DESIGN

3.1.1 Research Design Components

Through a multiple case study approach, this study will employ the five fundamental empirical research design components described by Yin (2009). These elements show the logical sequence that connects the empirical data obtained with the research questions and, lastly, with the study's results. The five components consist of (A) case study questions, (B) propositions, (C) units of analysis, (D) logic linking the data to the propositions, and (E) criteria for interpreting the findings.

The first three components (A,B and C) will guide the research design in terms of determining the data to be collected. The other two components (D and E) will direct the research into what should be done once the data has been gathered. The following section will further elaborate on how each of these components will be applied to the current study.

A. Case Study Questions: The earlier theoretical research set the basis for understanding the various types of capabilities that organizations possess, as well as their distinctive features. Based on the theoretical research, a linear DC framework for BM transformation was identified (Figure 11).

The case studies aim to further investigate the linear development path and implementation of DCs, as well as the identification of micro-foundations necessary for BM transformation toward the CE (RQ3). Based on real-life cases, the aim of RQ3 is to further contribute to the main inquiry of the research, by shedding light on the impact of CE on the BM of architectural firms in terms of value proposition, delivery, and capture.

B. Propositions: Due to the explorative nature of this research, no propositions were addressed before the case studies. The case study's purpose is to understand how architectural firms, have incorporated CE principles in their BMs and under which DCs micro-foundations.

C. Unit of Analysis: To address the aforementioned research question and the research's purpose, a qualitative multiple-case study approach with multiple units of analysis has been adopted. This methodology was chosen for four main reasons.

- Firstly, the literature shows that most of the research on DCs is conceptual in nature and lacks findings from practice.
- Secondly, the majority of empirical research on DCs, mostly published after 2005 (Eriksson (2014), has either been focused on largescale surveys or single-case studies (Albort-Morant et al, 2018).

- Thirdly, the unit of analysis for this research are of qualitative nature, as DCs are firm-specific and are embedded in a firm's organizational routines and processes making it difficult to identify through quantitative measures (Khan et al., 2020).

- Fourthly, due to the limitation that single-case studies present, a multiple-case studies approach is more suitable as it's considered more compelling and robust (Yin, 2009). There is no ideal number of cases to be chosen for multiple case studies, however, 4–10 cases are considered ideal for this type of research (Eisenhardt , 1989).

For the case studies, this research consulted well-recognized architectural firms in the Netherlands, that presented successful implementation of CE principles in their projects. The unit of analysis were based on the three dimensions of the circular business model canvas by Lewandowski (2016), see Figure 6. This BM canvas was chosen as it combines the original components of the canvas developed by Osterwalder and Pigneur (2010) with CE principles. More importantly, it adds two additional components to the framework: the take-back system and the adoption factors. The adoption factors emphasize on the internal organizational capabilities (DC's micro-foundations) that allow CE embodiment into BMs.

In that respect, the main unit of analysis for the empirical research are divided in three groups. First, CE approach; second, BM dimensions (value proposition, value creation and delivery, and value capture); and third, organizational mechanisms (micro-foundations of Sense, Seize and Reconfigure) that allow BM transformation in favor of the CE.

D. Logic linking the data to the propositions: The purpose of the case studies was to understand how these firms have incorporated CE principles in their BM over time, and the impact of the new economy on the way they propose, deliver and capture value. As said before, the main inquiry for the empirical research is to identify which micro-foundations of DCs have been developed by these firms and the order of their development. These components are part of the CBMC by Lewandowski (2016) and have been translated into the unit of analysis for the empirical research.

E. Criteria for interpreting the findings: The non-quantifiable nature of the qualitative data collected through the case studies becomes a challenge in terms of comparison and quantification of the findings. Nonetheless, the criteria for interpreting the findings will be based on the theory behind the DC framework developed by Teece (2007). In that respect his definition of Sense, Seize and Reconfigure Capabilities, and the characteristics placed at the end of Figure 12 will guide and validate the allocation of the identified micro-foundations from the case studies. Furthermore, the BM Canvas by Osterwalder and Pigneur (2010) and the CBMC by Lewandowski (2016), enables the research to interpret the findings in a evolving way, understanding which changes have occurred on terms of architect's BM before and after CE assimilation in the firm. Finally, the scientifical work of Marina Bos-de Vos in the FuturA project, who focused on deeply understanding the BMs of CPSFs and their value conflicts will also be used as criteria for interpreting the empirical research findings.

3.1.2 Case Study Design

This research implemented a multiple-case design with multiple units of analysis (Yin, 2009). The case studies include four architectural firms located and operating in the Netherlands (Figure 13). In each of the selected case studies, primary data was collected through questionaries and multiple semi-structured in-depth interviews with different stakeholders inside the firm.

Interviewees included partners, business development managers, senior and junior architects currently working on CE initiatives inside the firm or projects with strong CE ambitions. The mix of interviewees backgrounds allowed the research to obtain substantial and representative information from different organizational layers inside the firm. The collected information touched on diverse aspects of CE implementation, specific projects, CE initiatives, everyday tasks, and different understandings of the CE concept. As showed Figure 13, the participant firm have been anonymized as A, B, C, and D, and they will be collectively referred as case-study firms. Furthermore, the figure displays the three units of analysis, (1) CE understanding in the organization, (2) CE impact on BM dimensions, and (3) Dynamic Capabilities Path and micro-foundations.

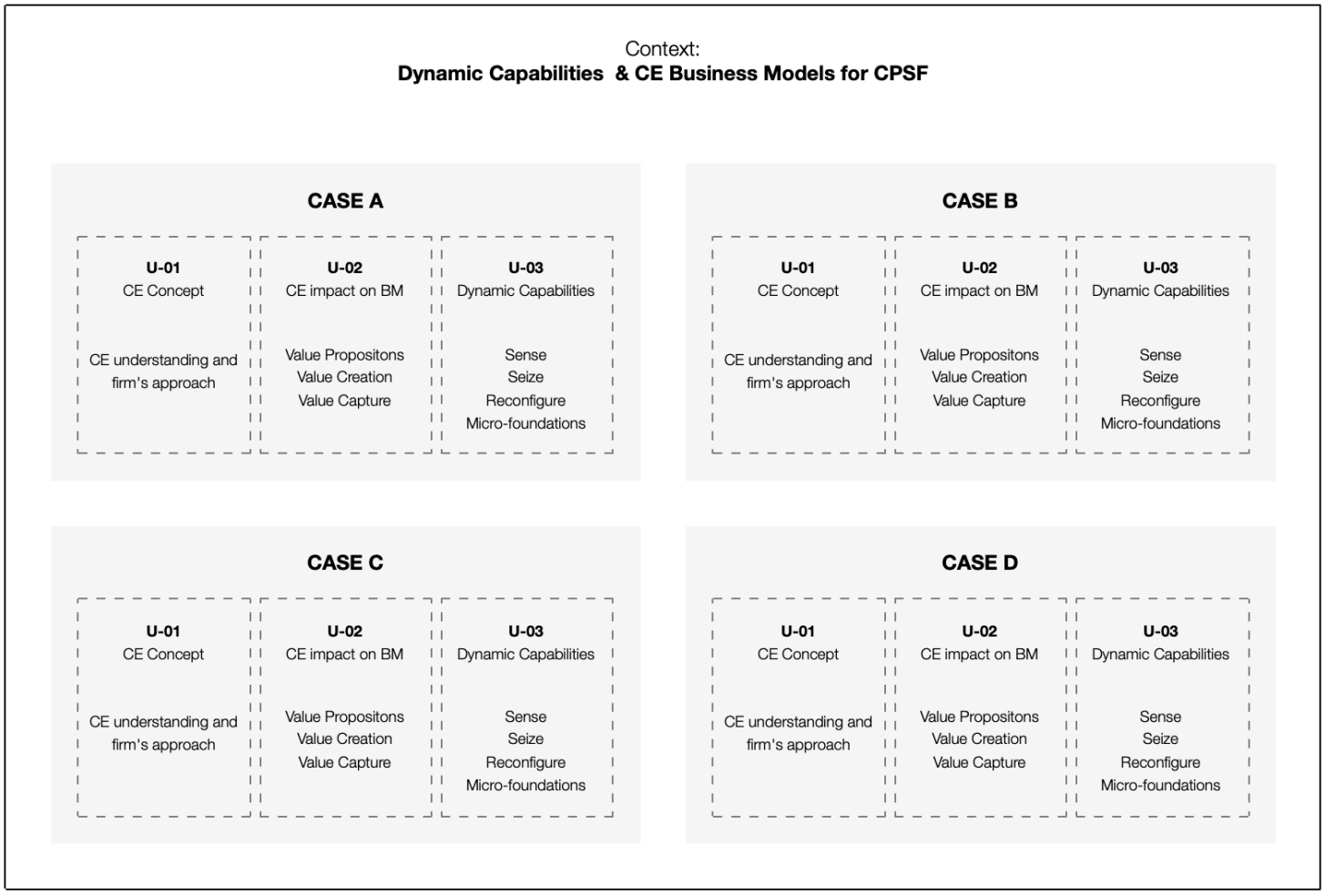

Figure 13: Case Studies Design, Source: Own Elaboration adapted from Yin, 2009

Following Yin (2009), the multiple case study procedure has been divided into three main sections (Figure 14).

Firstly, the "define and design" phase, where theory and literature-based frameworks and criteria have been established. As explained before the DC framework by Teece (2007) serves as a theoretical foundation to define and classify the micro- foundations. The CBMC by Lewandowski (2016) serves to understand the link between dynamic capabilities and the three main dimensions of the BM Canvas. Later, case studies were identified, and interview protocols have been developed.

Secondly, the research enters into the "prepare, collect and analyze phase", where questionaries and semi-structured in-depth interviews have been implemented. Thirdly, in the "analyze and conclude" phase, the research connects the empirical findings with the theoretical findings of the literature study. Finally, a workshop is organized with the participant firms to validate the main findings.

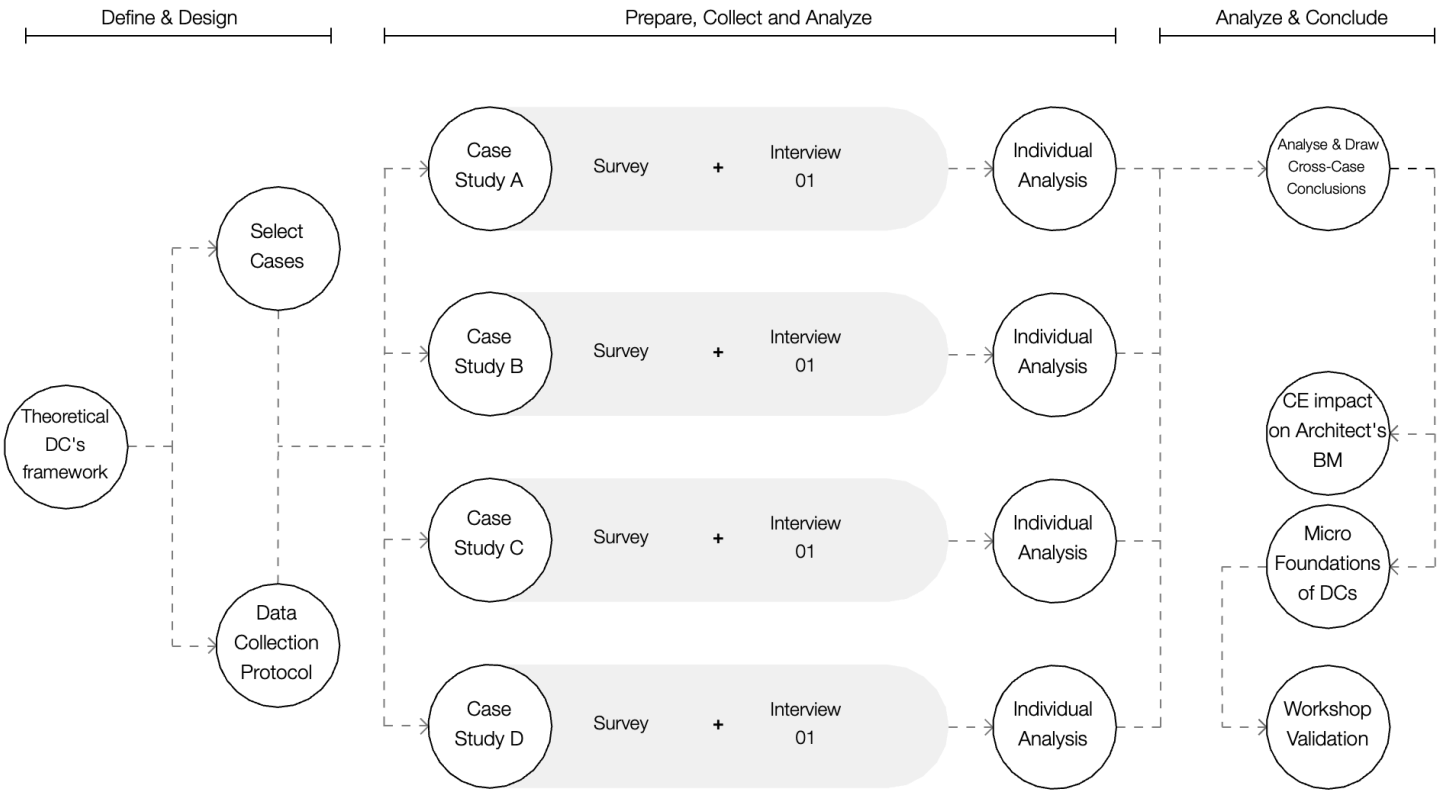

Figure 14: Case studies procedure, Source: Own elaboration adapted from Yin, 2009

3.1.3 Case Study Selection Criteria

Defining the criteria under which the case-study firms are selected, is critical for establishing parameters that assure the study's feasibility and consistency of findings. Table 7 presents the criteria used for cases-study selection and the reasoning behind them.

CRITERIA	REASONING
1. The organization's core BM is providing architectural design services	Architectural firms are part of CPSFs in the knowledge-intensive and creative industry. However, little research from a BM perspective has been performed on this typed of firms (Bos-de Vos, Volker & Wamelink, 2016).
2. They can be classified as project-based organizations	CPSF's often organize their tasks on project basis, developing BMs for individual assignments. In that respect, they present an overall BM and project base BM's (Kujala, Artto, Aaltonen, & Turkulainen, 2010). This research aims to explore the relationship between both levels in relation to CE embedment in the firm.
3. The organization is a small/medium size company (20-70 employees)	The majority of empirical research on CPSFs has been limited to large scale profit-driven companies, rather than smaller creative service organizations that need new strategies to survive in increasingly competitive environments (Bos-de Vos et al.,2017).
4. The organization is actively implementing CE design principles in its project.	As this research looks into the impact of CE into architect's BMs, the focus are organizations that have actively adopted this sustainability strategy in their design practice. Either through the 3 main CE principles or the 10 R's. As a result, they are designing out waste by closing a narrowing production and consumption loops.
5. The firms is located in the Netherlands	Geographical location can facilitate the gathering of data and allows conducting interviews face-to-face while visiting the organization. In addition, case study comparability improves, as they are operating in the same political, economic , and social context.
6. Driven by strategic objectives beyond financial revenue	Under the value umbrella, CPSFs pursue a variety of objectives (Bos-de Vos et al.,2017). As a result, it is critical that case studies publicly focus on capturing many types of value (environmental, professional, use, etc.), uncovering conflicts and balancing solutions.
7. Sustainability is part of the vision statement	As CE is a means towards the bigger picture of Sustainability. Case firms must present Sustainability in the built environment as their overall business driver.
8. The organization is an established firm with more than 20 years of experience	Developing DCs for business model transformations is more difficult for established firms as they have more processes to reengineer that firms, which were born in the sustainability and CE paradigm.

Table 7: Case-study selection criteria, Source: Own Elaboration

3.2 CASE STUDY INTRODUCTION

Based on the selection criteria of Table 7, four leading architectural firms in the Dutch context have been selected as case studies for the research. Table 8 gives an overview of the selected cases and the interviewees in relation to the previously defined criteria.

CRITERIA	CASE A Interviewees Junior Architect- FA1	CASE B Interviewees: Founding Partner- FB1 Junior Architect- FB2 Senior Architect- FB3	CASE C Interviewees: Founding Partner- FC1	CASE D Interviewees: Founding Partner- FD1 Senior Architect- FD2
1. The organizations core BM is providing architectural services	X	X	X	X
2. They can be classified as project-based organizations	X	X	X	X
3. Small/medium size company (20-70 employees)	X	X	X	X
4. The firms is actively implementing CE design principles in their projects.	X	X	X	X
5. The firms is located in the Netherlands	X	X	X	X
6. Driven by strategic objectives beyond financial revenue	X	X	X	X
7. Sustainability is part of the vision statement	X	X	X	X
8. The firm has been established over more than 20 years	X	X	X	X

Table 8: Overview of selected cases and interviewees, in relation to case study selection criteria, Source: Own elaboration

Case Firm A: They describe their approach as a practical idealism that pushes architecture and design towards the maximalization of flexibility, circularity, and future innovation. Active for more than eighty years with a current team of around 70 people.

Case Firm B: Medium-sized architectural firm operating nationally for over sixty-five years. Their portfolio consists of social and commercial projects with tasks involving interiors, new construction, and especially real estate transformations. They present an analytical and integral design approach that emphasizes on (re)develop functional, future-oriented, and expressive buildings.

Case Firm C: Firm operating in the Netherlands and abroad. The focus on new build projects, but specially their experts in the field of adaptive re-use of architectural heritage and urban development strategies. They are operating for 25 years under five core values context, community, new aesthetics, flexibility, and new values.

Case Firm D: Active in the Dutch market for thirty years, and currently operating under an international team of forty people. Their approach is described as a realistic idealism that aims for a sustainable future with people-centered design and livable cities. They are characterized by their data-driven design. In the last decade, they have expanded their project portfolio to other countries in Europe, Africa, and Southern Asia.

3.3 DATA COLLECTION METHOD

According to Yin (2009), qualitative methodology allows research to address complex research questions and gather rich and robust evidence. In first instance, a questionnaire ,based on the framework developed by Lowik (2020), was developed to understand the perception of CE innovation among the case studies in six different competences, being BM innovation one of them. Later, multiple semi-structured in-depth interviews were conducted per case study, with stakeholders fulfilling different roles inside the firm, from founding partners to junior architects. Finally, written materials about the firms on online platforms was reviewed to complement the information gathered with the first two methods.

Questionaries: The questionnaire (Appendix A) was divided in six main sections , which constitute the competences of what Lowik (2020) defines as Circular Innovation. They indicate the six areas where firms can innovate to design, develop, and commercialize sustainable products, services, and processes that contribute to the transition from a linear to circular society. The questionnaire was divided into Technological Innovation, Business Model Innovation, Value Network Innovation, Renewable Energy Process Innovation, and Social Innovation (Table 5). The primary goal of the questionnaire was to gain an initial understanding of the firm's perception of the impact of CE in their organization. In particular, the research focused on the business model innovation field in comparison to the other five. The information gained through this method supplemented the data gathered during the interview, providing insights into the primary areas of innovation that each participant had experienced in terms of CE.

Semi-Structured Interviews: An in-depth interview can be conducted through a semi-structured or non-structured process (Allmark, et al., 2009). For this research, in-depth interviews were conducted through a semi-structured process, as it allows concepts and theories to emerge out of qualitative data (Bryman, 2012). Furthermore, in-depth interview allowed a deeper understanding of the interviewees' perspective, experience, and personal opinion on the subject of the research. The interviews were structured according to the three main units of analysis (Figure 13) but provided enough flexibility for new questions to emerge obtaining more detailed information. The interview protocol (Appendix B) defined the main topic to be covered. In first instance, a general description of the interviewee's role, followed by the firm's understanding of the CE concept. Second, the impact of the CE on the BM dimensions (value proposition, value creation and value capture). Third, a deeper understanding of the individual skills, processes, and competencies (micro-foundations) developed to sense market opportunities and threats, to seize these business opportunities, and to reconfigure their BM and resources base. The data collected serves to understand changes that have occurred on the BM of architecture practices due to CE embodiment; and categorize different micro-foundations for CE into clusters according to the three higher-level DCs.

Case Material Review: In order to complement the data gathered from the interviews and the questionnaire, the data collection method includes reviewing publicly available written and visual material about the case study firms. The material includes background and historical information about the firm, vision statements, project descriptions, online presentations about their approach to sustainability and circularity.

3.4 DATA ANALYSIS TECHNIQUE

As explained above the questionary is based on the CE framework developed by Löwik (2020). The characteristics of the 6 innovation competencies have been adapted and translated into statements, that each firm has been asked to score from 1 to 5. For each competence the answers are quantified, and the individual average score is used to compare between the six areas of CE innovation.

As a first layer of analysis, the interviews will be fully transcribed, analyzed and coded using the ATLAS.it software. Coding in qualitative research ,refers to the process whereby the data is broken down into components of potential theoretical implication for the study and labeled according to concepts or categories (Bryman, 2012). In this research the categories in coding, refer to concepts embedded in the three units of analysis illustrated in Figure 13: (1) CE understanding in the organization, (2) CE impact on BM dimensions, and (3) Dynamic Capabilities Path and micro-foundations. It's crucial to mention that the same codes are used for the four case studies, as this contributes to the reliability of the research but also allows replication of the data analysis technique. This is also the case for the questionaries. In that respect, Table 9 presents the codes that emerged from theory, and that we used to analyze and classify the data.

UNITS OF ANALYSIS	U-01 CE understanding in the organization	U-02 CE impact on BM	U-03 Dynamic Capabilities
THEORY-BASED CODING (1st Analysis Layer)	CE Approach	Value Proposition	Sense Dynamic Capability
	Sustainability Vision	Value creation	Seize Dynamic Capability
	Firm's Evolution	Value Capture	Reconfigure Dynamic Capability
	Future of CE	Driving Values	CE Challenges
EMERGING CODING (2nd Analysis Layer)			Sense Micro-foundations
			Seize Micro-foundations
			Reconfigure Micro-foundations

Table 9: List of Codes used in AtlasTI, Source: Own Elaboration.

In the second layer of analysis, a new set of new codes emerged within the third unit of analysis involving the sense, seize and reconfigure DCs. The new codes, allowed to further identify the specific skills, competences, and systems, also known as the micro-foundations, that the four case studies have developed to transform their BMs. In this group, codes like "Collaboration", "Knowledge Generation", "Market Surveillance", "Initiator Capacity", and others constitute part of the main findings of the research.

3.5 DATA PLAN

A data plan indicates how data will be secured during the collection, documenting, and sharing of research information.

Data collected throughout the research will include both raw data and processed data. The interviews will be conducted in person and online, using online digital platforms and visiting the office of the case-study firms. The firms were given Informed Consent Forms which confirm the individual's permission to take part in the study, their understanding of the context of the interview, allow the researcher to utilize information shared in the interviews for the thesis and lastly, provide consent for the use of information for further research. The sample of the Informed Consent Forms can be found at the end of the document in Appendix C. Furthermore, permission to record and transcribe the interview was asked during the interviews. Throughout the data analysis, the name and private information of the participants and the case firms will be encrypted with an alternative identification. Important information may be quoted using the codes assigned to each interviewee in Table 8.

This research follows the FAIR guiding principles of Wilkinson et al. (2016), meaning that the analyses would be Findable, Accessible, Interoperable, and Reusable.

The working version of the thesis, charts, findings, raw data, personal information of interviewees, audio and/or video files, and transcripts of interviews will be stored offline with a copy on a hard drive. The final document will be stored on the repository of TU Delft as a standard document format and use appropriate keywords to ensure accessibility. To ensure interoperability, the current research will be documented in English (U.K. format) and by using the APA-style reference format. The audio and/or video recordings obtained in this study will be destroyed after the transcript's validity is confirmed by respective mentors. The transcripts will be used to gather information only for the current research's purposes. The original transcript will not be attached to the public report. Furthermore, this master thesis focuses on business model information, therefore raw data must be protected by a level of confidentiality based on standards rules of the TU Delft on Ethics and Privacy Committee or the General Data Protection Regulation.

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The empirical research analysis is organized in two sections (Table 10). First the individual firm analysis section then the cross-case analysis.

The individual case section is divided accordingly to the three units of analysis presented in Figure 13. **S1** presents each firms' approach to the CE. **S2** showcases the impact of CE in the three dimensions of the BM. First Value Proposition (VP), giving an overview of the impact of CE on the type of services, and products offered by the firm to their clients. Then, Value Creation and Delivery (VC & VD) include the fundamental changes experienced in terms of key partners, activities, resources, customer relationships, channels, customer segments, and take back systems. The last one being a new component of the CBMC introduced by Lewandowski (2016). Finally, Value Capture (VCAP), this section presents the types of driving-values for these firms in their search for CE practices and their influence on cost structure and revenue streams. **S3** includes the results in terms of the Sense, Seize and Reconfigure micro-foundations developed individually to embrace CE in their BM. Parallelly to the microfoundations, the main CE challenges encountered will be described. Finally, the cross-case examination **(XC)** presents the main differences and similarities among the firms.

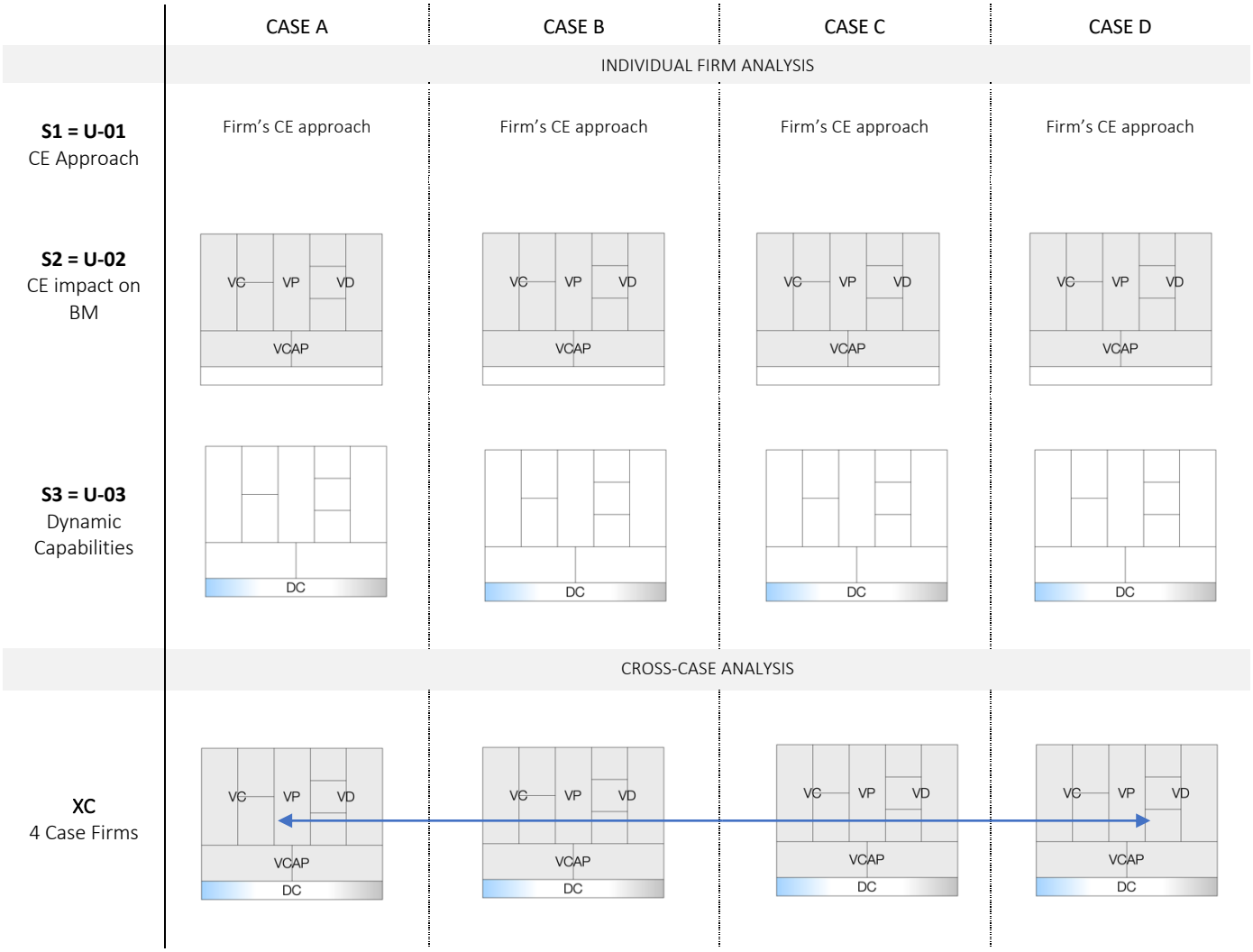


Table 10: Empirical analysis structure, Source: Own Elaboration

4.1 INDIVIDUAL CASE STUDY OVERVIEW

4.1.1 CASE STUDY A

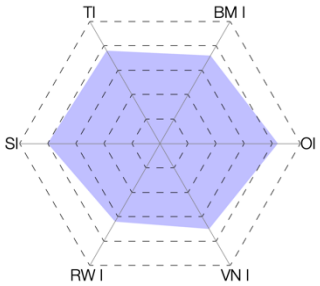
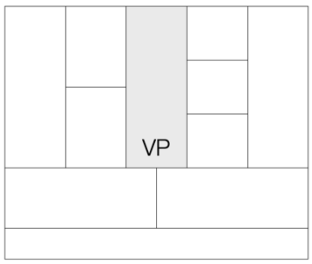


Figure 15: Questionnaire results Firm A, CE innovation sectors, Source: Own Elaboration.

S1FA CE APPROACH: The accompanying figure displays Firms A's results from the questionary. Organizational Innovation (OI) is ranked as the highest perceived area of innovation for CE. This indicates that Firm A perceives a high level of innovation concerning their organization's strategy, systems, and culture towards the CE. The data collected shows that Firm A, being the oldest out of the case studies with 70 years in the market, has experienced a shift in their organizational strategy over the last 25 years. The firm has gradually transformed their organizational culture and systems to turn CE into one of their current four expertise. The firm went from ad hoc responses to achieve their first energy-neutral building in the 90's, to an integrated and flexible path that aligns the firm's strategy with their design methodology aiming for 100% circular projects in the future. The data shows that concepts from which the CE emerged, like Cradle to Cradle, are embedded in the firm, and contribute to their CE approach.

In that respect, concepts like waste as a resource, use of renewable energy sources and biodiversity stimulation are described as the firm's approach to CE. However, that the concept of CE diverges among employees, often influenced by the tasks being performed. In the case of the interviewee, CE was associated with the use of bio-based materials in projects.

S2FA CE IMPACT ON BM: Parallelly, the spider figure shows, that Firm A perceived Business Model Innovation (BM I) as one of the lowest areas of innovation. This perspective will be further stressed according to the three dimensions of BMs.

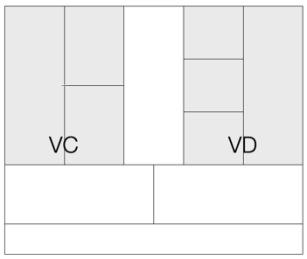


Value Proposition: Firm A focuses on two types of value proposition found in literature, Project Assistance and Product Design. Project Assistance refers to the broad range of process-related services that are delivered to facilitate the start or further development of a project. Due to the long-term nature of CE, their value proposition for clients includes services in the early stage but also during execution and after completion phases. The interview revealed that front-end services like setting goals and ambitions, take longer time in projects with strong CE ambitions. The interviewee expressed that this is largely connected to the lack of CE awareness among clients. Hence, on one hand, Firm A offers the elaboration of a Circularity Ambition Dashboard, which sets the base for the concept and design stage. However, this service demands for architects to work closely with clients in the initial phase to create SMART CE goals (Specific, Measurable, Ambitious, Realistic, and Time-Bound). On the other hand, the CE has expanded the services related to further development of the project to the execution and implementation phases, and even after completition.

" If you want to design a circular building, you have to start from the beginning and don't forget the end. " Interviewee FA1

Product Design refers to product-oriented services that are delivered to come up with the design of a product. In this regard, Firm A offers an initial design, where building orientation, light, and compactness of the volume, biodiversity and water spaces are assessed. Next, the preliminary design maps out positive future outcomes in terms of material, air, energy, water, and biodiversity flows. Ultimately the service, includes the delivery of a final design that materializes the product.

The analysis shows, that the value proposition of Firm A in relation to CE has not changed from the traditional approach to architectural business. They offer the same services, despite the CE approach. However, the complexity and the time during which they offer said services have increased in comparison to projects where the CE is not a key driver.

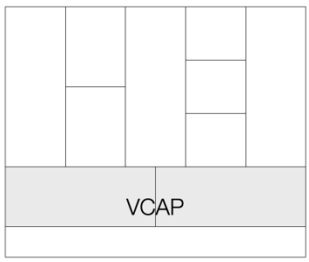


Value Creation and Delivery: Despite the lack if any change on the value proposition, the interview revealed that the value creation and delivery dimensions have had significant changes. The analysis shows that the CE has impacted the key partners, key activities, and key resources of firm A.

Firm A used two projects to explain where these changes have been perceived. In terms of key resources, the CE demanded for Firm A to introduce and develop new resources that were not used for projects developed in other stage of their existence. Material passports have become an essential part of CE projects, as they allow to repurpose and recycle old materials, but also codify new raw materials turning new built projects into future material banks. In addition, circular material and suppliers' libraries have been developed. These two new resources allow Firm A to increase the specifications and details of the project. These dynamic ultimately gives to the firm a stronger steering role in the project when it comes to involving key partners. The interviewee explains that creating a stronger role for yourself (architects), guarantees that CE ambitions won't be exchanged for lower prices by contractor or supplier selection.

In terms of key activities, the data shows that employees' responsibilities and tasks have increased due to the CE. Architects' tasks in the firms, have expanded beyond designing , to incorporate continuous update and monitoring responsibilities, but more importantly activities that implicate increase their CE knowledge. The last one being common among older architects educated on a linear architectural tradition, different form younger generations of architects being incorporated to the firm.

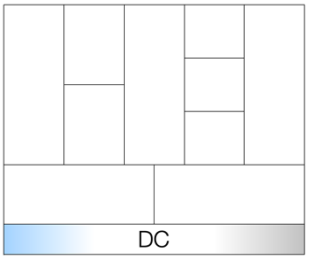
The interview and the documents reviewed did not reveal data in terms of take-back systems being put into place, beyond the use of material passports. In terms of customer relationships, segments and channels, the interviewee sustained that new CE projects and clients have been the result of the firm's reputation in terms of sustainability and CE projects built in the last decade. It was noticed that these projects have received special attention by the firm in all of their digital platforms and strong media coverage.



Value Capture: In terms of cost structure and revenue streams, the interview and documents revealed limited information. The respondent was unaware of the impact of CE on the firm's revenue streams, as this information (monetary value capture) was retained among upper management. The interviewee did not consider that developing financial knowledge was necessary as his fundamental role inside the office was to design for sustainability.

However, the interviewee stated that the architect's duty typically includes doing more than what is required, which is not a smooth process and makes the profession less enjoyable. The extra tasks often are not reflected on the firms or employees' revenues as this deviant behavior has been normalized as part of the occupation. The analysis shows that there is a clear conflict between monetary and professional value, yet architects consider as part of their occupation.

S3FA MICRO-FOUNDATIONS OF SENSE, SEIZE AND RECONFIGURE



Sense: It refers to competencies, skills, or systems used by firm A to sense opportunities and threats in the market. The analysis detected 4 microfoundations of sense in Firm A namely, Exploitation of media landscape, Competitions as market reflectors, Ambition Brainstorming skill and Employee specialization.

Firm A relies on developing a strong media strategy to that exploits existing projects and as result shapes new CE opportunities. Hence, public relationships and media coverage became extremely important for the firm to establish itself in a competitive market.

"Especially (project name), it's a project that is named a lot in the media because of its principles when it comes to a circular design, biobased design (…), clients then come to us because they see what we do, and they see what we think. It's important also on our website and in our communication, that's definitely a big factor… ". Interviewee FA1

Similarly, monitoring market trends it's essential. The interviewee explains that CE ambitions are increasingly becoming part of competitions' briefs. Firm A uses their participation in these events as ways of sensing new opportunities for CE as they reflect current and future market needs. Furthermore, the analysis shows that through this method, Firm A can sense opportunities for CE implementation mostly related to the public sector. Their approach for the private sector is different, as these clients not always aim for CE. Hence, the architect's job is to monitor the client itself. The interviewee revealed that once a client has established a relationship with them, Firm A uses early meetings as mechanisms for sensing the openness of clients. Once the client has being sensed the firm can start introducing and negotiating CE principles with them without risking losing the project. Finally, CE employee specialization has proven to be crucial for sensing the application of CE in project, and hence leading to look for these opportunities in the market

Seize: Two micro-foundations were detected for Seize. Firm A uses the provision of information to keep their clients motivated, securing, and exploiting previously detected opportunities. Architects need to not lose track of the client and guide them in the transitions to a circular built environment. As explained before processes to develop and implement material passports and CE booklets, become a second micro-foundation utilized by Firm A. The interviewee explain that is not only about developing the tools but, also about distributing and communicating these tools to clients and actors in the construction industry. Currently, they are developing a booklet for a positive footprint, which will be distributed to clients, incentivizing, and increasing their knowledge on CE and sustainability possibilities for projects.

Reconfigure: refers to the ability to continuously recombine and reconfigure specific tangible and intangible resources addressing the identified opportunities. As explained before, Firm A allows its team to specialize and generate CE knowledge. However, they actively implement Knowledge Sharing schemes as a way to spread CE awareness along the company. Monthly workshops and weekly update meetings support this micro foundation. During the workshop, one of the new experts in circular design provides lectures on a specific subject. Furthermore, having the skills to reconfigure and reorganize teams is crucial for CE projects. This micro-foundation could be critical to develop project-based BM as architectural firms often reorganize their employees in teams depending on the project requirements.

CLUSTER Higher DC	MICRO-FOUNDATIONS Firm specific	SUPPORTING DETAILS (Quotes/archival data)
Sense	Exploitation of media landscape	"Especially (project name), it's a project that is named a lot in the media because of its principles when it comes to a circular design, biobased design, energy…clients come to us because they see what we do and they see what we think. It's important also on our website and in our communication, that's definitely a big factor… " Interviewee FA1.
	Competitions as market reflectors	"There was one (competition) couple of months ago which really asked for a bio-based vision for some dwellings… I think clients and even competitions are asking these questions (CE requirements) more often…" Interviewee FA1.
	Ambition brainstorming	"Next week we are going to do some brainstorming and design thinking with clients for the project ambitions… thinking about circular design and healthy environments. This part of the business is also new for us, participation gets more important" Interviewee FA1.
	Employees Specialisation	"We have decided from this year that everybody has to develop or become an expert in some topic related to circular design…" Interviewee FA1.
Seize	Information as motivation	"The booklet that (architects name) is writing about the positive footprint, and all the things that you can do to make your building have a positive footprint …we shared this book with clients to incentivize them…" Interviewee FA1.
	Material Passports development	"Introducing a system of material passports made it possible to continue to innovate during construction. The passport records exactly what goes into the building" Interviewee FA1.
	CE tool Distribution	"The booklet that (architects name) is writing about positive footprint, and all the things that you can do to make your building have a positive footprint …we shared this book with clients to incentivize them…" Interviewee FA1.
Reconfigure	Knowledge sharing schemes	""We have decided from this year, that everybody has their expertise and that we share that expertise. And for example, we have folders where people can find an excess, all the information…" Interviewee FA1.
	Team reorganization skills	Teams should be smaller and concise for CE projects, otherwise we lose the focus and takes longer to inform everyone" Interviewee FA1.

Table 11: Firm B summary of micro-foundations of dynamic capabilities, Source: Own elaboration

4.1.2 CASE STUDY B

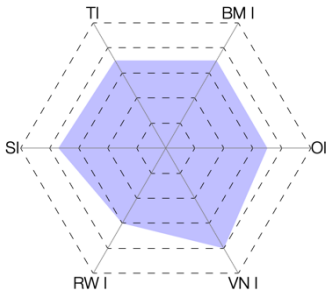


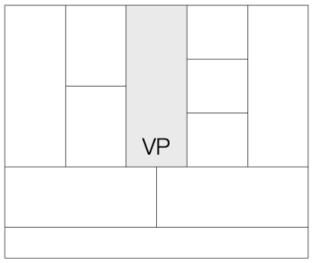
Figure 16: Questionnaire results Firm B, CE innovation sectors, Source: Own Elaboration.

S1FB CE APPROACH : Firm B has been operating in the Netherlands for more than sixty years. According to the interviewees, the principles of sustainability have been embedded in the firm's vision for generations, and its visible in projects dating from 50 years ago. Their approach to CE is not the only driver, but rather one piece of a holistic vision towards delivering sustainability in the built environment.

"I think it's funny to see that it's also something that was already embedded (...) some circular strategies are already embedded for years..." Interviewee FB1

The analysis shows that for Firm B positions CE and suitability as parallel notions. The firm associates both concepts with the responsible use of materials and the advocacy for building only what is strictly necessary. They explain that in the last 10 years, the CE has become a subject of attention in the construction industry and hence a stronger part of their firm. Although the CE is described by the interviewees as a design driver, they recognize that is not always applied to its full extent in all projects. Implementing CE largely depends on their relationships with clients and suppliers. In addition, the questionary shows that the field in which they have innovated the most in their approach to CE is value network innovation (VN I). As Figure 16 shows and also interpreted in the interviews, in the last decade firm B's approach to CE has gone from a more traditional value network with limited actors, into an approach that involves full collaboration with stakeholders along the entire value chain of buildings.

S2FB CE IMPACT ON BM: As observed in Figure 16, Firm B doesn't show as contrasting results as Firm A, yet BM innovations still presents a low perception compared to other categories of innovation for CE. The following sections provide insight into the current stage of Firm B's BM in relation to CE.



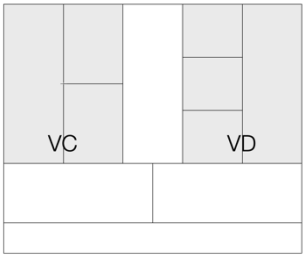
Value Proposition: Firm B described its value proposition as an Integral Design approach between Project Assistance and Product Design services. The interviewees stressed the link between the two services as crucial for the delivery of CE.

"Is not only a design of the physical building but is also a design for the process...". Interviewee FB1

According to firm B, product design services for CE architectural products requires to be complemented by extensive project assistance services at various phases of the project including initiation, construction, use, and end of the lifespan. Furthermore, their integrated design approach to CE is linked to the perception of the architectural role as role as a central coordinating point. They believe that the expansion of the architect's role to project developers or business case creators is not a niche they are interested on. According to the interviewee, the development part should be the responsibility of other stakeholders, as it might interfere with the core nature of the architects' profession. Moreover, they clarify that their value proposition doesn't offer any services related to reverse logistics, beyond designing for deconstruction and recovery. In that sense, the deliberately hesitate to take the responsibility of taking materials back from clients and buildings. However, the interviewee recognizes that there is a business niche in reverse logistics, represented by take-back systems in the CMBC. Past employees have started their own companies, taking advantage of CE business opportunities that Firm B is not.

"We buy materials, we collect them, and we tried to show them to different clients?... in that sense, to answer your question...we as an architecture office are not doing that part." Interviewee FB1

The analysis indicates that these new ventures, led by architects, are focusing on urban mining, collecting building components and materials, which are then treated and resold in the market. They reach out to customers who are looking for these services through online platforms and product catalogs. Furthermore, these new BM, offer training to clients as part of their value proposition to incentivize a CE and sustainability culture. The results show that entrepreneurial architects are offering different value propositions beyond product design and development services as Firm B yet Firm B doesn't consider them a threat but rather a potential collaborator for their projects.

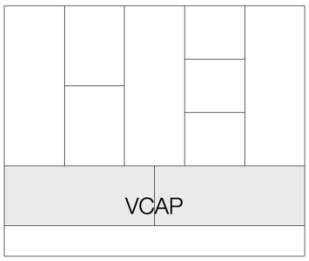


Value Creation and Delivery: Firm B highlights that one of the main challenges for CE implementation in their projects is the discrepancy in the CE concept among the entire value chain. The differences have impacted projects' ambitions and made it arduous to have clients, suppliers, and contractors under the same umbrella. The previous case study (Firm A) developed a CE supplier catalog, which allows them, through detailed specification, to steer the supplier selection. However, Firm B has worked with suppliers appointed by clients or contractors, who had no expertise in CE projects. As a result, they had to carry them through the process. Hence, they express that CE needs changes in the key partner that they work with and a stronger steering capacity by architectural firms.

Firm B recognizes the need to develop new key resources to embed CE in the way they create and deliver value. Currently, a team is developing a new resource to overcome challenges related to lack of CE knowledge along the supply chain. It will allow Firm B to better interact with stakeholders, making CE strategies transparent, measurable, and more tangible for clients. Through the toolbox value creation and delivery are divided in four sections. They narrate the key activities that Firm B considers necessary for CE implementation. First, together with the client, a CE ambition for the project is stablished. Second, the design strategy, which focuses on prevention, value retention, and value creation. Prevention refers to getting the assignment right. The team wants to know the question behind the question, this saves materials, costs, and space. Value retention refers to retaining as much of the original building as possible. Finally, value creation means designing for the future including the use of sustainable materials, minimal use of raw materials, and energy consumption concerns. Third, the tool contains a card with CE tools for each building component (façade, interior, installations, etc.). Fourth, it contains a stakeholder card that indicates the experts needed for each CE strategy (10 Rs). Both are located in a dashboard where the client can see exactly how the CE is affecting the project, how the budget is being used, and understand how circular the architectural product is.

The team developing the tool described that getting financial support for this special project was challenging. Moreover, they need to spend time between design tasks and developing the tool, which puts constraints on how fast the toolbox is developed and increases their tasks. They state that bigger firms can dedicate a full-time team to CE development while medium and smaller firms struggle to develop said tools. They also plan on testing the CE Toolbox with real estate developers, internal focus groups, and to evaluate and learn from previous projects.
Other key resources, include the use of the circular economy index to benchmark their projects. It involves an educational trajectory where employees learn how to use and calculate CE indicators. Furthermore, a material library is being developed to facilitate

design tasks. In order to develop these tools, the interviewees stressed changes in the key partners that they work with. New strategic partnerships include collaboration with universities who have become both, clients, and knowledge source. Similarly, other key activities include participation in fairs and material districts to increase CE knowledge, and networking for new partners. Real estate has also become a key resource for value creation. The interview sheered light on the importance of the firm's location, to partner with neighbors for possible collaborations and knowledge sharing between industries.



Value Capture: In terms of cost structure and revenue streams, Firm B believes that economic ambitions should not be the main driver behind CE, but rather the societal and environmental ambition of both, architects, and clients.

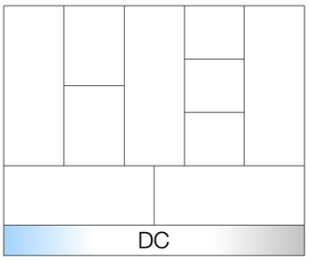
However, in their experience, this is quite challenging to achieve. Clients have high CE ambitions for their projects derived from their individual corporate strategy. Nevertheless, their budgets frequently falls short from those expectations. The discrepancy between expectations and client's budget have impacted the revenue streams of Firm B and their overall monetary value capture. This is visualized in the extra number of hours and resources that the firm has to invest in order to find a middle ground. Often these is not recognized by the client, leading to monetary loses and frustrations with the enjoyment of the work.

The interviewees` expressed discrepancies on their view to the architects responsibilities in front of clients' restrictive budgets compared to high expectations. On one side, one of the interviewees in a management position, stated that circularity can be achieved with any budget, and is the architects responsibility to create enough space for innovation that matches clients' requirements. Under this statement, the architectural firm needs to put extra effort and resources to match uninformed ambitions from the client-side.

"When there is no budget, there is no innovation, therefore if you want to set some goals for circularity, you must go one step further. The lesser the budget you have to make your thinking go further with those constraints..." Interviewee FB1

On the other hand, the other interviewee expressed that is the client's responsibility to have a budget that matches their ambitions, and architects should not incentivize a culture of doing more for less. This culture has become normalized among the creative industry, as there will always be a competitor willing to sacrifice monetary value to increase their professional value in terms of reputation and possible future projects. Finally, Firm B explained that in order to overcome these challenges, they had to come out with creative ways to make financial space in other services provided to the client. This allowed the firm to recover some of the monetary value that clients are not willing to provide. The interviewees agreed that a change is needed in the entire industry and that governmental action is necessary to set better fee regulations, and that tendering procedures should be quality driven rather than monetary driven.

S3FB: MICRO-FOUNDATIONS OF SENSE, SEIZE AND RECONFIGURE



Sense: Firstly, firm B emphasizes that the location of their office is of significant importance to sense and shape new opportunities that could have not been identified in previous locations. They have developed their office into their business card, attracting neighboring companies focused on CE and other sustainability strategies. These new collaborations have opened space for CE opportunities beyond the traditional front door clients.

"Chances for innovation or a new project especially in relation to circularity, those people, those clients, suppliers or partners they are entering in through the side door or the back door." Interviewee FB1

In a second micro-foundation, market monitoring is important to rethink the question of what is being asked from architects in contemporary times. Firm B has developed processes to be aware of the past and present needs as this allows for holistic view of how the market is evolving. Furthermore, awareness also includes monitoring competing firms. Early client involvement skills allow for a better understanding of the design brief specially when it comes to CE, as more time is needed in the beginning of the project. Finally, knowledge creation has become critical. Firm B uses retrospective learning to study previous projects as ways to improve its delivery of CE. Moreover, they participate in symposiums, fairs, and material districts to acquire knowledge about bio-based materials, new construction methods, and the latest development for CE.

Seize: Building characteristics as motivation-base, supplier selection by architects, academic institutions partnerships, and CE toolbox development are the main micro-foundations of Seize identified among Firm B. Buildings as opportunity banks, allows Firm B to look for opportunities in existing buildings that then become central negotiation points with clients steering the ambition towards CE strategies and allowing the firm to consolidate its vision. Firm B actively implements collaboration as one of their main processes for CE, especially with academic institutions. Furthermore, they emphasize on the importance of developing schemes that allow architects to have a bigger role in the selection of suppliers for the correct implementation of CE. Finally, developing tools like the CE toolbox is on their view, the next step to change the way businesses are made and how projects are proposed to clients.

Reconfigure: Internal knowledge spread, generational integration, client business model awareness, CE team development, and establish a circularity ambition are the top micro-foundations identified in Firm B. The firm developed an educational trajectory, to spread knowledge internally about circularity index calculations. They also stress the need to increase knowledge in bio-based materials and detachable building techniques. The questionary showed up differences in CE perception among older employee's generations and new architects who were trained in an academic environment that was further advanced into sustainability and CE concepts.

. "When filled the questionnaire, we realized that (top manager name) had a different idea than us, about how far we were our CE ambitions. He thought we were further than what we consider, so we had to come out to an agreement" Interviewee FB2

Finally, it's important to reorganize the structure of the firm to establish a dedicated team for CE embedment in the BM and the establishment of a coherent vision that allows for further reconfiguration of the resource base and the BM components.

CLUSTER Higher DC	FIRM MICRO-FOUNDATIONS First Order Concepts	SUPPORTING DETAILS (Quotes/archival data)
Sense	The side door skills	"Chances for innovation or a new project… especially in relation to circularity, those people, those suppliers or partners or other advisors… it (opportunity) never comes from one side, but two sides, three sides…" Interviewee FB1.
	Office as your business card development	"Because we are under some sort of innovation site, and it reacts… one of the other offices at the end of the volume are energy transition makers… so we got the chance to work together ." Interviewee FB1.
	Past and present market awareness	"Some circular strategies have been already embedded in the firm for years… so it's about taking from the past, taking from what is happening in the surrounding and rethinking the questions from what markets want" Interviewee FB1.
	Competition monitoring	"Because all these firms (competitors) are doing it, we are also thinking about what we are doing, and I think that also gives an extra boost to change and look for opportunities …" Interviewee FB2.
	Early client involvement skills	"Circularity is a really big subject, one of our ambitions is to find out together with the client what they want to do, and what is logical to do… we always start with what is the question and we must also find out as well, the question behind the question" Interviewee FB1.
	Retrospective project learning development	" It's something we are trying to do more and more, learn from our projects. " Interviewee FB1.
	Participation in material districts	"Some of our colleagues are now in the material district. which is an exhibition for 3 days to find new materials. In that sense we try to educate ourselves as much as we can" Interviewee FB1.
Seize	Buildings characteristics as motivation-base	"because of the existing technical situation over there (building foundations), it worked as a lead or as starting points to push a circularity strategy in the project…" Interviewee FB1.
	Supplier selection by Architects	"The question of circularity becomes more and more embedded in the firm; we also start looking for other firms that are able to help in this question….so yes there is a direct link with whom you choose to work with… Not only with partners and other suppliers but also with the neighbors" Interviewee FB1.
	Academic Institutions Partnerships	"Because of that (university as a client), we are working together with universities … they are thinking about change, it's really changing us that's the funny thing about what we are doing…" Interviewee FB2.
	Circularity toolbox development	" We are developing a Circularity Toolbox that will help us to guide the company and the projects…" Interviewee FB2.
Reconfigure	Internal knowledge spread skills	" "We started to have a sort of educational trajectory, to get people involved in how to make Circularity Index calculations… also knowledge about materials, knowledge about how to make details and how to disconnect everything. that's something (knowledge spread) that we are doing on the floor as well" Interviewee FB2.
	Generational integration	"When filled the questionnaire, we realized that (top manager name) had a different idea than us, about how far we were our CE ambitions. He thought we were further than what we consider, so we had to come out to an agreement" Interviewee FB3.
	Clients' business models awareness	"You also have to understand your client's business model, in order to push their ambitions" Interviewee FB1.
	"CE Team" development	"We organize an internal team to develop our CE ambition. However, bigger firms can have someone dedicated to this task 24/7, we can't" Interviewee FB3.
	Circularity ambition	"Together with two other colleagues, the three of them are busy developing a circularity ambition for the office…" Interviewee FB1.

Table 12: Firm B summary of micro-foundations of dynamic capabilities, Source: Own Elaboration

4.1.3 CASE STUDY C

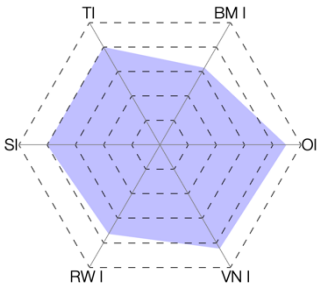


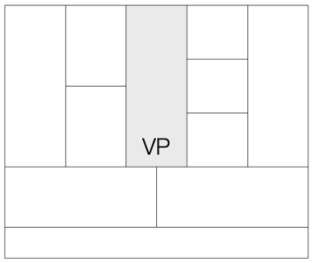
Figure 17: Questionnaire results Firm C, CE innovation sectors, Source: Own Elaboration.

S1FC CE APPROACH: Organizational Innovation (OI) and Value Network Innovation (VN I) are perceived as the highest areas of innovation for CE by Firm C. (Figure 17). Both areas strongly relate to their approach to CE.

The interviewee explains that in the last years they have strongly worked to redefine their vision, culture, and core values, especially in relation to CE. Firm C has translated CE and spread its principles among five core ideals that lead the company. These ideals reflect on context, community, new aesthetics, flexibility, and new values . Through these five principles where CE plays an important role, Firm A aims to solve social issues as they believe architects have the responsibility to shape a built environment that deliver shared value for all stakeholders respecting the history the location, nature, and future living environment.

Firm C emphasize that the further development of these principles is accompanied by the evolution of how they collaborate with public and private actors. In this regard. They have actively established strong collaborations systems in the whole value chain regarding, raw material use, re-use of existing real estate and components and academical development for CE

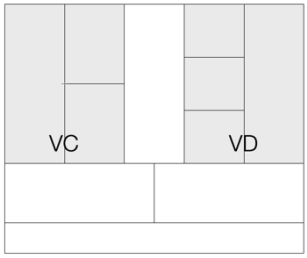
S2FB: CE IMPACT ON BM: As seen in figure 17, BM innovations similar to case A is the lowest are of perceive innovation for the firm.



Value Proposition: The value proposition of Case C, at first sight, is similar to cases A and B. Their offer to clients mostly focuses on Project Assistance and Product Design for three specific expertise that includes urban planning, building repurpose, and new architecture. However, the interview revealed that CE has played an important role in the expansion of their value proposition in the market towards offering Product Development, which includes the process-oriented services necessary to realize the designed product. Additionally, their value proposition also includes Business Case Development, which consists of the services that are necessary to design and realize a marketable product that has its own revenues stream.

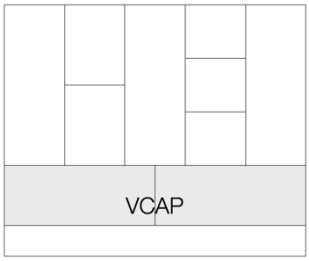
These new services are not done directly through the architectural firm but in collaboration with a new development venture or sister real estate development company that prioritizes the delivery of “detachable” buildings, and the utilization of biobased and fully reusable materials as much as possible. As the interviewee explains, in the last years they have become project initiators, as a response to the tardiness of developers and investors to provide projects that aim for CE and sustainability goals. Their developer function has boosted the architectural branch's long-term thinking, which has impacted their Product Design and Project Assistance offerings. This is due to their direct investment at stages of the building's lifespan where they previously just worked as advisors.

“You must begin to take the initiative. If you are waiting and complaining as an architect to developers and investors you will never succeed, you must do it yourself”
Interviewee FC1



Value Creation and Delivery: In order to create value under the above-described value proposition, which includes product development and business case development; Case C had to find new key partners with a different mindset, who were willing to invest in what they describe as one of the most innovative buildings in the region in terms of sustainability and CE strategies. These key partners are described by the firm as pioneers. Parallelly, they represent a different customer segment looking for distinctive types of architectural products, away from anonymous building that don't reflect their values for a sustainable lifestyle.

The pioneers become key stakeholders as they not only act as investment partners but also as future inhabitants of the project. The interviewees explain that due to this double role, their customer relationships were different, as these stakeholders were included in the decision-making process in terms of building programming, flexibility demands, housing layouts, material choices, etc. They also mentioned that the decision-making process was framed within a CE framework developed by the architectural branch. As explained above, collaboration has become critical to create partnerships, especially for projects where they are the developers. Specifically, new construction typologies and circular materials broaden their stakeholder cloud. As result, academic institutions, specialized material suppliers in different geographical contexts, bioneers, biodiversity experts, and other actors who are not present in convectional projects became involved. Finally, agreements to ensure confidentiality were also important due to the novelty of the technology in materials and construction methods.



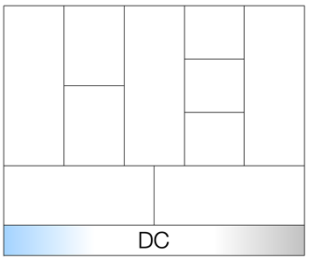
Value Capture: Case C, stresses that one of the main challenges in CE projects is to capture enough monetary value for the firm. Currently, the cost of sustainable and CE-based construction is quite high compared to conventional projects. Hence, to compensate for the costs and ensure enough monetary value, the firm needs the support of financially strong partners driven by sustainability ambitions.

Furthermore, they employ innovative ways to secure monetary value for the company. For example, using flexibility as a CE design strategy in terms of layout and apartment combinations allows for greater pricing per square meter, resulting in increased revenues that pay for additional investment expenses.

Another strategy for firms' survival in terms of value capture is the change of approach depending on the short-term or long-term needs of the office. For example, if there is a lack of revenues streams at a specific moment, the firm develops projects with lower sustainability and CE ambitions that will ensure a short-term influx of financial resources. Then the firm can use this capital to keep operating and focus on its long-term goals or redirect this capital into projects with higher ambitions for CE. At the same time, the interviewee stated that their attitude toward monetary value capture is different from that of traditional developers. Traditional developers aim to maximize monetary value capture, whereas the approach of the firm is towards securing enough revenues for the firm's survival but not for maximization. Instead, their main objective is the intensification of social and use value capture for the inhabitants of the building and the areas of intervention.

"Profit is absolutely important but not number one... this is really needed for this type of innovation otherwise it is impossible, that is why we took the initiative ..."
Interviewee FC1

S3FC: MICRO-FOUNDATIONS OF SENSE, SEIZE AND RECONFIGURE



Sense: Speak out skills, monitoring of unsatisfied markets, workshops with pioneering clients, and knowledge networking skills have been identified as the main microfoundations to sense and shape CE opportunities and threads in the market.

In order to find new clients and opportunities, Firms C's philosophy is to be outspoken. The interviewee stated that architects need to use all their resources to spread their thoughts and ideas to find people with similar mindsets willing to move away from linear consumption lifestyles. Being active on press releases, social media, and digital channels is a great way to communicate their goals to the market. Furthermore, new ventures can also appear from informal conversations in social events where different industries are present.

Monitoring has allowed finding CE opportunity niches in unsatisfied markets as the social housing market, yet this cannot be the only one as this can evolve into financial challenges. Furthermore, close work with pioneering clients, through workshops, has allowed the firm to understand new ways to push CE principles not only in the design or the project but also to influence the lifestyle of the future inhabitants. For example, by extending the program of the common areas to allow repurpose, repair, and remanufacture activities by residents and the surrounding community. Finally, networking skills have allowed Firm C to generate new knowledge in terms of bio-based materials, biodiversity, and new construction methods. Knowledge generation is also handled through retrospective learning from previous projects.

Seize: Architect as a developer capacity, expert circle, and confidentiality agreements have become core micro-foundations for Firm C. Evolving their real estate development skills allowed the firm to exploit CE opportunities that were missed before. More importantly, this microfoundation gave the firm a stronger power in the decision-making process, allowing them to achieve societal value that was not possible when traditional developers were involved, as they prioritize monetary value.

Surrounding yourself with a circle of experts in CE delivery is extremely important. This permits the firm to provide expertise to the client, which is currently not in-house. Academic institutions have become a pivotal part of this expert circle. Furthermore, establishing agreement systems guarantee a competitive advantage for both, suppliers, and architects.

Reconfigure: Finally, internal knowledge spread, business model design skills , and the establishment of core values allow Firm C to constantly reconfigure structures and resources that have turned rigid. Internal knowledge spread includes the establishment of a learning academy inside the firm and the appointing of a learning development manager. This learning system allows knowledge to be continually updated through the firm. Business model design skills are the ones that allow Firm C to expand its value proposition portfolio into product development and business case development. However, is important to say that these skills are mostly restrained to top management inside the firm and not among architects in middle or junior roles. Finally, since the development of the five core values Firm C has been able to reconfigure parts of their BM to the best of their capacities aligning with their vision for CE.

CLUSTER Higher DC	MICRO-FOUNDATIONS (Firm Specific)	SUPPORTING DETAILS (Quotes/archival data)
Sense	Speak-out skills	"In order to find people (clients), the answer is easy: be outspoken "Interviewee FC1.
	Pioneering clients	"We started this project with 6 pioneers. You need to attract people who like your kind of approach or that kind of building" Interviewee FC1.
	Unsatisfied Markets	"Middle-class rent is very important for social sustainability; it needs to be affordable for the police officer and the nurse. This project should be an inspiration for the new generation" Interviewee FC1.
	Knowledge networking	"The case we are facing now is to explore more knowledge about materials, biodiversity, and construction methods. If you know your circle, you know where you can find your knowledge." Interviewee FC1.
	Learning from projects	"Even we learn from our insight and from our outside… this means going to our projects and then talk about it and see it together" CASE" Interviewee FC1.
	Workshops with pioneering clients	"Workshops with pioneering clients to see how can improve our program and ambitions" Interviewee FC1.
Seize	Architect as developer	"In (Project Name) we are not only the architects but also the developer. We took the initiative for the project… it allows us to take our vision further" Interviewee FC1.
	Expert Supply Circle	"We have a kind of circle around with people who have expertise on that (CE Knowledge. We don't have it in our own company for renewable materials and component fabrication…" Interviewee FC1.
	Universities as knowledge suppliers	"For a specific project, we have been collaborating with universities in multiple ways to help us develop all the components from this building" Interviewee FC1.
	Confidentiality Agreements	"Agreements to ensure confidentiality was also important due to the novelty of the technology in materials and construction methods…" Interviewee FC1.
Reconfigure	Internal knowledge academy	" We have an academy this is important, and also a learning development manager where his expertise is learning and how to train people " Interviewee FC1.
	Internal update spaces	Every 6-7 weeks we have internal talks about what we are doing to update projects and then it's also sharing knowledge …" Interviewee FC1.
	Business model design knowledge	" The business model especially changed by developing ourselves (real estate development), I think this is the biggest change" Interviewee FC1.
	Addition of specialized professionals	"We introduced a learning development manager, and software specialist to improve our response… " Interviewee FC1.
	Internal core values	"We established our main principles… our core values and of course, everything has a relationship with sustainability and circularity" Interviewee FC1.

Table 13: Firm C summary, micro-foundations of dynamic capabilities, Source: Own elaboration.

4.1.4 CASE STUDY D

"Finally, the awareness breakthrough. I mean, it was like shouting in the desert to somebody who didn't want to hear you" Interviewee FD1

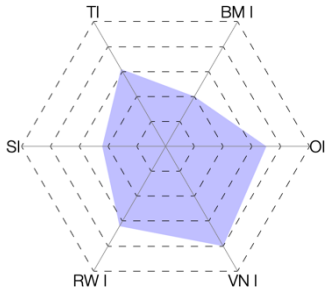


Figure 18: Questionnaire results Firm D, CE innovation sectors, Source: Own Elaboration.

S1FD CE APPROACH: Firm recognizes a strong change in the construction industry in the last decade. In their 30 years of experience in the Dutch construction sector, Firm D has undergone an evolutionary process, where the CE is perceived as one more step on their journey to a more sustainable built environment.

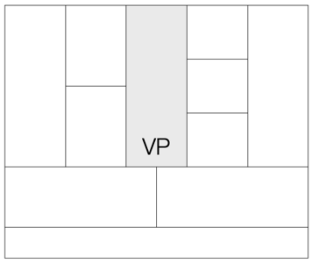
"During the last 30 years, every time they're coming up new, let's say items, new ways of talking about it (sustainability in the built environment). So, we have the handbook of sustainability, that was the 20 years ago, and then we had the discussion on cradle to cradle (...), but the basic is and you will hear me say it a lot (...) is not making things we don't need is the most sustainable thing we should do. So, I think all these terms are about why are we making things? do we need it? can we make it smarter? can we make less? can we use less? (...) that is real sustainability" Interviewee FD1

They describe their approach to the CE as hesitating. On one hand, they recognize that it is a powerful means to solve current global environmental challenges, and hence they offer it to clients as part of project visions and through the 10Rs design principles. On the other hand, they stated that CE is a concept that is being pushed in the market by other sectors like the concrete industry. They are creating a forged narrative about how to achieve sustainability, generating confusion in the concept. This ultimately leads to the entire construction industry forgetting the big picture and instead putting their efforts in a very small part of the problem. This means developing products that fit in with the CE concept but that are not solving the problem of a better world with less pollution and waste.

"I think CE and circular design could be a means towards this goal (sustainability in the built environment) you know, where we respect our planet and the world, etc. . But if the means becomes the goal in itself, then we get a bit lost. I think that's what's happening now." Interviewee FD2

The analysis shows that Firm D's vision focuses on sustainability in the built environment. In this regard, they evaluate multiple strategies to achieve it, being CE one of them. However, they are clear that the concept still needs development specially, one that is accepted by the entire industry supported by guarantees and explicit goals. Furthermore, they are focusing on carbon emission reductions as a new principle to deliver sustainability. They describe it as a more tangible, measurable, and with results that have results in the present rather than decades in the future like the CE promises.

S2FD CE IMPACT ON BM : As illustrated on Figure 18, the field of BM is the lowest area of innovation scored by Firm D. Based on the qualitative data gathered, iteh analysis suggest that CE has not majorly changed Firm D's BM in terms of value proposition, value delivery and value capture. The following subsections present the results.



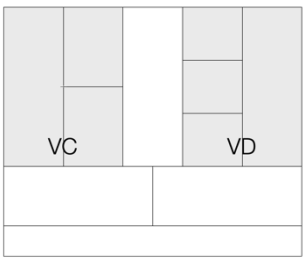
Value Proposition: Firm D defines its value proposition for clients as an integrated solution. In that respect, they offer Project Assistance, Product Design, and advice for Business Case Development based on three pillars: connection, future, and innovation.

On one side, their offer is strongly based on facilitating a broad range of process-related services not only to start the project but also for its further development. They describe themselves as being the creative link and process conductors that link people, projects, and places from beginning to end. On the other hand, their product design services have always been offered from a sustainability standpoint. Their design core is to be future-oriented, addressing climate change and primarily focusing on social and environmental value delivery. The interviewee explained that these values have always been included in the vision of the firm and hence the CE has not drastically changed its approach toward the solutions that they offer to clients. In that respect, their value offer is described as realistic. They explain that during the communication with clients, the firm tries to set achievable, tangible, and measurable goals for the built environment. Different than other firms who have made the slogan of being "sustainable architects" part of their business model rather than achieving it.

"In answering your question... what we do for CE, that's I think one item of the whole. Because what we offer to the client is a broad office with a lot of knowledge on several aspects related to sustainability..." Interviewee FD1

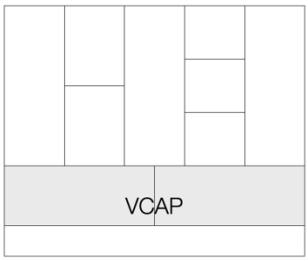
In light of CE and suitability goals, their process-related services have become increasingly important. As they explain in the interview, clients are struggling to set ambitions and goals for their projects. This is the result of the abundance of names (C2C, CE, CO2 Reduction) and the constant evolution of the strategies behind sustainability in the built environment. In that sense, it's concluded that similar to the other case studies, their value proposition or the type of services have not changed, but instead, it has become more complex putting pressure on the firm to develop more capabilities to assist clients.

"A lot of our clients we find are struggling a little bit. Where should we focus on sustainability? There is such an abundance of new names... they're confused. They don't know where to focus on and they lose interest..." Interviewee FD2



Value Creation: The interviewees revealed that in terms of customer segments, their main focus is on social-oriented development which represents up to 40% of their projects. This specific niche allows them to work with key partners like housing associations, differentiating from competitors, as they perceive that most firms aiming for suitability ambitions focus on middle and high-end market segments. This type of customer relationship allows them to achieve their goal of delivering societal value.

In order to deliver its design services, Firm D implements innovation as one of its key resources. Specifically, the use of smart building methods and data analysis software that supports their product design and project assistance services. The use of digital tools helps the firm to stand out in the market and make faster choices in every phase of the project. Furthermore, another key resource is its approach to inclusivity and diversity in terms of work force. The firm has improved its policies to hire a balanced number of men and women from different academic and cultural backgrounds. This approach is also important for the firm, as they contribute to social sustainability in the built environment and enables them to offer clients a diverse and wider outlook of the construction and design sectors.



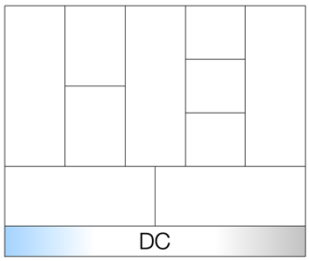
Value Capture: Firm D's strategy to capture enough monetary value for the firm's survival consists of strategically working on different segments like offices and social housing projects. Office buildings allows them to use a different business case that secures financial stability, as the ambition for this type of project is often different than for other project with less sustainability requirements.

"It might sound a little bit arrogant, but I've never been busy with: How can we make money? I mean it's kind of what it is to have a balance. .... Our ambition should all be a little bit in the middle..." Interviewee FD1.

However, they emphasize that their ultimate goal is not revenue driven, but rather capturing social and environmental value has a heavier weight. Some of their projects include advising for project development free of charge, especially in developing countries, where clients cannot afford their fees. In conclusion, the firm prioritizes sticking to its reputation as a societally driven firm rather than allowing financial goals to interfere with the vision of sustainability.

"I think our approach has always been about sustainability, and you cannot just say, well, I made a very sustainable building, but I'm sorry, it's just for the higher 10% of the world to live in..."

S3FD: MICRO-FOUNDATIONS OF SENSE, SEIZE AND RECONFIGURE



Sense: International market monitoring, client participation mechanisms, look-back systems and vision strategies have emerged as the main skills developed by Firm D to sense opportunities in the market.

They explain their strategy to public communications as one that is palpable and obvious. In that sense, they don't aim to smear the term of sustainability all over social channels and online platforms, but rather let their projects talk. They do not aim to use sustainability as a way to say, "we are different" and there are other ways to get the same goals. Instead, their narrative to clients is that sustainability is the only option. One of the interviewees emphasized on the importance of emerging international markets as new niches for CE. To their view, these markets present unique characteristics to implement CE as their processes are not embedded in a huge and interconnected value chain. Rather, they focus on local production and small value chains, which present opportunities for CE that industrialize countries don't.

" I mean if we think somewhere else is possible, we have so much opportunity. They already managed; they are ahead of us (...) they already understood and used everything, and we are sloppy..." Interviewee FD1.

Furthermore, developing mechanisms for client participation in early stages, allows the firm to collaboratively organize different ways to integrate suitability through CE principles into buildings, understanding the question behind the question. Finally, , looking back into their projects as a leaning mechanism, has allowed them to generate knowledge inside the firm and find opportunities for improvement in coming projects.

Seize: Long-term motivation schemes, architect as initiators capacity, software development involvement, tool development, and guarantee systems have been identified as the competences that allow Firm D to exploit CE market opportunities.

Projects with strong sustainability ambitions take longer periods of time. Hence, there is a need to establish motivation schemes to keep all stakeholders involved in a way that the project's ambition doesn't deviate. Moreover, in order to exploit market opportunities architects, need to be self-driven and look for solutions themselves, and not wait for the market to solve it. This applies specially in the CE context where due to the high demand of collaboration, stakeholders often expect that other actors will give the answer. They have also developed tools like ambition documents that include project scores, and BIM software that make sustainability and CE outcomes visible and tangible for clients. Tool development is not possible without the collaboration of experts that were not part of projects in the beginning of the company like software and BIM developers. Finally, the explain that guarantee systems from policymakers is lacking to ensure that their efforts to achieve sustainability are not erased by the next wave of concepts and ideologies about the built environment.

" We tried many strategies, we carefully developed a catalog of existing components to be repurposed in the new building, but everything went to the trash pile because suddenly the regulations changed. There were no guarantees, that our investment and actions will be actually useful in the future. We need to rethink the systems..." Interviewee FD1.

Reconfigure: Through knowledge sharing platforms, and one of one sharing, Firm D is able to learn more about their organization but also identify areas or structures that need to be reconfigures to align with their vision.

"I always believe in is 1 on 1 sharing. Passing skills and knowledge, now I'm also sitting with the two of you, and I learn again" Interviewee FD2.

The interview showed that Firm D, employs protocols to measure their workload, allowing them to reconfigure their key activities and resources in the most efficient way, as their vision changes. Furthermore, they have developed a new narrative or paradigm for their office , which allows them to interchange their BM components in a distinctive way than the other case studies. Finally, they explain that what really influences the work of architects, and their business models is the narrative behind the current architectural discourse. Hence, if architects control the narrative, they can reorganize how it is supported by their activities.

"We have a certain carbon budget for our planet at the moment. The amount that we can emit in total. So, you could calculate how much is that for the Netherlands, for example, in terms of inhabitants and then you can start to calculate how much is that for the building industry and you can calculate, how much can we then emit per square meter? So that's something we're doing at the moment" Interviewee FD2.

CLUSTER Higher DC	KEY INFORMANT TERMS First Order Concepts	SUPPORTING DETAILS (Quotes/archival data)
Sense	Clear Statement development	"I think that our approach has always been more (...) we think we should not tell them that we build sustainable because that should be always obvious…" Interviewee FD1.
	Emerging international markets monitoring	" I mean if we think somewhere else is possible, we have so much opportunity. They have already managed; they are ahead of us… They already understood and used everything, and we are sloppy…" Interviewee FD1
	Client Participation skills	"So, then you can with your client really from start… work together how you can organize a different way of seeing things. We try to start at the beginning, ok what is the question behind your question as a client" Interviewee FD1
	Look-Back as learning mechanisms	"Building is also making decisions and looking back in our projects. I always think ok we suggested this but yeah, ok… we can always readjust and improve the next time" Especially, knowledge about materials… so that then we know how we can use them for circularity" Interviewee FD1
Seize	Long-term motivation schemes	"When you offer this kind of services (sustainability-related services) that your client it's interested in, we need to convince and motivate everybody. So, we had a year-long talk with the client and all stakeholders." Interviewee FD1
	Architects as initiator capacity	" There is an idea , and people say we don't have to do it, the market will do it, the market will find the solution… architects are the experts, we have to do it" Interviewee FD1
	Software Developers Involvement	"We work with a firm that makes software that we can say how much CO2 is in the building that we are designing. Also, with new software for example on the wind software you try to be ahead" Interviewee FD2
	Ambition score Document development	"We said let's see what the dream score for this building will be (ambition level) and then we made a small booklet for the client…" Interviewee FD2
	BIM as a sustainability tool implementation	"We invest a lot in BIM development to establish a building catalogue including components and emissions" Interviewee FD2
	Guarantees mechanisms	" We tried many strategies, we carefully developed a catalog of existing components to be repurposed in the new building, but everything went to the trash pile because suddenly the regulations changed. There were no guarantees, that our investment and actions will be actually useful in the future. We need to rethink the systems" Interviewee FD1
Reconfigure	Knowledge sharing platforms development	"We have internal presentations and discussions. More importantly, we have an online platform where knowledge and experience are being shared" Interviewee FD2
	One on One Sharing skills	"I always believe in is 1 on 1 sharing. Passing skills and knowledge, now I'm also sitting with the two of you, and I learn again" Interviewee FD2
	Workload & workplace protocol development	"I started to build a program to calculate hours, how much time this (activities inside the firm) takes. From this software, you can also start making procedures. Why would you have to invent something new every week" Interviewee FD1
	New Business practices	"We have a certain carbon budget for our planet at the moment. The amount that we can emit in total. So, you could calculate how much is that for the Netherlands, for example, in terms of inhabitants and then you can start to calculate how much is that for the building industry and you can calculate, how much can we then emit per square meter? So that's something we're doing at the moment" Interviewee FD2
	Multibackground team strategies	"We decided to slowly incorporate different types of people, from masters to practical schools. Later on, we included people from other countries including Europe, and outside of Europe" Interviewee FD1
	Organize the storyline	"Architects have to organize the narrative that the storyline. It's not about telling end of the world stories, but being realistic and factual" Interviewee FD1

Table 14: Firm D summary, micro-foundations of dynamic capabilities, Source: Own elaborations

4.2 CROSS CASE ANALYSIS

The cross-case analysis of the research is based on comparing the analysis and results of the four participating firms and assessing the similarities and differences with regard to the three units of analysis from the empirical research: (1) CE approach, (2) CE impact on BM, and (3) Micro-foundations of Dynamic Capabilities.

4.2.1 CE APPROACH

Firm's Vision : According to the case study findings, the four organizations agree that CE is a viable method for achieving sustainability in the built environment, addressing societal, environmental, and industry-level concerns that endanger the planet. They understand that the concept has gained enormous traction, particularly in the previous decade. However, the analysis of the four firms reveals that the principles of CE have been a component of their architectural discourse long before the concept gained attention. As a result of the study suggests that CE has been embedded by the case studies trough their history, and currently it can be found in the case studies in distinctive shapes. In some cases, more explicit than others.

On one hand, Firm A and C explicitly include CE in the organization's vision. Firm A includes it as distinctive expertise offered to clients, while firm C has spread its principles in the shape of core values present in all of their projects. Firm D, on the other hand, hesitates to mention CE in their vision as they describe the focus should be on the ultimate goal of sustainability. Nevertheless, Firm D's description of their approach to the built environment still touches on the CE principles of optimize resource yields, foster system effectiveness by designing out negative externalities like CO2 emissions, and the preservation and enhancement of finite stocks and renewable resources. Finally, Firm B does not explicitly include CE in their organizations vision, but rather is embedded in the type of architectural products that they offer and on their direct conversations with clients.

CE Concept: Despite the awareness of the case studies regarding the CE notion, none of the interviewees gave a concrete answer on the definition of CE. Moreover, the four case studies acknowledge that there is a multiplicity of CE definitions across the entire value chain in the construction industry. During the interviews with Firm A, B, and C, the concept of CE was often placed at the same level as the notion of sustainability. Firm D was fully aware that the concepts cannot be placed one next to another , stating that the overlapping is obstructing the role of architectural firms to deliver suitability in the built environment through their business models, and that they acknowledgement that CE is means to and end should be made more explicit not only among architectural firms , but also among all industries.

CE in Project Portfolio: The qualitative data suggests that CE is not applied by the case studies at the same extent across all their projects. On one hand, Firm B and A explained that conflict between client's ambitions and their budget often get in the way of CE implementation. The representative of Firm A, indicates that the required return on investment from clients, sets a timeframe that restricts architectural firms to employ CE strategies. However, is not only the client financial constraints, but also those of architectural firms that influence when and how CE is embedded in the firms' BM.

Firm C and D, present similar outcomes, as they state that their occasional need for capital that supports the firms' operations plays a role. In that respect, the research concludes that if the firm needs a short-term capital injection, CE ambitions are affected and therefore applied in less extent to projects. The difference in applicability of CE across projects also means that CE is seen as an individual BM applied intermittently on a project base within a wider constellation of BM applied by architectural firms.

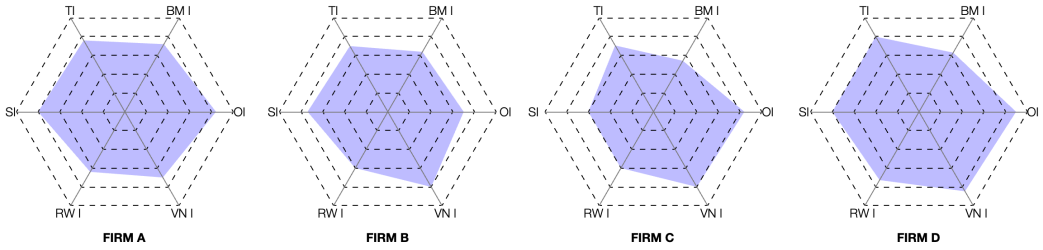


Figure 19: Questionary results comparison between the four firms, Source: Own Elaboration

Furthermore, the collected data suggests that in terms of the six areas of Circular Innovation, which refers to a systematic approach to develop sustainable products, services, and processes that contribute to the transition from a linear economy and society (Lowik, 2020); Organizational Innovation (OI) and Value Network Innovation (VN I) have the highest score, whereas Business Model Innovations (BM I) is perceived as an rea bit little to any changes by the case studies.

Organizational Innovation: The data from Firm A and C shows that they have innovated the most regarding Organizational Innovation. They have gone from no strategy, culture, or systems in place, to a systematic approach to embed CE in their organization. This statement is also supported by the recollection of data from their online platforms, where out of the four case studies they are the most explicit and clear about how they implement CE in their vision and in their projects.

Value Network Innovation: Firm B, C and D, also perceive high innovation in terms of collaboration systems and strategies. The qualitative data implies that through their lifespan they have evolved from limited collaboration to an increase and improved collaboration of their value network in order to achieve CE in their projects. For example, firm C and D have included professionals in fields like BIM and software development, bioneers, biodiversity experts, circularity consultants, learning managers, etc. Experts that have increase their collaboration with architectural offices thanks to the principles that CE encompasses.

Business Model Innovation: This innovation area has been perceived as the lowest innovation are for CE among the four firms. This category concerns, the need for new ways of creating, delivering, and capturing value moving away from linear systems. In that regard, the data shows that the services that architectural firms offer to clients are the same as any other office in the market. However, this research argues that the complexity of how they create and deliver these propositions has increased and is directly connected to the higher score in areas like value networks and organizational innovation.

Technological Innovation: This section refers to the application of technological innovation to allow design for circular flow and responsible material use. In the case of the research this innovation area refers to which design principles (10 Rs) are predominantly being used that by the case studies.

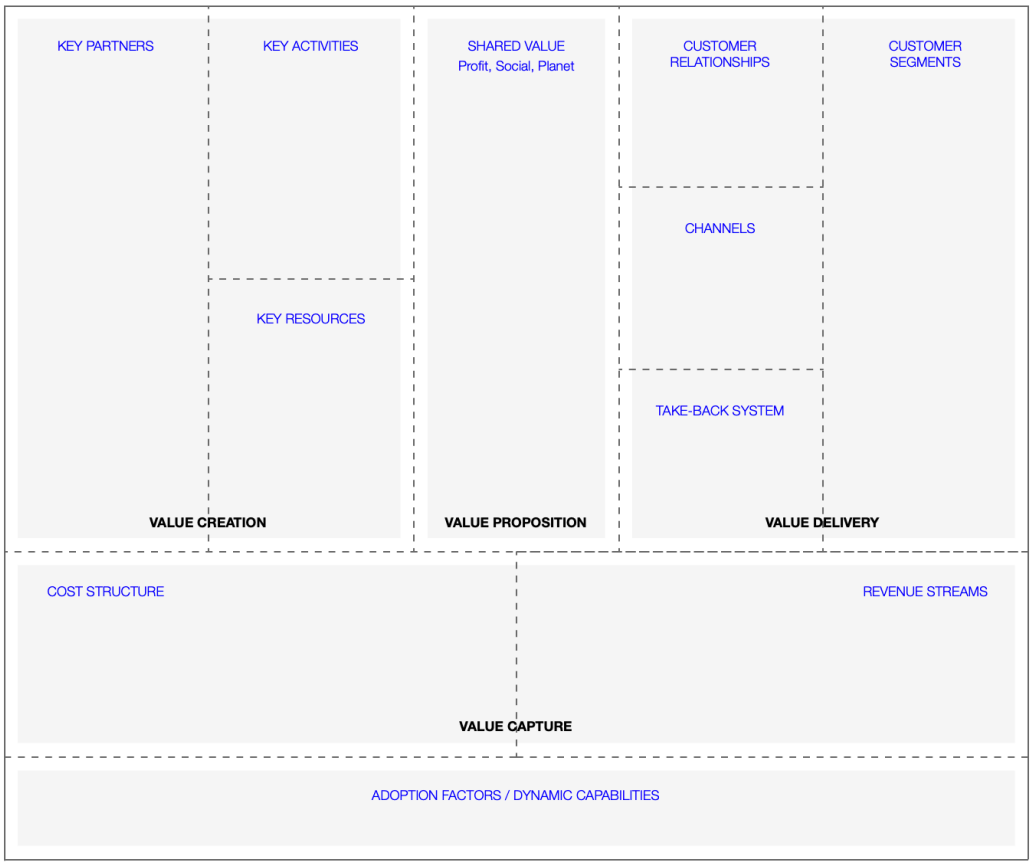
The results show the strategies that include short loops, such as refuse, reduce, reuse, repair are generally used by the four firms. Either in the project's design or by providing spaces in their program for future users to align with theses CE strategies.

Medium loops like refurbish, remanufacture, repurpose are apply in less extent. Remanufacture is not being applied by architects as they believe these competences should be taken by other actors in the supply chain. Refurbish and repurpose are mostly associated by the firm's approach to the renewal of heritage buildings or the lifespan extension of existing real estate. Finally, longer loops that include Recycle of materials, Recover and Remine are not being implemented as technological innovation for CE. The case studies are actively engaging in developing relevant knowledge and even hiring specialized architects, yet these three strategies seem to be challenging to implement. It's noticed that the use of material passport technology to recover materials in the future is applied more and more by architects, however their effects will be perceived in the 40 to 50 years.

Renewable energy process Innovation: Most of the interviewees expressed the importance to comply with requirements to proactively increase energy efficiency in their projects. This area of innovation is a very important selling point for clients as they associate energy efficient in business with productivity and employee well-being. However, it was noticed that the same logic was not applied to their own real-estate as the questionary showed that energy consumption inside the company is not managed with the same bar as for their projects.

Social Innovation: When firms strive for the earth's well-being, they also strive for the well-being of people and society. This means that organizations can go from minimal regulatory requirements to full societal responsibility and stewardship. Although all the interviewees expressed that they social sustainability is important for their firm, the responses in this area of innovation were very different. Only Firm C and A sustained that the UN sustainability goals are very strong drivers in their organization and that corporate social responsibility was embedded in their operations.

4.2.2 CE IMPACT ON BM



Value Proposition: This dimension of the BM canvas refers to services and products offered by architectural firms to satisfy client's needs (Osterwalder and Pigneur, 2010). The CEBM canvas, used as a theoretical base (Figure 6), proposes that organizations aiming for sustainability and CE provide value propositions that offer shared value (Porter & Kramer, 2011; Bocken, 2015).

In this regards the cross-case analysis shows that the case studies are moving away from conventional economically and customer-centric value propositions, but rather considering other stakeholders, like nature and future generations, as direct benefiters of the value that they propose. In this way they aim to create profitable projects that satisfy clients and investors financial needs, but also provide high societal and environmental benefits.

However, the case studies strive to produce shared value through the same specialized services and products as before. In their documents and throughout the interviews they describe the same bundle of services specific to architectural firms as the ones identified by Bos-de Vos et al. (2017). Project Assistance and Product Design prove to be the common denominator among the case studies. However, Product Development and Business Case Development also show significant importance to deliver CE among two of the participants. Table 15 illustrated the main similarities and difference in terms of value proposition between the case studies.

CASE STUDY	FIRM A	FIRM B	FIRM C	FIRM D
TYPE OF VALUE PROPOSTION	○ Project Assistance ○ Product Design	○ Project Assistance ○ Product Design	○ Project Assistance ○ Product Design ○ Product Development ○ Business Case Development	○ Project Assistance ○ Product Design ○ Business Case Development
VALUE DESCRIBED	○ Environmental Value ○ Social Value ○ Economic Value	○ Environmental Value ○ Social Value ○ Economic Value	○ Environmental Value ○ Social Value ○ Economic Value	○ Environmental Value ○ Social Value ○ Economic Value
PROJECT ASSITANCE	○ Services in the beginning of the project take longer	○ Ambition services are often revised taking more time than anticipated	○ Programming and Brief services are often reviewed with clients	○ Clients need more assistance as they struggle with the CE concepts
PRODUCT DESING	○ Repurpose, Reuse, Reduce, life span extension can be perceived ○ C2C principles are present in the firm	○ Repurpose, Reuse and Reduce can be noticed in projects dating from decades previous to the CE concept	○ Principles like rethink, reduce, flexibility, Repurpose and Refurbish have been embedded for years in the firm	○ C2C principles guide their value propositions
PRODUCT DEVELOPMENT			○ Maximalization of social and environmental values different than competitors	
BUSINESS CASE DEVELOPMENT			○ Business case development through the sister company	○ Services offered in the Netherlands but also in emerging international markets

Table 15: Cross-Sectional value proposition analysis, Source: Own Elaboration

Value Creation and Delivery: On one hand, the collected information suggests that the infrastructure (key resources, key activities and key partners) that firms implement to create value for themselves, and society has turned more complex due to the CE. On the other hand, the infrastructure used to deliver value propositions (customer relationships, customer segments, channels, and take back systems) has changed, however not to the same amount as the preceding dimension.

- **Key Resources:** Firm A and C have been implementing material passports as a way to optimize resource use from recycled building components, but also turning buildings into future material banks. Circular supplier and material catalogues have been developed by A and B to further steer CE supplier selection, but also turning the design process smoother with available information for the entire team. Firm B has developed a CE toolbox to address the lack of knowledge in the construction industry, making the concept transparent, measurable, and more tangible. In addition, they implement Circular Economy Index assessment as a way to benchmark their projects. Firm D uses data analysis software to monitor pollutant externalities in their projects like CO_2 emissions. An inclusive and diverse team is also important for Firm D, as they explain it contributes to social sustainability. Finally, two firms mentioned the need for schemes that guarantee that their current actions won't be hopeless when regulations changed in the future. Confidentiality agreements have also increase between architectural firms and suppliers due to the novelty in technology, materials, and construction methods.

- **Key Activities:** key activities mostly include the increase of CE knowledge through retrospective learning from projects, increase participation in events, networking for partners and suppliers, CE specialization and monthly and weekly meetings. At the same time workshops and brainstorming session have become a constant activity to push client's ambitions as architects perceive clients are confused with the concept. Furthermore, Firm A and B recognize that their daily activities have increased. Besides their normal activities in specific projects, they have to continuously update and monitor tools developed for the specific purpose of CE and spend time increasing their knowledge in subjects that were not part of the academic discourse as they are now.

- **Key partners:** The cross-sectional analysis showed that knowledge that is not currently in the firm needs to be outsourced, hence increasing the number of experts involved in CE projects. Professionals like scientific researchers, investors with different mindsets, suppliers specialized in biobased materials, biodiversity experts, learning managers, and others, have been included in the networks of creative organizations.

- **Customer segments:** Two types of customer segments were a notorious niche for CE. Firm C and A reveled that in order for them to realize their CE ambitions they look for "pioneering customers". This type of customer characterizes for the search of a different lifestyle and hence look for distinctive architectural products that represent them. However, it is noted that these clients have a high acquisitive power as they often act on a doble role as initial investors and final users. The social segment was also identified as an area for CE implementation. Firms work with housing associations as they are highly interested in aligning with national initiatives for sustainability and CE.

- **Customer relationships:** Due to the doble role of "pioneering clients" as initial investors and final users, architectural firms need to implement stronger and constant mechanisms to keep this customer segment motivated and informed at all times. Firm C explains that they these clients were provided with a bigger role in the decision-making process in terms of building programming, flexibility demands, housing layouts, material choices, etc. Furthermore, the interviews showed that reputation plays a significant part of customer relationship, specially to connect with entrepreneurial mindsets; but also, to nurture clients who have been working with them already but present the openness to improve their approach towards CE.

- **Channels:** Online platforms, academical and supplier events, but also informal interactions have become important to increase awareness of the distinctive architectural products and services that the firms offer. Social media and the firms' websites have proven to be a direct channel for the firm to reach its customer segments, impacting on business development and public communications teams. Furthermore, Firm D uses professional and personal relationships to reach customer segments in international emerging markets.

- **Take-Back systems:** Not significant improvements were identified among the case studies' BMs in terms of strong take-back management mechanisms. The only exception is the use of material passports to code building components that can be recirculated in the future, and the provisions of spaces that incentivize repair reuse and repurpose as part of the program in projects.

Value Capture: Literature showed that CPSFs aim to capture different types of values beyond monetary value, but also exchange value, user value, societal value, and professional value. The last one includes all the non-monetary elements that are important for the firm's existence and survival such as reputation, development, work pleasure (Bos-de Vos et al., 2016). This section only addresses monetary value related to revenues and profits, however in the next chapter the data collected from this section will be contrasted with other definitions of value that CPSFs chase.

- **Cost Structure:** In relation to the costs incurred by architectural firms to operate a BM that embraces CE. The data did not provide quantitative data on firm's expenditure related to CE. However, it was recognized that architects are investing in the development of new resources and new activities, that impact on the distribution of financial resources in the firm. The conflict between cost structure and revenue streams is one of the challenges that architectural firms face for implementing CE and obstructs top management to continue investing resources on this cause. In this regard, teams in charge of developing CE tools have to struggle to find financial support from the firms.

  Finally, architects invest financial resources to develop CE tools, but clients are not willing to recognize these investments which ends up in top managers hesitating to allocate not only financial but human resources for the CE. This ultimately slows down the transition. However, this could be the case only for middle size firms, as the interviewees sustain that bigger firms have enough financial resources to consolidate a full-time team to CE.

- Revenue Streams: This section represents the capital that firms generate from their operations and value offerings to clients.

  The interviews show that the CE has had an effect on the financial arteries that nurture the architectural business. Specially, disbalance between client's ambitions and their budget ends up affecting the fees of architects, leading to monetary loses and frustrations with the enjoyment of the work. Often, clients are not willing to pay for the extra costs and resources invested by CPSFs as they cannot really perceived these efforts, in a sense that they are not so evident or tangible to clients. As result architectural firms are investing resources to find ways to make CE more tangible

  In this respect, firms have to come out with creative ways to build financial space in other services recovering some of the monetary value that clients are not willing to provide.

4.2.3 IDENTIFIED MICROFOUNDATIONS FOR SENSE, SEIZE AND RECONFIGURE

Table 16 puts together the firm-specific micro-foundations identified in each of the case studies. They have been clustered, as they present similar characteristics across case studies. They are grouped into final microfoundations which represent the main findings from the research. Each of the final micro-foundations will be explained in the next chapter as they not only represent the unit of analysis for the empirical research, but more importantly the answer to the third research questions of the study.

D. CAPABILITIES	FINAL MICRO-FOUNDATIONS	FIRM SPECIF MICRO-FOUNDATIONS	CASE STUDY
SENSE	**ARCHITECTURAL MARKETING**	○ Exploitation of medial landscape	Firm A
		○ Speak-out skills	Firm C
		○ Clear statement development	Firm D
		○ Pioneering clients	Firm C
	THE SIDE DOOR	○ The side door skills	Firm B
		○ Office as your business card development	Firm B
	MARKET SURVEILLANCE	○ Unsatisfied markets	Firm C
		○ Past and present market awareness	Firm B
		○ Competitions as market reflectors	Firm A
		○ Competition monitoring	Firm B
		○ International emerging markets monitoring	Firm D
	THE QUESTION BEHIND THE QUESTION	○ Early client involvement	Firm B
		○ Ambition brainstorming skills	Firm A
		○ Workshops with pioneering clients	Firm C
		○ Client participation development	Firm D
	KNOWLEDGE GENERATION	○ Participation in material districts	Firm B
		○ Knowledge networking skills	Firm C
		○ Retrospective project learning	Firm B
		○ Learning from projects	Firm C
		○ Look-Back as learning schemes	Firm D
		○ Employees specialization	Firm A
SEIZE	**CONTINUOUS MOTIVATION SCHEMES**	○ Long term motivation schemes	Firm D
		○ Buildings characteristics as motivation-base	Firm B
		○ Information as motivation	Firm A
	INITIATOR CAPACITY	○ Architect as developer capacity	Firm C
		○ Architect as initiator capacity	Firm D
	COLLABORATION	○ Expert Supply Circle	Firm C
		○ Supplier selection by Architects	Firm B
		○ Software Developers Involvement	Firm D
		○ Academic Institutions Partnerships	Firm B
		○ Universities as knowledge suppliers	Firm C
	CE TOOL DEVELOPMENT	○ Material Passports development	Firm A
		○ Ambition score documents	Firm D
		○ Circularity toolbox development	Firm B
		○ BIM as a sustainability tool skill	Firm D
		○ CE tool distribution	Firm A
	GUARANTEE SYSTEMS	○ Confidentiality Agreements	Firm C
		○ Guarantee systems	Firm D
RECONFIGURE	**INTERNAL KNOWLEDGE INTEGRATION**	○ Internal knowledge academy	Firm C
		○ Knowledge sharing platforms	Firm D
		○ Internal knowledge spread	Firm B
		○ Knowledge sharing schemes	Firm A
		○ Internal update spaces	Firm C
		○ Generational integration	Firm B
		○ One on One Sharing	Firm D
	BUSINESS MODEL DESING SKILLS	○ Business model design knowledge	Firm C
		○ Clients' business models awareness	Firm B
	NEW BUSINESS PARADIGMS	○ Workload & workplace protocols development	Firm D
		○ New Business practices	Firm D
	ORGANIZATIONAL RESTRUCTURE	○ Team reorganization skills	Firm A
		○ Addition of specialized professionals	Firm C
		○ Multi background team	Firm D
		○ "CE Team" development	Firm B
	ORGANISE THE NARRATIVE	○ Circularity ambition	Firm B
		○ Internal core values development	Firm C
		○ Organize the storyline	Firm D

Table 16: Micro-foundations identified by the research, Source: Own Elaboration

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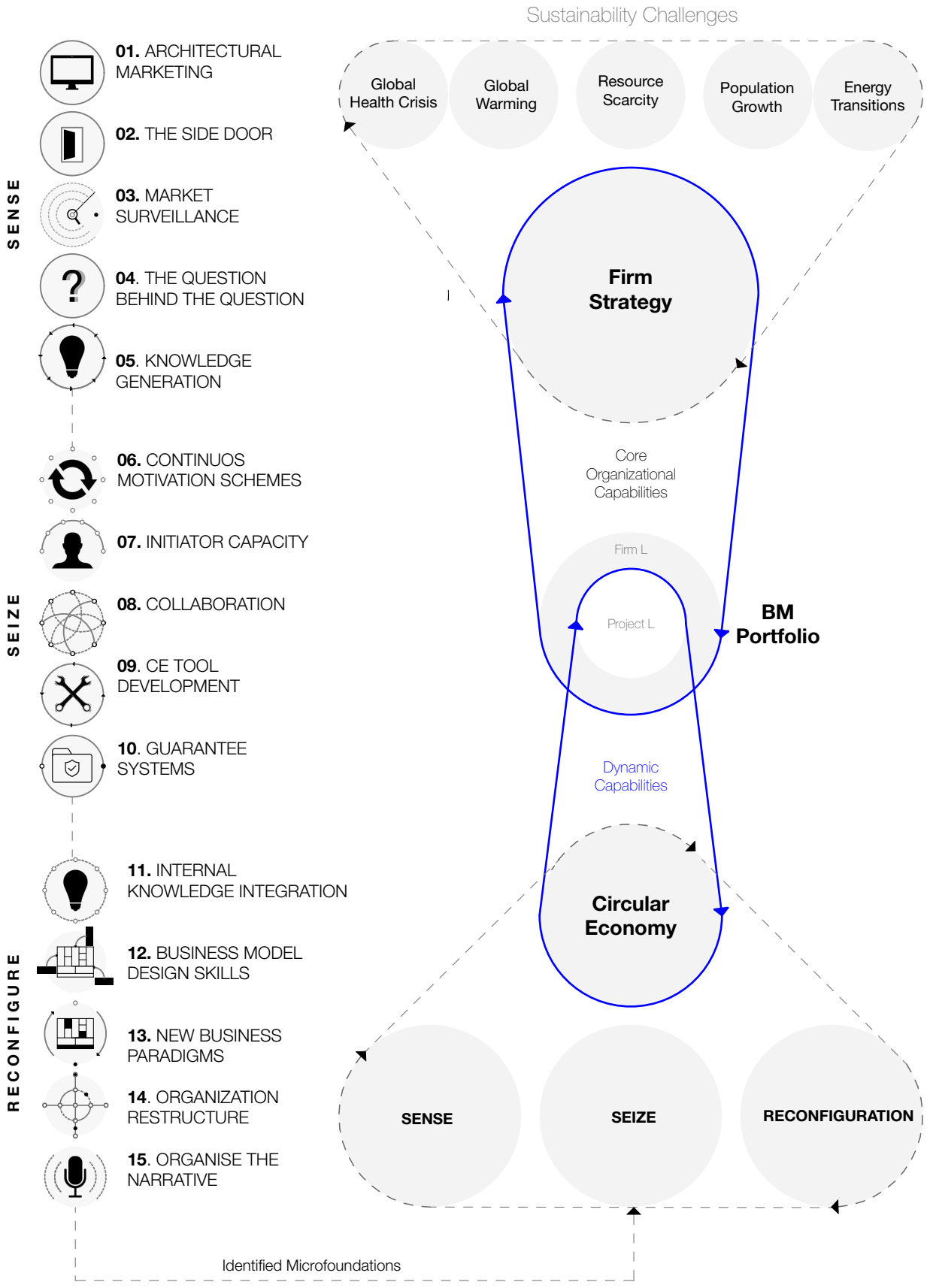

Figure 20: Conceptual framework adapted reflecting the main finding of the research, Source: Own Elaboration

5.1 FINDINGS

The conceptual framework (Figure 12) has been adjusted and complemented to reflect the main findings of the study (Figure 20). Accordingly, the findings are presented in relation to the main research objectives, which are connected to the core topics of the research: the CE paradigm, BM for CPSFs, and the Dynamic Capability Approach.

5.1.1 CE paradigm on Business Models for CPSFs

The first objective of this research was to **explore and understand the BM concept in relation to CPSFs in the context of CE.** The BM concept describes the rationale or architecture that firms employ to create, deliver, and capture different types of value in a network of actors (Osterwalder & Pigneur, 2010; Bos-de Vos et al.,2017).

The concept of BMs applied to CPSFs represents the development of a BM portfolio comprised of two levels (Figure 5), the firm level and the project-based level (Kujala et al., 2010). In this sense, this research suggests that CE is embedded at the project-level BM of architectural firms. The results from the empirical research show, that CE is not applied consistently across all architectural products by the case studies. Instead, CE is deliberately applied to very specific projects. Furthermore, this study finds that CE and its principles are marketed as a distinctive solution available to clients, yet not as the only one. The interviewees indicated that although they try to promote CE as the most viable option through strong client interactions, often face-to face, clients are not completely receptive and conscious of CE and rather negotiate the customization of the architectural product in relation to their financial and organizational needs, which often leads to compromises on CE ambitions.

This research concludes that the lack of market receptivity and awareness of the CE concept among clients, obstructs the possibility of CE being placed at the firm-level BM. This would constrain the operations of architectural firms to a single strategy hindering their survival in a market that is still in a stage of transition and has not fully embraced the CE concept. The empirical data showed that architectural firms have a diverse view on the concept of CE; however, they all agree that CE is a means to an end, being it sustainability in the built environment. In this regard, the research argues that the firm-level BM is composed by the offer of specialized architectural services (project assistance, product design, product development and business case development) centered around the overarching concept of sustainability, to which most clients and organizations can relate by establishing similar goals.

The positioning of CE at the project-level BM enables architectural firms to navigate different paths to meet client and planetary needs while also creating value for the company, its partners, and society. Furthermore, it may be argued that architects are heavily reliant on clients', contractors', and end users' objectives to shift their operations toward more sustainable practices. In this regard, based on the data collected through the cases study analysis, we conclude that there are two options to embed the CE paradigm on BM's for CPSFs life architectural organizations. On the one hand, architects can develop the necessary managerial and organizational processes to become their own clients and contractors, extending their operations along other stages of the building's lifecycle; on the other hand, architects can develop the processes and systems required to influence the clients' behavior as well as the behavior of other actors along the construction industry.

Future research can focus on comparing projects where the architect was both the developer and the client to projects where additional stakeholders were involved and architects were limited to the concept and planning phase. This type of research could disclose details on which approaches are most effective in achieving sustainability through CE principles, and to what extent the architectural role, in particular, can influence its context, influencing societal and industry level change. In this regard, further research into CE and BM for architectural firms would provide greater insights if carried out at project-level rather than at the firm level as this research envisioned.

Additionally, authors explain that project-level BMs derive from the firm-level BM (Mutka & Aaltonen, 2013). This was evidenced in the case studies, as the applicability of CE on a project basis as a way to reduce waste and close linear production and consumption systems, derives from their primary ambition of providing services that lead to a sustainable built environment. However, theory also explains that the development of autonomous project-level BMs by CPSF'S can in some cases influence the firm-level BM (Bos-de Vos M. et al., 2017). This was not as recognizable in the empirical research, as the before mentioned top-down approach.

Finally, the research determines that the concept of "Circular BMs" applied to architectural firms, refers to projects where the value creation logic has been designed to generate shared value, meaning economic value that not only benefits shareholders, but also aligns with broader public values benefiting the environment and society in general. Furthermore, this value creation logic closes and narrows and slows down material loops, parting away from traditional resource-intensive AEC processes that are contributing to climate change.

Value Proposition: The first value dimension of BM refers to the solutions or bundle of products and services that firms offer to fulfill client's needs (Osterwalder & Pigneur, 2010). The mains findings indicate that architectural firms are moving away from conventional economically and customer-centric value propositions, but rather considering other stakeholders, like nature and future generations. In this regard they aim to provide economic value that not only benefits direct shareholders, but also value that impacts society in general and the environment. However, the research argues that although they aim for value propositions with greater impact, and that their architectural products can be differentiated between CE projects and traditional projects; they strive to provide it through the same specialized services namely, project assistance, product design, product development, and business case development. Hence, the research concludes that there is a lack of further innovation from the case studies on this area of the business model canvas.

In this regard, Vermeulen et al. (2019) state that the architects' role in relation to CE is restricted to implementing the 10R's (CE strategies) to only develop services focuses on the "product concept and design stage. The empirical results show that this is the case for three out of the four case studies who only offer project assistance and product design services as they are not involved in any other stage of the building's lifecycle. On the contrary, it was observed that firm C is moving up in the architectural product lifecycle exploring the construction and developing phase. This has influenced the expansion of their services into product and business case development.
Althought the expansion ocurred within the four traditional services, it only occurred once firm C expanded their scope into other stages of the buildings's lifecycle. Hence, the research distinguishes a strong relationship between building lifespan stages and value propostion (specialized services and products) for architects.

Hence, in order for these organizationa to expand the type of services that they offer, they need to scale up their scope into other stages of the building lifecycle (Design, Manufacturing of components, Construction, Use, and End of Life). This could detonate a new type of architectural and none architectural products that have yet to be explored by professionals in the architectural domain.

Value Creation and Delivery: Although the value proposition of architectural firms has not change significantly in relation to CE, the architecture by which they create value has become more complex. The findings depict a strong dependency on a wider group of stakeholders in the creation of value, especially when it comes to deliver sustainability in the built environment through CE.

Adams et al (2019), acknowledges that actors in the construction industry employ CE principles in isolation and frequently within a specific expertise and specific building lifecycle stages. However, the findings show that this has changed significantly among CPSFs in the construction industry. Collaboration has become a pivotal stone among the case studies and their value network. This is evident in each of the projects where CE has played an important role.

The research concludes that the increase dependency on other actors for CE, intensifies the key partners component of the circular business model canvas. In addition, the research argues that although none of the firms provided an exact definition of CE, the principles that it represents are embedded in the firms either in the form of a vision statement core values or project briefs. In this regard based on the qualitative data collected, this study dares to say that architects are the front of understanding of the CE concept in comparison to suppliers, contractors, and clients. Hence, not only architects benefit from collaborating and determining key partners, but also less-aware stakeholders profit from knowledge of architectural professionals in this area.

The intensification of key partners means the expansion of key resources and key activities. This research finds an intensification of activities related to knowledge creation and management, market monitoring and networking, client incentive activities, and software analysis. It was also observed that the new bundle of resources and activities are mostly related to turn the concept of CE and its outputs more transparent, measurable, and more tangible for other stakeholders.

On the value delivery side , the CBMC (Figure 6) explains that take back systems should be embedded in the BM as a new component as they are the ultimate element that permits the material loops to happen recirculating, recycling, remanufacturing and refurbishing products, parts and components (Lewandowski, 2016). However, based on the findings the research argues that this component of the circular business model canvas is largely neglected by architectural firms. In this regard, they are only beginning to realize the true potential of this circular business model component. The findings indicate that most of their initiatives on take back systems, such as the use of material passports or the vision of new projects as material banks, suggest a long-term nature with modest impact in the short term. Hence, the study concludes that architects need to develop business models with short term results, with advantages perceivable in the coming years address current planetary challenges.

Additionally, customer segments were characterized by an emphasizes on entrepreneurial clients looking for architectural products that mirror their aims for a sustainable lifestyle. The social market sector was also mentioned as niche for CE implementation as public regulations favor sustainability measures among these entities. The interviews show that reputation plays a significant part of customer relationship, specially to connect with entrepreneurial mindsets; but also, to nurture clients who have been working with firms already but present the openness to improve their approach towards CE. Finally, Online platforms, academical and supplier events, but also informal interactions have become important channels to increase awareness of the distinctive architectural products and services that the firms offer.

Value Capture: According to Bos-de Vos et al. (2017), CPSFs go beyond profit as the main driver and rather chase a variety of goals with a distinctive nature under the value umbrella.

On one side, architectural firms aim to capture monetary value that prolong their operations and survival in the market. In this regard, the findings suggest a conflict between cost structure and revenue streams as one of the biggest challenges that architectural firms face for implementing CE. Specifically, architectural firms invest financial resources to develop CE tools and new activities to match the requirements of the market aiming for a better delivery of their specialized services. However, clients are not willing to recognize these investments as they are not perceived as tangible and concrete for them. The conflict can ultimately lead to top managers hesitating to allocate not only financial but also other tangible and intangible resources in favor of CE. This study claims that more research is needed to validate this scenarios, as the case study focused on middle size architectural firms and not bigger firms which may have stronger financial resources to allocate for CE.

Additional research focusing on the demand side of CE projects could be highly beneficial in order to better understand clients' perceptions of CE and the conflict between cost structure and revenue streams. This type of research could gather information on what is required to motivate clients to allocate financial resources for CE. These insights might then be used to reinforce the organizational processes highlighted in this study, giving architectural firms a competitive advantage or CE premium influencing client's preferences for organizations with higher CE capabilities for sustainability goals.

On the other side, professional value refers to goals involving status and reputation, knowledge development, and work pleasure (Bos-de Vos et al, 2016; Brejaart, 2018). The findings show a disbalance between client's ambitions and budget, which ends up affecting the fees of architects, leading to monetary loses but more importantly hindering the profession and enjoyment of the work. The findings show discrepancies on interviewees' response to professional value conflicts, result of clients' restrictive budgets and high expectations. Interviewees expressed that is the architect's responsibility to create enough space for innovation that matches clients' uninformed ambitions; even if this means sacrificing enjoyment of the work, as this is responsibility is embedded in the profession. Other interviewees claimed that is the client's responsibility to have a budget that matches their ambitions, and architects innovation should go toward disincentivizing a normalized culture of doing more for less.

Finally, the findings suggest a connection between the maximization of societal, exchange and use value and the capture of monetary value.

The research suggests that architects can develop business models and subsequent organizational mechanisms that support the maximization use value for clients. As showed by the case studies, this could be done through the implementation of CE strategies like flexibility, adaptability and dismantlability. The maximization of use value can then potentially lead to higher exchange value in project with strong CE ambitions. Finally, the study argues that higher use and exchange value become a source of adequate financial stability for the firm supporting its survival in the market.

5.1.2 Barriers of CE Implementations for CPSFs

According to Linder and Williander (2017), despite the business potential of CBMs, widespread adoption is yet to happen due to many internal and external challenges. These challenges demand for architectural firms to renovate obsolete core organizational capabilities, networks, and BMs (Antikainen & Valkokari, 2016; Bocken & Antikainen, 2019). The second objective of the research was, **through academic and empirical research, identify the barriers that architectural firms experience while integrating CE in their BMs.** Table 17 and Table 18 link theory and practice by displaying the main findings concerning internal and external barriers faced by architectural firms when integrating CE in their BMs.

	LITERATURE BASED CE BARRIERS		**EMPIRICAL RESEARCH RESULTS**			
Internal Barriers: limitations that emerge within an organization (Vermunt et al., 2019).			**FIRM A**	**FIRM B**	**FIRM C**	**FIRM D**
Companies' culture, policies, and strategies	o	Hesitant company culture, no sense of urgency, opposed of changing ways of working	-	-	-	-
	o	Not integrated in the strategy, mission, vision, goals & key performance indicators	-	-	-	-
	o	Not fully understanding the holistic approach of the circular economy	-	X	-	X
	o	Process and quality management systems are organized in a linear way	-	X	X	X
	o	No reverse supply-chain in place	X	X	X	X
Financial Barriers	o	Higher financial risks	X	X	-	-
	o	Focus on short term return on investment and costs reduction	X	X	X	X
Technological Barriers	o	Absence of organizations technological capacity and knowledge	-	-	-	-
	o	Inadequate information management systems (IMS)	-	-	-	-
Lack of other resources	o	Time as resource for caring circularity ambitions	-	X	X	-
	o	Lack of information and knowledge	X	X	X	X
	o	Lack of financial resources.	-.	X	-.	-
Collaborations	o	Limited willingness to collaborate in the value chain	-	-	-	-
	o	Lack of interorganizational collaboration among firms	-	-	-	-
Product Design	o	Issues in the design of products, not designed for longevity, easy maintenance, disassembly, and reuse	X	X	X.	X
Internal stakeholders	o	Lack of communication among departments in terms of BM	X	X	-	-
	o	Unclear departmental responsibilities toward circular practice	X	X	X	-
	o	lack of trained personal	-	-	X	X

Table 17: Main challenges encountered for CE implementation among architectural firms, Source: Own Elaboration

Concerning internal cultural barriers, this research finds that architectural firms have integrated CE into their BM either through their mission statement, core values, or the indicators used in their projects. All interviewees acknowledge the urgency to change current practices and have not detected any opposition among their team.

However, they are still facing a lack of holistic understanding of how CE can be applied along the different stages of the building's lifecycle. More importantly, there is a lack of reverse supply chain as there is a hesitation among architects to take responsibility for these tasks.

Financial internal barriers appear as one of the most prominent among the case studies. CE implementation in projects can lead to financial risks by the firm, as they might invest capital in resources and capabilities to improve their CE delivery, yet this is often not recognized by clients and occasionally the investment is not recovered in cases where the client backs out ending the initial agreement to collaborate. At the same time, the research argues that CE is compromised by architectural firms in order to survive in a transitionary market. If the firm needs short term return on their investments, then they are willing to reduce their CE implementation ambitions to close a deal ensuring an injection of capital to keep operating. However, architectural firms are actively investing in technological and employee training for new operations and the production of CE architectural products.

Regarding technological barriers, all firms are developing and investing on technological capacity and technological knowledge, as they explain is fundamental for CE. Similarly, the field of collaboration presented less barriers as the interviewees explain they are eager and willing to collaborate with stakeholders along the value chain. Collaboration among architectural firms has also increased as firms expressed the importance of clustering into knowledge development groups, exposure forums or simple share ideas among other architectural professionals.

Barriers associated with lack of resources are still present. Time plays a big role as CE projects take longer periods of time to detail and execute, but also in terms of client approval. Lack of knowledge was unanimous recognize as the main internal barrier for CE. However, the findings argue that architects are leading the closure of the knowledge gap as they are actively and extensively investing in knowledge generation and integration for CE. Lack of financial resources was also mentioned as a barrier, especially regarding budget appointment for CE tool development

Although all of the interviewees recognized that they are designing architectural products that aim for longevity, easy maintenance, future disassembly, and reuse of materials; there is still some barriers in term of the measurement of the effectivity of the design to achieve CE. Most of the implemented design strategies focus on long-term effects rather than short-term results. Hence, the benefits of CE design strategies are not directly contributing to immediate planetary needs.

Finally, the findings show that architectural firms need to increase their capabilities to overcome the lack of communication among departments specially in relation to business models. The results show that his is kept among top management, however the research argues that if this type of knowledge is better distributed among the employees, they have the opportunity to contribute to business model innovation for CE. A BM holistic awareness inside the firms could also contribute to better distribution of task among departments.

LITERATURE BASED CE BARRIERS			EMPIRICAL RESEARCH RESULTS			
External Barriers: Limitations that arise outside the firm (Vermunt et al., 2019).			**FIRM A**	**FIRM B**	**FIRM C**	**FIRM D**
Consumer related barriers	o	Lacking consumer awareness and interest	X	X	-	X
	o	Consumers prioritize investment capital when choosing a product, consumers may regard CE practices as costly	X	X	X	X
Legislative and Economic Barriers	o	Obstructing laws and regulations	X	X	X	X
	o	Lacking global consensus on sustainability approaches	X	X	X	X
Supply Chain related barriers	o	Lack of CE concept understanding along the supply chains	X	X	-	X
	o	Lack of trust and transparency in the supply chain	-	-	X	X
	o	Lacking standardization and reverse logistics	X	X	X	X
	o	Lack of internal organization in the suppliers' firms	-	X	X	-

Table 18: Main challenges encountered for CE implementation among architectural firms, Source: Own Elaboration

According to Kirchherr et al. (2018), in relation to CE, particularly the lack of consumer interest and awareness is considered one of the main external CE barriers by businesses. This was confirmed in the research as consumer-related barriers were frequently mentioned by interviewees. There is a lack of awareness among clients about the CE concept. Clients have lost track of the evolution of the concept becoming to intangible, which has ultimately led to the loss of interest in implementing CE as part of their architectural demands. On one hand, the architect's tasks have then intensified to promote and foster awareness and interest among clients. On the other hand, the lack of market interest can foster initiator capabilities among architects to become their own client assuring delivery of CE products. Furthermore, investors/clients believe that CE projects are costly. This research sates that micro-foundations like CE Tool Development can assist architects to make CE tangible, measurable and transparent for clients, increasing awareness and incentivizing clients to pick for this type of architectural product.

Authors (Rios et al., 2016; Kirchherr et al., 2018; Ormazabal et al. (2018), sustain that lack of market interest is often accompanied by lack of synergistic governmental interventions to accelerate the transition towards a circular economy. In regard to legislative and economic regulations, the empirical results show that public institutions are keenly working with architects and that public circular procurement is not limited but rather increasing. However, these institutions often present a disbalanced between ambitions and budget hindering the architect's job. In order to create a balance, micro-foundations like the Question Behind the Question and Continues Motivation Schemes should be implemented. Lack of consensus on how to approach sustainability by legislative bodies has caused architect to waste their resources on initiatives that were later overturned by changes in legislation and construction regulations. Hence being able to develop Guarantee Systems capabilities with policy makers its crucial.

As stated, before collaboration along the supply chain for the delivery of architectural products based on the CE is perceived as increasing. Alliances and partnerships among different actors inside and outside the construction industry has become an essential part of the architectural profession. However, due to the novelty of the concept and the techniques needed for its delivery, architectural firms are establishing confidentiality agreements with suppliers and contractors, which in some extent contributes to the lack of trust and transparency perceived in the creative sector.

To conclude this section, the initial theoretical study expressed that these challenges and the adoption of long-term strategic approaches toward circularity can be more limited for companies that have been found in the linear economy rather than startups and younger firms born under this paradigm (Ormazabal & al, 2018; Eikelenboom & de Jong, 2021; Urbinati & Chiaroni, 2017; Nußholz, 2017).

The findigns indicate that the above-described challenges are present among all the participats dispite their longevity. Hoewer, the emprical research showed that case studies established 30 to 25 years ago managed to be at the same compettive level as firms who were born more than 60 years ago. Based on the qualitative data and on the overview of firms' documents , the reseach dares to say that younger firms have had a smoother path towards CE than firms who have been established for years before.

5.1.3 Dynamic Capability Path

The third objective was to understand how the Dynamic Capability Approach (DCA) enables BM transformation for architectural firm overcoming CE barriers.

In this regard, the main findings of this research show that the DCA enables BM transformation by becoming the internal adoption factors that dictate the extent to which CE is embedded in the operations of architectural firms. Hence, dynamic capabilities and their microfoundations describe the organizational capabilities or intangible processes associated with organizational change, strategic renewal of the firm and adaptation within firms and industries in ever changing markets. DCs enable BM transformation by supporting organizations in the development of three specific types of capabilities namely Sense, Seize and Reconfigure (Figure 20).

First, the empirical analysis and the later workshops for findings validation with architects and students, suggest that the development of these three types of skills is not always a linear process as illustrated in Figure 11. Instead, sense, seize and reconfigure processes or microfoundations can be developed in a distinctive order that the one describe in theory where sense capabilities are developed first, followed by seize microfoundations and finally by reconfigure processes.

As illustrated in ¡Error! No se encuentra el origen de la referencia. and Figure 21, the workshops results suggest that sense, seize and reconfigure capabilities can be developed parallelly and not in a specific order. The study suggest that the development of capabilities of different nature depends on the market perception of the participants. Hence, the transformation of their business models is heavily dependent on their clients approach to the built environment.

Second, in terms of the microfoundations' applicability, the participants observed distinct linkages between game cards. In this manner, each of them devised a unique implementation path or method of playing the game. Nevertheless, some similarities were identified in the multiple approaches. The initial approach is to prioritize specific skills, differentiating between microfoundations with a central role and others under a supportive position. Furthermore, based on the workshops, the research suggests that the applicability path of microfoundations for business model transformation can be in clusters. The study indicate that the clusters can be divided into time periods and applied to different stages of an architectural project life's cycle.

Third, previous research on the business model transformation stated that the development of microfoundations is the primary source of competitiveness (Teece, 2018). Other authors (Johnson et al., 2008; Casadesus-Masanell and Ricart, 2011) believed that business strategy was the main source of competitiveness. Based on the empirical study and the workshops this research concludes that strategy, BM and DCs are deeply intertwined as showed in Figure 20.

Hence, the research proposes that the dimension of competitiveness does not come only from developing new skills, possessing specific resources, or from a particular strategic view to the built environment; but rather competitiveness occurs from the careful orchestration of the relations between these elements. In that logic, this research concludes that DCs and strategy guide organizational transformation by combining to create and refine a defensible BM.

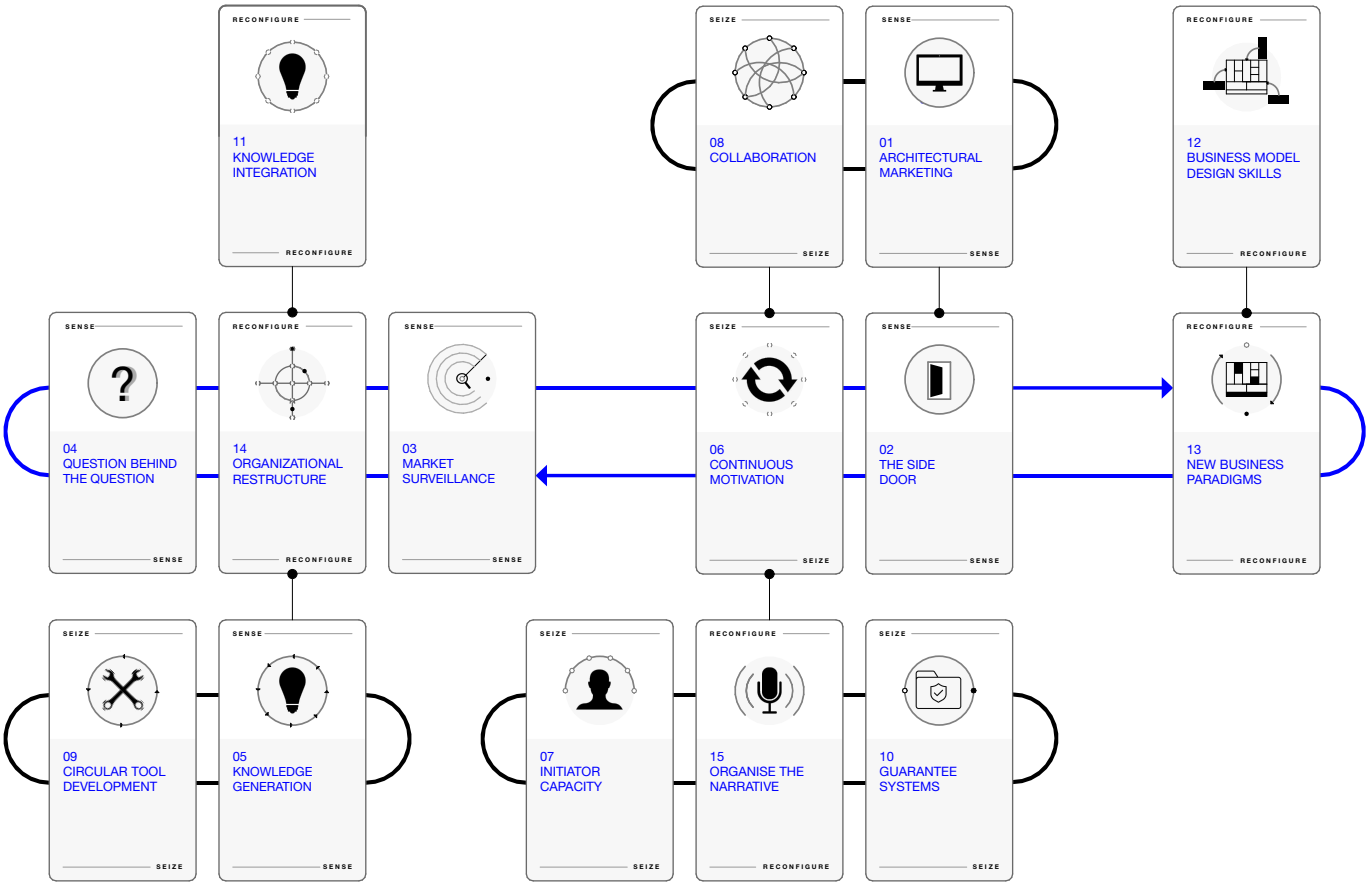

Figure 21: Examples of business model transformation through the implementation of dynamic capabilities' microfoundations , Sources: Own elaborations based on results from workshop with case studies.

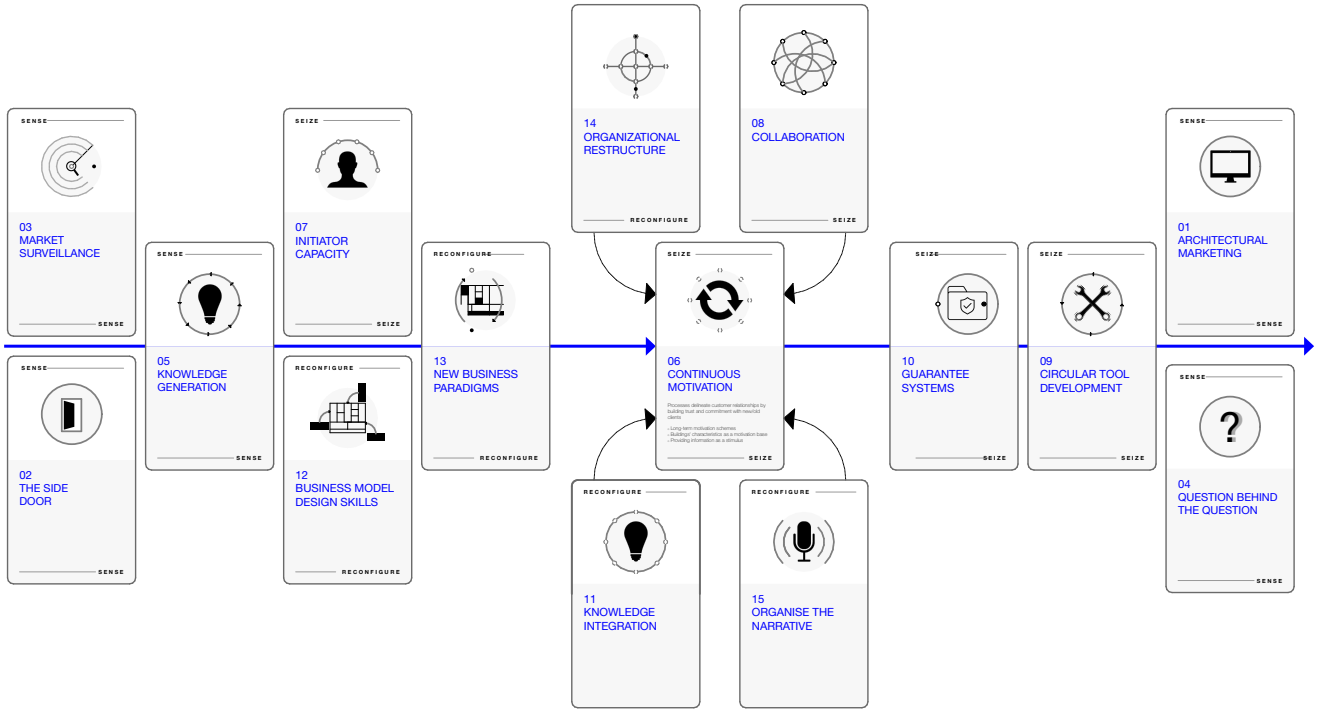

Figure 22: BM transformation through the implementation of DCs' microfoundations , Sources: Own elaborations based on results from workshop with students

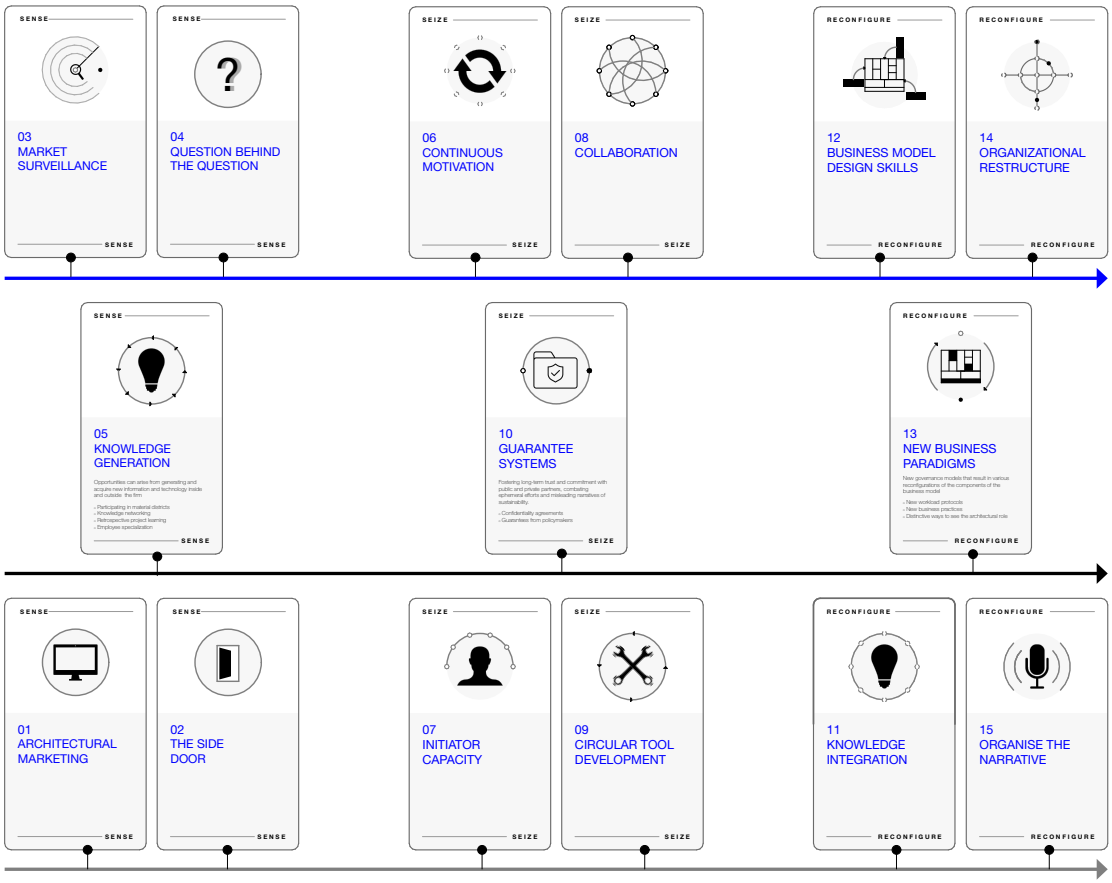

Figure 23: BM transformation through the implementation of DC's microfoundations , Sources: Own elaborations based on results from workshop with students

5.1.4 15 Dynamic Capabilities' Micro-foundations

The last objective was **through the collection of empirical data, delineate a Dynamic Capability toolbox for architectural firms and other CPSFs to approach CE.** In this section the toolbox is presented in the shape of 15 game cards.

Figure 24: Dynamic Capability game cards needed for business model transformation, Source: Own Elaborations

The game cards encapsulate the 15 microfoundations of DCs identified among the case studies, which represent the organizational and managerial skills, processes, systems, and structures that undergird each of the three higher order dynamic capabilities of Sense, Seize and Reconfigure (Teece, 2007). Their applicability, as mentioned before, was validated through workshops conducted in the last phase of the research with previous interviewees and students.

In this regard, Bowman and Ambrosini (2003), stated that micro-foundations are unique processes that emerge from each individual firm and often hard to replicate. During the empirical analysis, firm-specific micro-foundations were identified for each of the case studies (Table 11, Table 12, Table 13, Table 14).

In accordance with theory these processes were developed independently by each firm. For example, only Firm C has developed microfoundations to offer product-development services, allowing them to consolidate in the Dutch market in less than 25 years. Differently than other case studies who have been operating for 60 or 75 years and still have not develop these skills. Furthermore, his research states that organizations with stronger DCs and microfoundations react better to market needs through entrepreneurship and innovation, which ultimately leads to BM expansion as seen in Firm C. The same situation occurs for Case D being the only firm actively advising for architectural services in emerging international markets, which has increased their project portfolio in markets than none of the other firms have. The development of unique firm-specific skills by each of the case studies confirms Teece's statement.

However, while micro-foundations can be tailored to the needs of each organization and the context in which they operate; they also present commonalities in their concepts, which has allowed for this research to cluster them into groups of final microfoundations aiming for the same purpose (Table 16). Theory supports this argument by stating that microfoundations also present associative key features that enable generalization across firms and industries (Eisenhardt & Martin, 2002). For instance, all case studies developed distinctive new key resources like CE toolboxes, CE supplier and material catalogues and material passports, yet they all aim for the same purpose of implementing CE into their projects and expanding the knowledge of the concept.

Furthermore, as suggested by Wang & Ahmed (2007), two or three firms can develop similar microfoundations, yet what distinguishes them and gives them a competitive advantage is which firm was more effective in implementing them sooner, astutely, and fortuitously. This was evident during the workshops, when each participant, including case study representatives, intentionally prioritized the deployment of different cards based on what they perceived to be the most logical approach to drive change in an organization. Likewise, the participants established different connections and strategize unique combinations of game cards to ambition organizational change.

The next subsections elaborate in detail each of the microfoundations according to the Higher-Order dynamic capabilities.

Sense: In the case of the first high-order DC, it refers to the adaptive capacity of a firm to sense, filter, and search for new exploitation opportunities in the market (Wang and Ahmed, 2007). The framework developed by Teece (2007) in Figure 8 and later incorporated in Figure 12; explains that opportunities get detected depending on two factors.

On one side, differential access to existing information; and on the other side, opportunities that arise from new information and new technology. Both characteristics were reflected in the five micro-foundations identified for this section namely, (1) Architectural Marketing, (2) The Side Door, (3) Market Surveillance, (4) The Question Behind the Question, and (5) Knowledge Generation (Table 20).

In this respect, differential access to existing knowledge was present in micro foundations (1) Architectural Marketing, (2) The Side Door and (3) Market Surveillance. Firm A,B and C used previously generated information about their projects to promote their vision on CE and sustainability, capturing new opportunities. Firm B relied on their direct access to an innovation cluster or side door with like-minded organizations to sense new collaboration opportunities. Firm D also had differential access to information, through long-term established relationships with stakeholders in international emerging markets which resulted in new projects for the firm.

Opportunities that arise from new information and new technology were detected in micro-foundations (3), (4) and (5). Firm A relied on employee specialization to generate new information through specialization of a specific topic becoming the only firm capturing those opportunities. Firm B participated in material districts and learned from old projects as a way to search for improvement areas. A similar situation was observed in Firm C and D, who developed knowledge networking skills and retrospective learning mechanisms to acquire new information about technological and material advancement in the field of CE. Opportunities were also sensed through new information in market surveillance in terms of competitions, competitive firms, international markets, and unsatisfied markets. Finally, new information generation through constant client involvement allowed the case studies to understand clients' needs and latent demands by discerning the real questions behind the initial demands of uniformed clients.

MICROFOUNDATIONS CHARACTERISTICS	MICRO-FOUNDATIONS	FIRM SPECIF MICRO-FOUNDATIONS	CASE STUDY
○ Opportunities that arise from differential access to existing information	**(1) ARCHITECTURAL MARKETING**	○ Exploitation of medial landscape ○ Speak-out skills ○ Clear statement development ○ Pioneering clients	Firm A Firm C Firm D Firm C
○ Opportunities that arise from differential access to existing information	**(2) THE SIDE DOOR**	○ The side door skills ○ Office as your business card development	Firm B Firm B
○ Opportunities that arise from differential access to existing information ○ Opportunities that arise from new information and new technology	**(3) MARKET SURVEILLANCE**	○ Unsatisfied markets ○ Past and present market awareness ○ Competitions as market reflectors ○ Competition monitoring ○ International emerging markets monitoring	Firm C Firm B Firm A Firm B Firm D
○ Opportunities that arise from new information and new technology	**(4) THE QUESTION BEHIND THE QUESTION**	○ Early client involvement ○ Ambition brainstorming skills ○ Workshops with pioneering clients ○ Client participation development	Firm B Firm A Firm C Firm D
○ Opportunities that arise from new information and new technology	**(5) KNOWLEDGE GENERATION**	○ Participation in material districts ○ Knowledge networking skills ○ Retrospective project learning ○ Learning from projects ○ Look-Back as learning schemes ○ Employees specialization	Firm B Firm C Firm B Firm C Firm D Firm A

Table 19: Sense micro-foundations main findings and description; Source: Own Elaboration

Seize: According to literature the seize DC refers to react quickly to previously sensed opportunities in the market, recognizing their value and integrating them into the BM or if necessary, creating new ones (Wang and Ahmed, 2007).

As suggested by Teece (2007) in Figure 9, the microfoundations of this section refer to four categories: delineating the customer, solution, and the BM; selecting decision-making protocols; selecting enterprise boundaries to manage complement and control platforms; and building loyalty and commitment. The five micro foundations identified in this section are: (6) Continuous Motivation Schemes, (7) Initiator Capacity, (8) Collaboration, (9) CE tool Development and (10) Guarantee Systems.

Micro-foundations (6), (7), (8), (9) mostly focus on the first category of delineating the customer, solution, and the BM.

In this regard, Continues Motivation Schemes allows firms to not only delineate but strengthen the market segment that they are targeting with their CE initiatives. Firm D explained that these skills allow them to work with old clients like housing associations but more importantly strengthen their relationship and trust. Firm B, coverts existing characteristics of buildings into negotiation points which then delineate the entire BM for that project. Firm A constantly stimulates and strengthens client's commitment with the distribution of informative booklets about the positive environmental outcomes of their decisions.

Initiator Capacity delineates the type of services that will be embedded in the BM. Firm C develop skills and systems beyond their architectural branch in order to deliver product development services. Firm D sustains that these skills are necessary in the profession specially for CE as there is paucity from other stakeholder in the industry to push the circular and sustainable transition forward. Collaboration micro-foundations delineates the network and the experts needed to implement CE by the case studies. CE Tool Development helps organizations to introduce CE technology into the services that they offer. As seen in Table 20, the four case studies have developed different but also similar systems to improve their technological approach to CE.

Micro-foundations (6) and (10) also relate to building loyalty and commitment as explained by Teece (Figure 9).

Continuous Motivation Schemes also demonstrate leadership and effective communication from architects to their clients. Guarantee Systems emerged as an important competence as the data collected in the empirical study showed that architectural firms need assurance from public bodies and policy makers to safeguard that there is a long-term strategy to sustainability and that any actions taken by architect now are contributing to those goals and not just adding to ephemeral efforts to promote false narratives of sustainability. Furthermore, the findings show that loyalty and commitment systems are also necessary between research institutions, suppliers and architectural offices as it may play an important role to create competitiveness.

MICROFOUNDATIONS CHARACTERISTICS	MICRO-FOUNDATIONS	FIRM SPECIF MICRO-FOUNDATIONS	CASE STUDY
○ Delineating the customer, solution, and the BM ○ Building loyalty and commitment.	**(6) CONTINUOUS MOTIVATION SCHEMES**	○ Long term motivation schemes ○ Buildings characteristics as motivation-base ○ Information as motivation	Firm D Firm B Firm A
○ Delineating the customer, solution, and the BM	**(7) INITIATOR CAPACITY**	○ Architect as developer ○ Architect as initiators	Firm C Firm D
○ Delineating the customer, solution, and the BM	**(8) COLLABORATION**	○ Expert Supply Circle ○ Supplier selection by Architects ○ Software Developers Involvement ○ Academic Institutions Partnerships ○ Universities as knowledge suppliers	Firm C Firm B Firm D Firm B Firm C
○ Delineating the customer, solution, and the BM	**(9) CE TOOL DEVELOPMENT**	○ Material Passports development ○ Ambition score documents ○ Circularity toolbox development ○ BIM as a sustainability tool skill ○ CE Booklets	Firm A Firm D Firm B Firm D Firm A
○ Building loyalty and commitment.	**(10) GUARANTEE SYSTEMS**	○ Confidentiality Agreements ○ Guarantees from policymakers	Firm C Firm D

Table 20: Seize micro-foundations main findings and description; Source: Own Elaboration

Reconfigure: The final dynamic capability is described by Teece (2007), as the ability to continually recombined and reconfigure organizational assets and current structures under constant changing markets. These micro-foundations create continues innovation in dynamic competitive environments. Micro-foundations in this group are characterized by allowing decentralization and decomposability, governance, specialization, and knowledge management (Figure 10). The main findings in this section include (11) Internal Knowledge Integration, (12) Business Model Design Skills, (13) New Business Paradigms, (14) Organizational Restructure , and (15) Organize the Narrative.

Regarding decentralization and decomposability, micro-foundation (12) Business Model Design Skills, refers to having this type of knowledge inside the firm as this is the ultimate skill that allows BM transformation and development of new ones. Firm C is the only case studied that expanded their value proposition. They explain that this was not possible if they didn't have enough theoretical and practical knowledge about how to run a business.

Hence, they were able to decompose their old BM and decentralize the resource based of the existing architectural branch, embracing innovation by seizing previously sensed opportunities in the market consolidating as a distinctive real estate developer who prioritizes CE. In the same line, this microfoundation not only allows to understand one's BM but also that of the client. As explained by firm B, this skill permitted the firm to steer their actions and resources for a strategy that implemented CE in the architectural product but also benefited the BM of the client.

Governance was detected in (13) and (15). New Business Paradigms allowed Firm D to achieve inventive alignment of their resources by introducing new business practices. CO_2 emissions suggested a different type of governance in this firm, where architectural firms are operating with an expiration date based on how much CO_2 emissions their project creates. This implies that at one point the firm will stop operating and employees' contracts are restrained to this timeline as well.

This different governance mode stimulates the firm to improve their actions and diminish the harm to the planet, in a way that they are also fighting for the survival of the profession and their business. Workload and Workplace protocols developed by Firm D also allows the company to govern in a way that prioritize employee wellbeing and performance, going against the 24/7 workload promoted in other offices. Organize the narrative, makes a call for architects to develop ambition documents and internal core values that oversee how to reconfigure their resources to achieve CE. More importantly, this skill is necessary for architectural firms to organize the storyline at a societal level governing over false narratives for sustainability.

Cospecialization, according to theory, refers to micro-foundations that allow strategic management in a way that the combination of resources enhances value for the firm. Micro-foundation (14) organization restructure presents these characteristics. Firm A has developed mechanisms to evaluate the size of their teams changing them accordingly to the needs of the project. They explain that small and succinct teams are necessary for CE projects. Firm C added a Learning Manager who oversees the knowledge of the firm specially related to CE advising tom management on how to restructure the organization to enhance value. In addition, Firm D advocates for organizational restructure of their team, on base of background and type of education to allow a better mix for the benefit of the firm.

Finally, (11) Internal Knowledge Integration is directly linked to Knowledge Management. This proved to be one of the most important micro-foundations among the case studies as their responses revealed more skills and processes developed in this area than any other. Firm A, transfer all the knowledge acquire through employee specialization into curated CE catalogues. Firm B spreads knowledge internally through weekly and monthly meetings. Firm D believes in one on one sharing, and digital platforms to manage their information and protect their intellectual property. All these mechanisms allow firms to recombine and reconfigure their tangible and intangible assets.

MICROFOUNDATIONS CHARACTERISTICS	MICRO-FOUNDATIONS	FIRM SPECIF MICRO-FOUNDATIONS	CASE STUDY
○ Knowledge Management	**(11) INTERNAL KNOWLEDGE INTEGRATION**	○ Internal knowledge academy ○ Knowledge sharing platforms ○ Internal knowledge spread ○ Curated internal catalogues ○ Internal update spaces ○ Generational integration ○ One on One Sharing	Firm C Firm D Firm B Firm A Firm C Firm B Firm D
○ Decentralization and decomposability	**(12) BUSINESS MODEL DESING SKILLS**	○ Business model design knowledge ○ Clients' business models awareness	Firm C Firm B
○ Governance	**(13) NEW BUSINESS PARADIGMS**	○ Workload & workplace protocols development ○ New Business practices	Firm D Firm D
○ Cospecialization	**(14) ORGANIZATIONAL RESTRUCTURE**	○ Succinct and flexible teams ○ Addition of specialized professionals ○ Multi background team ○ "CE Team" development	Firm A Firm C Firm D Firm B
○ Governance	**(15) ORGANISE THE NARRATIVE**	○ Circularity ambition ○ Internal core values development ○ Organize the storyline	Firm B Firm C Firm D

Table 21: Reconfigure micro-foundations main findings and description; Source: Own Elaboration

Teece (2018), stated that firms will not be necessary strong across all types (Sense, Seize, Reconfigure). This statement was evident during the workshop as participants chose cards based on their current strengths, or where they perceived that development path was already embedded in the firm or in the architectural profession. This can also be observed on the above-tables, where dome firms developed more DCs to sense opportunities, and in less extent to seize them into BMs and consequently reconfigure their resources.

To conclude, the participants expressed a positive evaluation of the outcome of this research, yet some areas for improvement were detected. Through playing with the game cards, architecture professionals and students expressed a reassessment of their roles within an architectural firm, expanding their thinking beyond the provision of specialized services but into managerial tasks. Furthermore, the game cards raised awareness among the participants about the lack of understanding on the operational side of architectural organizations.

Similarly, the workshop showed a concept overlapping between the cards, which ultimately led the participants to establish connections between sense, seize and reconfigure cards, influencing their implementation strategy. Additionally, despite the initial emphasis of this study to identify CE specific microfoundations, the research concludes that the micro-foundations described above are undeniable beneficial for CE implementation in architectural firms, yet not exclusive to this subject. The findings and its later validation suggest that the gamecards or identified microfoundations can be used for more than merely CE implementation but also in a multitude of approaches in the search of sustainability in the built environment.

5.2 RECOMMENDATIONS

This research main purpose is to address the knowledge gap/know-how between CE implementation and BM transformation for CPSFs. The findings of this research can be applied by actors and organizations active in the architectural realm or entrepreneurs aiming to enter this market and future proof their approach for constant BM transformation. In this regard, actors can use the 15 identified dynamic-capabilities' microfoundations (Figure 20) to transform their current BM or develop new ones. Based on the figure and on the main finding of the research some general recommendations are presented:

Recommendations for Architects

- The study found a strong relationship between the dimension of value proposition and the stages of a building's lifecycle. In this regard, the empirical research concluded that most of the case studies' business models focus on the concept and design phase. Hence, architectural firms aiming to expand the services and the type of products that they provide need to expand their operations a long a building's lifecycle.

- The take back systems component of the BM canvas is a niche that remains unexplored by architectural firms as seen in the empirical research. Hence, architects or entrepreneurs that aiming for strategic change toward sustainability through CE implementation can expand their business model to this area, as it represents the ultimate element that permits material loops to happen recirculating, recycling, remanufacturing and refurbishing products, parts, and components.

- The information collected from the case studies, shows that architectural firms in their approach to CE are mostly focusing on short-loops that have long term results. Hence, this study recommend that architects aiming for change should expand and strengthen their focus into longer loops that bring materials and components back into the loop, including remining and recovering strategies.

- The participants answers on the questionaries showed that, although they motivate their clients to manage and implement energy efficiency strategies on their projects; energy efficiency innovation inside the firm is not being managed. In this regard, the implementation of intelligent systems or the hiring of a trained individual in this field could accelerate the accomplishment of CE and sustainability goals by architects not only externally but also inside their organizations.

- The above-described initiatives can be combined with the Side Door game card, where the architect's office is used as their business card, attracting new opportunities. Furthermore, these changes can be maximized by implementing the Architectural Marketing game card, being outspoken about their internal initiates for CE. These two cards where often combined by the participants during the workshop, as a way to potentialize their value.

Recommendations for actors in the construction industry

- The interviews revealed that although collaboration barriers for CE implementation have decreased; there is a lack of consensus on how to apply CE initiatives into the built environment by not well-informed developers, contractors, and suppliers. Hence, there is a call for other actors to also innovate the way they create, deliver, and capture value sharing the responsibility with architects.

- The study showed that the principle of the CE are still too abstract for clients in the construction industry. As a result, this study recommends that any tool developed by developers, contractors, suppliers and consultants to encourage CE should make the concept as tangible, quantifiable, and clear as possible for clients and people outside the construction industry.

Recommendations for clients

- According to empirical study, clients frequently place high expectations on architects to accomplish a high level of innovation and creativity with a limited budget. This dynamic not only reduces architects' opportunities for monetary value but also their enjoyment of their work. As a result, the study advises clients to have a detailed and well-informed brief for their architectural projects based on current sustainability criteria.

Recommendations for policy-makers

- The interviewees sustained that there is a lack of governmental systems that guarantee the legitimacy of architects' efforts to achieve suitability in the built environment through CE implementation. Hence, policy makers should focus on developing legislation and building codes that part away from fragile and transitionary regulations.

6 CONCLUSION

6.1 CONCLUSION OF THE RESEARCH

As determined across the theoretical and empirical studies of this research, while the principles underpinning the CE concept have been embraced in the architectural discourse as a powerful strategy toward sustainability in the built environment; architectural firms, due to the lack of BM transformation know-how, are still struggling to translate the CE concept into the way they propose, create, and deliver value. Hence, the purpose of this research is to address the knowledge gap between CE implementation and BM transformation know-how for creative professional services firms, specifically architectural firms.

This research concludes that the Dynamic Capability Approach, through the development of three types of microfoundations, is an effective and practical method that drives organizational change among CPSFs such as architectural firms. In this regard, the DCA offers know-how for BM transformation in architectural practice in favor of CE; but it is not limited to this subject and may also be employed to favor other strategies to achieve sustainability in the built environment.

The previous chapter presented the research findings in relation to the main objectives of the study, which serve as the base for answering the below research questions:

RQ1: How is the CE embedded in BMs for Architecture firms?

The research concludes that currently CE business models in the context of architectural firms, consist of the provision of specialized project development and design services for architectural products where the value creation logic aims to close and narrow resources loops while generating shared value for shareholders, society, and the environment.

The research concludes that the CE is embedded at the second level of architectural firm's BM portfolio, meaning the project-level BM (Figure 20). The un-awareness and lack of market receptivity among clients, who prefer to negotiate the customization of architectural products in relation to financial and organizational needs rather than urgent environmental demands, difficult the embodiment of CE at the core of architecture firm's business model. In this regard, the embedment of CE at the second level of the architect's BM portfolio, allows these organizations to expand their operations beyond a a single sustainability strategy, securing their survival in a market that is still in a transitionary stage and has not fully embraced the CE concept.

The notion of CE is consistently regarded as a means to achieve sustainability in the built environment. The wider acceptance of sustainability as corporate strategy across industries and sectors, facilitates the client-architect relationship. Hence, the research concludes that the first layer of the BM portfolio, the firm-level BM, is composed by the offer of architectural services (project assistance, product design, product development and business case development) centered around the overarching concept of sustainability.

To encapsulate, the placement of CE at the project-level BM and that of sustainability at the firm level BM, allows architectural firms to navigate different paths that satisfy customer and planetary needs, while also generating value for the firms, its partners, and society.

RQ2: How can BMs be transformed through the Dynamic Capability Approach?

This research concludes that the Dynamic Capability Approach enables BM transformation by facilitating the development of three types of particular skills, processes, and organizational activities needed for organizational change and strategic renewal among architectural firms.

Firstly, the skills necessary to sense CE business opportunities that could potentially expand the value proposition of architectural firms in terms of services and products, while also considering a wider group of stakeholders beyond the client and shareholders.

Secondly, the organizational activities necessary to unluck those opportunities, seizing them into new or existing BMs. This section of the DCA delineates each of the BM components in terms of value creation, delivery, and capture. It's worth mentioning that take-back systems have been included in this group as they are the ultimate component that allows reverse logistics to happen. The study concludes that this component has been deliberately neglected and largely unexplored by architectural firms, as architects believe that the tasks related to actively remining and a recovering material should be the responsibility of other actors along the construction industry.

Thirdly, the DCA approach allows BM transformation by guiding firms in the development of managerial processes and skills needed for the continuous reconfiguration of their resource base and current competences.

Finally, Dynamic capabilities, specially seized dynamic capabilities, and business strategy work together to create and refine a defensible BM. It's concluded that the BM transformational process in architectural firms is not a linear process applied equally across firms. BM transformation is rather a customized process influenced by the current resource base of a firm, the managerial skills of the actors behind the organization and their market awareness and interpretation. Hence, architects can use multiple and interchangeable paths for BM transformation, developed by the distinctive combinations of microfoundations.

RQ3: How are architectural firms currently addressing the circular economy ?

The initial conception of this research was to address the extent to which the CE was perceived among architectural firms as the ultimate solution for environmental challenges. The study concluded that the current approach of architecture firms to CE is characterized by being a tailored and cautious practice. The study finds that CE is being adopted and marketed by architects, not as a solution in isolation, but rather as one of the available options for clients to achieve resource efficiency and the reduction of waste.

Architectural firms current approach to CE is heavily reliant on client perception and familiarity with the concept. In this regard, CE is only achievable by architects to the extent to which their private and public clients, investors and regulations allow it. Their approach to CE focuses mostly on the design and concept phase including the implementation of the 10Rs to design architectural products. However, the empirical analysis showed that current approach also include firms shifting their strategy in order to become their own clients and expedite the transition to more sustainable practices. The change in paradigm has allowed them to liberate from constrains from private investors and locate new opportunities niches in the market away from linear practices.

MRQ: Which organizational processes enable architectural firms to transform their business models in favor of the Circular Economy?

As presented through the findings of this study, the introduction of CE has become a game changer not only for actors shaping the built environment through spatial design, but also for entire economies, cities, and societies. If architects want to become part of global efforts for sustainability and change the way they propose, create, and deliver value, they first need to understand the business model game and the position of their organizations as players in an everchanging market.

Understanding the game means, acknowledging the BMs concept beyond a mere endowment of bundles of specific resources, but rather advocate for a far-reaching rationale that contemplates the mechanisms that put these tangible and intangible resources together making a BM work and compete in dynamic markets. These mechanisms refer to the internal organizational and managerial processes and skills by which firms can identify, adapt, and reconfigure new opportunities and threats for CE.

The research concludes that the 15 microfoundations or game cards (Figure 24) represent the organizational processes needed for BM transformations in favor of CE. Furthermore, the study indicates that the game cards developed in this research, are undeniable beneficial for CE implementation, yet not exclusive to this subject. The findings and the validations suggest that the 15 microfoundations can be used for more purposes that CE, including different approaches in the search for sustainability in the built environment.

In this regard, architectural firms may apply five micro-foundations to sense CE business opportunities in the market specifically: (1) Architectural Marketing, (2) The Side Door, (3) Market Surveillance, (4) The Question behind the Question, and (5) Knowledge Generation. Once, CE business opportunities have been sensed, firms may address those opportunity through five seize microfoundations that will impact each of the BM components, namely (6) Continues Motivation Schemes, (7) Initiator Capacity, (8) Collaboration, (9) CE tool Development, and (10) Guarantee Systems. Finally, the last organizational processes that enable architecture firms to transform their BM are five reconfiguring microfoundations namely (11) Internal Knowledge Integration, (12) BM design skills, (13) New Business Paradigms, (14) Organization Restructure, and finally (15) Organize the Narrative.

To finalize, BM transformation and CE, demands for motivated professionals in the creative industry that believe that a deeper change is needed in the essence of the profession and the construction industry. The game cards should support professionals to constantly reevaluate their approach to the built environment allowing to respond and enhance social, economic and environmental sustainability.

6.2 CONTRIBUTIONS OF THE RESEARCH

This thesis contributes to the fields of corporate real estate management and design and construction management by providing knowledge about BM transformation processes in favor of CE and its supporting organizational mechanisms.

The main contribution of this research relates to the identification of fifteen microfoundations of dynamic capabilities that architectural firms and other creative firms can pursue to incorporate CE into the way they propose, create, and deliver value for the firm, society and a broader group of stakeholders that include nature and future generations. In this line, the research provides a toolbox in the shape of gamecards that explain how BMs can be transformed depending on three core capabilities, namely sense, seize and reconfigure dynamic capabilities.

Additionally, the study has revealed different internal and external challenges that architectural firms in the Dutch context have experienced when implementing CE principles as part of their BM portfolio.

This information is particularly relevant not only for top managers or senior architects, but also for every member of architectural organizations or entrepreneurs aiming to enter this field, as it gives insight into the BM dynamic of this part of the construction industry. This research contributes to the exiting body of knowledge and closes a gap in literature regarding BM transformation in the context of CPSFs. The research provides a more comprehensive view of the topic, as previous studies have focused only on large profit driven organizations or have been developed in single unit of analysis methodology.

6.3 EVALUATION OF THE RESEARCH

This section evaluates the research in four tests: construct validity, internal validity, external validity, and reliability. According to Yin (2009), these four dimensions provide the best evidence in terms of the quality of the research design.

Construct Validity: This dimension focuses on the appropriateness of the operational method for the topics studied (Yin, 2009). In this regard, multiple sources of evidence were used. On one hand the literature review not only focused on scientific papers, but also on reports performed by practitioners in the field of architecture. Both, academic and practice-oriented sources allowed to construct the theory supporting the research. On the other hands, the empirical study collected data from different sources inside each case study, which allowed for comparison validating of showing discrepancies between the answers from the interviewees. Furthermore, a chain of evidence was developed to back up the findings. Quotations are used throughout the document to illustrate and support the findings, and the sources of data are always referenced and coded in the text to increase the transparency of the evidence. Finally, a workshop was used for further validation of the mains findings.

Internal Validity: According to Yin (2009), internal validity is an assessment that applies only to explanatory or causal studies. Due to the exploratory nature of this study, this dimension is not considered in the evaluation of the research.

External Validity: The third test deals with the problem of knowing if the research findings are generalizable beyond the immediate study, regardless of the research method used (Yin, 2009).

This research implements a multiple case study approach, Yin (2009 suggest that a replication logic study can validate the externality of the research. In this regard, the empirical research has been replicated across four case studies of architectural firms operating in different regions of the Netherlands and in different stages of development in the construction industry. Furthermore, although micro-foundation development is firm-specific, theory explains that they also present commonalities that allow for generalization across organizations and industries (Eisenhardt & Martin, 2002). Besides, the findings from the empirical research have been compared with the theory developed during the literature review. This enabled for the assessment of the alignment between the research findings and the existing theories, resulting in either validating previously established theoretical concepts about the Dynamic Capabilities Approach of the firm or contributing with new concepts that developed in the study.

Reliability: The final test of reliability determines the repeatability of the research methods and the data collection procedures used in this research. According to Yin (2009, this includes the use of case study protocols and the develop of a case study data base. In this regard, the data collection process has been extensively described in Chapter 3. Additionally, the interview protocols can be found in the appendices chapter, and material such as audio/video recordings, transcripts of interviews, data analysis documents by AtlasTI have been safeguarded by the researcher in a proper manner.

6.4 LIMITATIONS AND FUTURE RESEARCH

The findings of this research are subject to certain limitations of context, timing, methodology, and scope, which provide opportunities for future research paths.

First, the empirical research of this study is based on data collected form architectural firms based in the Netherlands. In this regard the findings are influenced by the social, political an economical context in which the case studies operate. Thus, future studies may conduct a similar study in other geographical contexts or provide insights into the influence of different national regulations on the practices of architectural firms in different countries on their efforts to achieve CE.

Second, the subject of study for this research are architectural firms; future research can explore the dynamical capability approach on other sectors and actors of the creative industry that is yet to be observed in the current study. Additional research focusing on the demand side of CE projects could be highly beneficial in order to better understand clients' perceptions of CE and the conflict between cost structure and revenue streams. This type of research could gather information on what is required to motivate clients to allocate financial resources for CE. These insights might then be used to reinforce the organizational processes highlighted in this study, giving architectural firms a competitive advantage or CE premium influencing client's preferences for organizations with higher CE capabilities for sustainability goals.

Third, in relation to methodology, this research is based on qualitative data exploiting the case-study approach. However, the empirical study evidenced that an increased number of interviews per case study could be very fruitful and provided greater details about the organization. Hence, a longitudinal study for research on the evolution of a firm's dynamic capabilities for CE implementation is not discarded. The longitudinal study can also be performed with one of the organizations that were part of this study yielding insightful information about the evolution of the firm

Moreover, quantitative data collection could improve the comparability between case studies and the use of the game cards, regarding the impact of CE on architects' business models, costs expenditures, investment of time, increase of fees, hiring of new stuff, among others.

In the same line, the methodology could be adjusted to use the game cards and acquire insight from a business model perspective by comparing two specific projects from the same firm. This is suggested as literature showed that creative firms have the capacity to develop specific business models on a project base. All these suggestions can be accomplished by modifying approach and adding adjustments to match the specific goals and conditions of future studies.

7 REFLECTION

7.1 POSITION WITHIN THE MASTER TRACK

This research is part of the Management in the Built Environment (MBE) track of the MSc Architecture, Urbanism and Building Sciences program at Delft University of Technology. The research has been developed in the intersection of two core disciplines within the MBE master track, the Real Estate Management (REM) and the Design and Construction Management (DCM) chairs.

On one hand, the REM chair, through a multiple-perspective approach to real estate management, emphasizes on facilitating a sustainable built environment that contributes to societal, environmental, and organizational goals of stakeholders in the construction industry. On the other hand, the DCM chair is closely related to architectural design addressing the processes and activities necessary for the appropriate development of the architectural components of the built environment.

Within this intersection, the purpose of this research is to address the knowledge gap between CE implementation and business model transformation for creative professional services firms. This research identifies organizational mechanisms for architectural firms that allow business model transformation to embrace CE. In this respect, the REM chair provides the theoretical background and guidance, trough the Dynamic Capability Approach, to explore organizational change towards sustainability. The DCM chair provides the understanding of the strategic management perspective and processes of architectural firms, who are shaping and developing our built environment.

7.2 RELEVANCE

The findings of this study are intended to provide knowledge that is relevant for science and practice.

In regard to academic relevance, this research shreds light into current interpretations of the CE concept among architectural firms, developing a state of the art of the CE among this organizations, informing different parties about the progress and development of the concept and how is being applied to the built environment. Secondly, this research fills a knowledge gap between business model transformation and CE for smaller creative firms that are driven by ideals beyond monetary value. Thirdly, this research advances the dynamic capabilities theory by collecting data from practice and identifying key micro-foundations of dynamic capabilities. In regard to the practical relevance, the research provides insights for stakeholders in a strategic position within creative organizations, who want to become leaders in the industry and secure their relevance in the new economy. The findings include CE approaches from practice in the Dutch context, understandings into business model transformation paths through the Dynamic Capability Approach, specific skills, and process necessary to sense opportunities and threads in the market, seize those opportunities into business models, and skills to reconfigure the business models components and the resource-base of CPSFs. The generic and specific approaches are undoubtedly relevant for establish architectural firms but also for entrepreneurs in this architectural field as it provides a base for future architects or designer who want to understand the dynamics of business models and anticipate change in their future firm. Finally, this research is part of the growing global effort to promote sustainability among cities, businesses, and society addressing the planet's deterioration.

7.3 RESEARCH METHOD AND APPROACH

Literature Review : The first part of the research, the literature review was fundamental to set the theoretical base that guided and structures the empirical review. Through the development of the research, the literature review opened the doors to multiple theories behind the view of the firm, specifically two of the Resourced Based View and the Dynamic Capability Approach of the firm. As the intention of the research was to understand and generate Know-How knowledge, the second theoretical approach was chosen. Together in consultation with the first set of tutors, it was decided that that this view was appropriate for the study as it allow a more dynamic view of architectural organizations and its business components. Another critical section of the literature review was the Circular Economy notion. This section enriched the study by showing what is the current state of the concept and the different strategies that have been developed from a design standpoint. Finally, the last section explored the literature behind architectural practices. This study was very insightful and enjoyable as never before have I minced the architectural profession in such detail, understanding every part of the activities behind the creation of architectural products.

The literature study mostly focused on academic journals and scientific publications. However, multiple publications from practice, like books, online websites, reports; were analyzed and used to construct the narrative as the topic has been neglected from academia and there has been paucity of to study architectural firms as units of analysis. The information was collected and distributed according to the three main concepts of the research, building a cohesive narrative that supported by clear graphics created a scientifically supported storyline.

Empirical research: The empirical research was originally planned to be developed in one month and based on a minimum of six case studies but aiming for eight. However, contacting architectural firms willing to collaborate and provide insight into their business models proved to be a challenging process. As an alternative plan, firms outside the Netherlands were contacted having positive answers in the UK. However due to time concerns and to keep the comparability of the data collected, the case studies were preserved to the Dutch context. The approach of the empirical research changed from the collection of qualitative primary data through one semi-structure interview per firm to two or three interviews, as this allowed the research to obtain more supportive data about the business activities that these organizations performed. The increased number of interviews also increased the perceived trust between the interviewer and interviewees and allowed for better collection of data, as well as refining of the research questions for the other case studies.

Reflecting back into the interviewees, due to the complexity of the research topics and the lack of knowledge on business model theory from some if the interviewees; it was concluded that using a structured interview and sending the research protocol in advance would have made the process more fruitful and smoother as the components of the BMC could allow for this structuration and time for reflection on the interviewee side. Additionally, the empirical research could have been benefitted from quantitative data that led to a more rational comparison between the case studies. It's important to say that although the number of case studies did not achieve the initial ambition and turn frustrating at some point; the increase in number of interviews per case study yielded significant information that contributed to the quality of the research and a stronger relationship with the interviewees.

7.4 RESEARCH PROCESSING AND PLANNING

The graduation research journey proved to be a very emotionally, academically, and physically demanding process, yet very rewarding at the end. Through the process there were constant feelings of uncertainty and enthusiasm.

On one side, as researcher we want to believe that our work will make a huge impact in the world, discovering something big and groundbreaking . Later the process shows us that we are exploring a very small particle of knowledge and that multiple people have already walked that path. However, the question still remains if that small particle of scientific research will at one point change the world through the lens of the architectural discourse.

The process was challenging but fortunately not that lonely. The mentors Dr. Tuuli Jylhä, Dr. Hans Wamelink and Dr. Hilde Remoy provided me with substantial feedback to set the structure for my research, supported me during the defiant empirical research and the motivation to keep on exploring my research topics. At the same time, they gave me the confidence and freedom to trust my research decisions and follow the process at my own pace and developing a logical and fruitful chain of thoughts. This dynamic between uncertainty and enthusiasm fostered an awareness, and multiple reflection stages that ended up in re-assessment, changes, discussions, and uncountable drawings to design the path towards the answer for the research question.

Business Models is a topic that architectural firms and professional in this industry often neglect. This research showed the importance of gaining knowledge in this field for professionals who sometimes encapsulate in design tasks, forgetting that at the end of the day in order to achieve all the societal goals that ambition, they still need to run an office and understand the intricacies behind managerial and strategic tasks. The ultimate outcome reaffirmed my choice for this research topic and master's program, remaining loyal to improving the practices of the actors shaping cities and society through spatial design.

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9 APPENDICES

9.1 APPENDIX A-QUESTIONNARY

The following questions refer to six clusters of innovation based on a literature study necessary to adopt CE principles at an organizational level. The final output will allow the better understanding of how innovation for CE is perceived among the case studies. Respondents must rate the following questions on a scale of 1 to 5, with 1 indicating no engagement or minimal attention and 5 total adoption.

1. Not aware **2.** Aware but not incorporated **3**. Occasionally incorporated **4.** Usually incorporated **5.** Fully incorporated

COMPETENCE	STATEMENT	SCORE
Technological Innovation The application of technological Innovation to allow design for circular flow and responsible material use	Is the firm focused on designing to Refuse and Rethink linear construction models ?	1 2 3 4 5
	Is the firm focused on designing to completely reduce the use of natural resources and raw materials in projects ?	1 2 3 4 5
	Is the firm focused on designing for Life Span extension of architectural products ?	1 2 3 4 5
	Is the firm focused on designing for Standardization and Replicability of architectural products ?	1 2 3 4 5
	Is the firm focused on designing for future upgrading and adaptability to allow future expansion and modification ?	1 2 3 4 5
	Is the firm focused on designing for Repair and Maintenance, Refurbish and Remanufacturing, meaning that the architectural product can be easily disassembled and reassembled, and components can be easily repair and replaced ?	1 2 3 4 5
	Is the firm focused on designing for Recycling and Recover of materials that can be easily extracted and sorted from the architectural product ?	1 2 3 4 5
	Is the firm aware of the toxicity and environmental impact of the materials they implement in the development of their projects ?	1 2 3 4 5
Business Model Innovation Circularity calls for new and different business models, and hence changes to the "business as usual" of architectural firms.	To what extent has the Circular Economy changed the business model of the firm?	1 2 3 4 5
	To what extent has the firm innovate their "value proposition" segment in relation to the CE, in terms of the services or benefits offered to the customer?	1 2 3 4 5
	To what extent has the firm innovate their "value creation" segment in relation to the CE, in terms of changes in key partners, key activities, or key resources that are being implemented ?	1 2 3 4 5
	To what extent has the firm innovate their "value delivery" segment in relation to the CE, in terms of customer segments, customer relationships, channels and take-back system?	1 2 3 4 5
	To what extent has the firm innovate their "value capture" segment in relation to the CE, in terms of their cost structure or revenue streams?	1 2 3 4 5
Organizational Innovation	To which extent is circular economy embedded in the firm overall corporate strategy?	1 2 3 4 5

From no strategy, system and culture in place to continuous and systematic strategy, systems and culture towards circular economy	To which extent is top management in the firm familiar with the concept of circular economy ?	1 2 3 4 5
	To which extent are employees in the firm familiar with the concept of circular economy ?	1 2 3 4 5
	To which extent are employees/designer open to reconsider formerly applied linear design principles ?	1 2 3 4 5
	To which extent are systems for feedback and brainstorming put into place at the firm?	1 2 3 4 5
	To what extent is your company active in sharing circular economy related information through its communication channels?	1 2 3 4 5
Value Chain Innovation From no insight into value network and limited collaboration to full insight, full collaboration, and leading position in the circular innovation network	To which extent is your company active in collaborating with external partners for circular economy?	1 2 3 4 5
	Is your company associated with one or more organizations related to circular economy?	1 2 3 4 5
	To which extent is your supplier selection process based on circular economy criteria?	1 2 3 4 5
	To which extent is your company active in collaborating with customers for circular economy initiatives?	1 2 3 4 5
	To which extent is your company active in sharing circular economy-related information and resources in formal and structured system with other firms in the same industry	1 2 3 4 5
Renewable Energy Process Innovation From complying to minimal requirements to proactively increasing energy efficiency as key driver inside the firm but also outside the firm through its design process.	To what extent the energy consumption within the firm comes from renewable energy sources?	1 2 3 4 5
	To which extent is energy consumption managed in your company?	1 2 3 4 5
	To which extent does the firm implement or design for energy efficiency in their architectural products?	1 2 3 4 5
	To which extent is the firm adhering to regulatory requirements with regard to sustainability and energy policy ?	1 2 3 4 5
Social Innovation When firms strive for earth well-being, they also strive for wellbeing of people and society in general. From minimal regulatory requirements to full societal responsibility and stewardship.	To which extent is Corporate Social Responsibility incorporated in the firm strategy and operations?	1 2 3 4 5
	To which extent are the UN Development Goals incorporated in the firm strategy, operations and value chain?	1 2 3 4 5
	To what extent are actions geared towards regulatory requirements for human rights and environmental protection?	1 2 3 4 5
	To which extent the firm aware the societal and environmental impact of the whole value network chain activities?	1 2 3 4 5

9.2 APPENDIX B-INTERVIEW PROTOCOL

INTERVIEW PROTOCOL

Delft University of Technology, Master Track: Management in the Built Environment, 2022

Interviewer	Pedro J. Vásquez Gómez
Interviewee	XX
Research Title	Circularity as a Game Changer: An Exploration of Architectural Firms' Dynamic Capabilities for Business Model Transformation
Date	XX

Introduction: This research maps out the transitionary path of architectural firms towards circular economy implementation in their business models, and the enabling organizational mechanisms (routines, skills, process). The semi structured interview is structured in three sections. They refer to the three units of analysis established for the empirical part of the research. The questions provide a guide for the research, yet the interviewees are not restricted to them. As an introduction, the interview protocol presents the definitions of the main concept being used in the research.

Business Model Concept: A business model describes the systematic architecture by which organizations create, deliver, and capture different types of value. A business model can be described as the configuration of a firm's resources, the linkages among these components, and the overarching dynamics that allow the business model to work.

CE Concept: The CE represents a new economic system aiming to make the concept of waste obsolete by closing and narrowing open production systems built on linear consumption models.

Circular Business Models: BMs that are based on the main principles of the CE. Hence, generating business models that close and narrow resource loops, extending the life span of products and resources resulting in the reduction of waste.

UA1-CE APPROACH OF THE FIRM

- What is the understanding of Circular Economy by the firm?
- How would you define the current business model of your organization?
- Where is the firm now in relation to the circular economy transition? To what extent has the Circular Economy changed the business model of the firm?
- What is the market like for circularity, are current clients interested?
- Was CE Implementation as part of the firm based on a particular project or was applied from a business strategy level?
- To what extent did national policies influence the decision to work within circular economy principles?

- In terms of the design phases is it different for projects with strong CE ambitions that for other projects?
- Why do you consider the firm hasn't managed to be fully circular yet?
- How could your projects be even more circular?
- What is the firm working on now in order to be more circular in the future?
- Has circularity influence the reputation of the firm or the way the firms is perceived by clients?
- How do you start with this project? How do set ambitions or a framework to start with the project?

UA2-CE IMPACT ON BM

- What parts of the business model do you perceive a change in ?
- How did you experience finding investors and clients for the development of new CE business models?
- How has the value proposition changed in your firm, regarding services and products once CE became a core strategy ?
- How has the value creation and delivery sections changed in your firm once CE was implemented?
- Did the revenues of the firm increased in these projects or financially were they not as satisfactory as other projects where CE didn't play a major role.

UA3-CE MICROFOUNDATIONS OF DYNAMIC CAPABILITIES

- How do you deal with major organizational changes such as a CE transition within the organization?
- Were additional resources or skills needed to implement circularity in the firm? Which?
- How do you ensure that there are knowledge and skills necessary for CE implementation in the firm?
- During the transition how did logistics changed? Are you focusing on reverse logistics? do you recover products or building component back from clients?
- How do you scan the market for opportunities? Which processes and technologies could you also apply?
- To what extent do clients influence your choice of how and whether to implement CE in your projects? What about competitors?

- What are the biggest barriers to change the current BM in favor of CE?
- What parts of your overall business model needed to be reconfigured in order to be able to create and deliver circular projects?
- Did the firm experience resistance or fear to change from your partners? how did you mitigate it?
- How can you better collaborate within the value and supply chain? Which technologies and processes are necessary?
- Are there incentives from public and governmental organizations to accelerate the circularity transition?

9.3 APPENDIX C-FORM OF CONSENT

The following document is part of the invitation for your participation as an interviewee for my thesis research entitled: "Circularity as a Game Changer: An exploration into the dynamic capabilities of architectural firms for business model transformation". This research is being carried out by me, Pedro J. Vásquez Gómez, as part of my graduation project for my master's degree in the Management in the Built Environment at the Architecture Faculty at Delft University of Technology

The aim of this research is to explore and identify the skills, processes, and organizational mechanisms by which architectural firms can incorporate circularity principles into their business models at different circular economy maturity levels, and the impact of said processes into their professional value. To that end, case firms were chosen based on their corporate strategy's approach to delivering sustainability in the built environment, as well as their relationship to the circular economy (CE) as a part of these efforts. Similarly, their strategic aims beyond financial revenues, as well as the various levels of business models imbedded in their projects, were examined as sample selection criteria.

The result of the study will be in the form of a framework or roadmap that can serve as a guide for organizations and entrepreneurs in the architectural and real estate development field, aiming to understand and overcome the barriers of the circular economy transition, while boosting their maturity level in terms of circular economy implementation into their organization. The framework's design is being carried out in parallel with the data collection process composed of one questionary and one consecutive interview. On the one hand, the questionary aims to determine the CE maturity level of each case-firm and will be based on the CE innovation levels of each firm. On the other hand, the interviews will have a semi-structured form: they will be structured by specific topics of discussion whereby the interviewees can express their professional experience and opinion without being limited to a list of strictly predefined questions. For the first round of interviews, the focus is to go deeper into the maturity level of the firm as well as identify some of the barriers that have been overcome and those that still need to be addressed. The firm's definition of circular economy, their reasons for choosing circular economy implementation instead of other sustainability strategies will also be part of these interviews. The same interviewees will be approached to assess the micro foundations of dynamic capabilities that allow the case firms to overcome circular economy barriers. By categorizing different micro foundations belonging to different firm maturity levels, the study can develop a framework of micro foundations and cluster them according to the three higher level dynamic capabilities identified in literature. The duration of the interview will be approximately 50 to 60 minutes. The questionnaire and the interview will be conducted between March and April 2022. I would like to request your permission to record the interview and transcribe it accordingly. All the data will be anonymized (If required by the interviewees) and used for the sole purpose of research. Finally, for your participation in the interview, I would like to ask you to fill in and sign the Consent Form of the next page and email it back in a PDF version. The form will be signed and returned to you.

If you have any questions about the research, you can always contact me at the following email: P.J.VasquezGomez@student.tudelft.nl

INTERVIEW CONSENT FORM

Delft University of Technology, Master Track: Management in the Built Environment, 2022

Interviewer : Pedro J. Vásquez Gómez
Research title : Circularity as a Game Changer: An Exploration of Architectural Firms' Dynamic Capabilities for Business Model Transformation
Interviewee :

Please tick the appropriate boxes

1. Taking part in the study
    - I have read and understood the study information. I have been able to ask questions about the study and my questions have been answered to my satisfaction.
    - I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.
    - I understand that taking part in the study involves participating in a questionary and semi-structured interview by answering questions and providing information. The interview will be recorded and analyzed only for research purposes. It will be anonymized, and the recording will be destroyed when the research project is complete.
2. Use of the information in the study
    - I understand that information I provide will be used for an educational purpose by being incorporated in a graduation thesis report and its presentation at TU Delft.
    - I understand that personal information collected about me that can identify me, such as [e.g. my name or where I live], will not be shared beyond the study team.
    - I agree that my information can be quoted in the research output and anonymized accordingly.
    - I understand that in the scenario of the research being published, my identification as a participant will not be possible.
3. Future use and reuse of the information by others
    - I give permission for the information that will be provided through the interviews to be used for a thesis report. The report will be published in the education repository of TU Delft and can be used for future research and learning.
4. Research output
    - I would like to be informed about the final output of this research. In that case, I would like the researcher to keep my contact information (email) and inform me about it at the end of the research

Signatures

_____	_____	_____
Name of participant	Signature	Date

I have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

_____	_____	_____
Researcher name	Signature	Date

Study contact details for further information: Pedro J. Vásquez Gómez, P.J.VasquezGomez@student.tudelft.nl