

Master's Thesis

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Master Sustainable Development

Measuring maturity in corporate Circular Business Models



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Abstract

Circular economy (CE) remains underdeveloped although it is gaining momentum as an alternative to the current environmentally damaging linear economy. Organizations, under socio-technical regimes, are currently trapped in path dependencies towards linear production processes. However, they can become enablers of a transition towards a CE by implementing circular strategies in their business model (CBM) such as cycling, extending, intensifying or dematerializing their value chains. In any case, there is a lack of guidance on the know-how required to effectively implement CBMs in organizations and on how to assess their progress.

The present study aims to develop a maturity model for CBM implementation that takes into account the dynamic process of innovation, while providing a diagnostic and a benchmarking tool for organizations and policymakers. To build such a model, the following research question was investigated: *How can organizations measure their maturity in terms of CBM implementation?* Research for the study followed a deductive design, conducting an integrative literature review to identify 14 organizational capabilities required for CBM implementation, according to recent research on Dynamic Capabilities applied to CBMI. Such capabilities are described according to four levels of maturity, setting best practices at the highest level. The maturity model also contains a grading mechanism that provides organizations with an overall grade, as well as a grade per stage of implementation to guide them into identifying areas for improvement. Such a preliminary model was then tested with two case studies from the denim industry, following a maximum variation sample approach and refined with their feedback as a way to validate the model and improve its universality.

Compared to existing theory on CBM implementation where practices are cataloged, the present study not only gathers more recent practices, but also introduces an unprecedented assessment mechanism that allows organizations to evaluate their current CBM implementation status and to plan their future steps, for each level of maturity. The maturity model developed in the present study provides guidance on CBM implementation that policy makers, academics, and practitioners have been requesting, thus enabling a wider discussion on CE adoption.

Key words: CBM implementation, maturity models, dynamic capabilities, Circular Economy, corporate capabilities

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1. Introduction

Population and economic growth driven by globalization has led to an overshoot of the Earth's resources, exceeding its carrying capacity since 1992 (Meadows et al., 2005). In fact, the doubling of the population in the last half century has led to a tripling of the amount of material flows (Circle Economy, 2022). Production and consumption patterns are the main cause, as they are characterized by a 'take-make-dispose' behavior proper from a Linear Economy (MacArthur, 2013). The consequences of such behavior, if continued, are projected to raise Earth temperatures 3-6 degrees by 2050 (Circle Economy, 2022).

In recent years, Circular Economy (CE) has gained momentum among policy makers, academics, and industry professionals (Geissdoerfer et al., 2020; Henry et al., 2020; Kirchherr, 2022). Such concept was popularized by Ellen MacArthur as an alternative system to the current linear economy, which aims to 'close the loop' –it is regenerative by design, as it eliminates waste when designing in restorative terms; it is powered by renewable energy; and it aims to increase products' lifetime and prioritizes sharing over ownership (MacArthur, 2013).

Although it is considered a promising solution, its implementation remains underdeveloped. In 2020 the global circularity was 8.6% (Circle Economy, 2022) leaving a 90% improvement potential. Innovation studies attribute such lack of implementation to 'socio-technical regimes' which, according to Berkhout et al. (2003), are "patterns of artefacts, institutions, rules and norms assembled and maintained to perform economic and social activities" (p.3) which are locking society into path dependencies and leaves out more sustainable alternatives such as the Circular Economy.

Organizations, and incumbents in particular, have been identified to be locked into core regime elements such as "beliefs and mindsets; identity and mission; regulations and policies; and technical knowledge and capabilities" (Penna & Geels, 2015). Yet, they are also considered to play a fundamental role as enablers of CE implementation, considering they operate globally with large market shares (Frishammar & Parida, 2019). To do so, they must first challenge these lock-ins and transform their business model into a circular one (MacArthur, 2013; Bocken et al., 2016; Geissdoerfer et al., 2020; Henry et al., 2020). Circular Business Models (CBM) are considered an important driver to adopt CE at an organization level (Geissdoerfer et al., 2020). This will require redesigning the value chain, by rethinking value creation, delivery, capture and proposition (Bocken & Konietzko, 2022) to be aligned with circularity values such as minimizing emissions, eliminating waste, maximizing the value chain and aiming for nature regeneration (Bocken & Geradts, 2020; Geissdoerfer et al., 2020). The paradigm is changing and what has traditionally been profitable may no longer be so due to the volatility of material prices, supply disruptions and other risks associated with a linear economy (MacArthur, 2013).

Regulations, indicators, and metrics on circularity provide guidance to companies; however, the volume of information can prove readings confusing and thus make it difficult for companies to know how they are doing in terms of circularity. In this sense, the Ellen MacArthur Foundation took the lead in developing different tools to measure circularity such as the product-oriented Material Circularity Indicator (Ellen MacArthur Foundation, n.d.); or the ResCom project (ResCom, 2017), identifying which type of business model is more suitable

for a product; or their last and more holistic one, the Circulytics tool (Ellen MacArthur Foundation, 2020). However, there is no tool assessing the maturity of organizational structures involved in CBM implementation.

Additionally, previous research has focused on giving a shared theoretical conceptualization of CBM in terms of its future design, implementation, and execution (Geissdoerfer et al., 2020). Also, research on CBM has proposed strategies (Macarthur, 2013) or even roadmaps for incumbents to transform their business models into circular ones (Frishammar & Parida, 2019). Other academics propose strategies and frameworks that operationalize CBMs to be deployed in start-ups, such as Henry et al. (2020), or have evaluated existing CBM tools, identifying those that represent 'good practice' (Bocken et al., 2019). Yet there is a clear research gap in benchmarking the level of CBM implementation in organizations, as an evaluation tool to quantify and assess CBM implementation (Rosa et al., 2019). Urbinati et al. (2017) make a first approach by proposing a taxonomy to evaluate the adoption of CBM from the perspectives of customer value proposition and value network; however, there is still lacking an analysis at the organizational and strategic management level on how to implement CBMs through guidance and best practices (Assmann et al., 2023; Galvão et al., 2022).

The aim of this research is to develop a benchmarking tool to measure how well an organization is doing in terms of CBM implementation. The tool seeks to take a holistic view by assessing the maturity of an organization in terms of its circularity performance based on a maturity model (more detail in section 2.2). This tool could be used by companies to see their circular competitive advantage or as a guideline to identify areas for improvement. As a diagnostic tool, it is expected to guide organizations into scaling-up their CBM implementation and contributing to a higher CE implementation rate.

In order to develop such a benchmarking tool, the following research question and sub-questions were proposed:

RQ: How can organizations measure their maturity in terms of CBM implementation?

- 1. What organizational capabilities are needed for CBM implementation?*
- 2. How can these capabilities translate into levels of a maturity model?*
- 3. How do different CBM score in terms of their level of maturity?*

The scientific relevance of this study lies in understanding how organizations are doing on their path towards a Circular Economy, not only from a conceptual perspective but also from a more empirical view regarding its implementation. New business models (Geissdoerfer et al., 2020) and changes in consumerism (Kirchherr et al., 2018) have been identified as main enablers of CE transition, yet organizations remain locked into linear practices which are their main barriers to CE adoption and diffusion.

Society is facing times of resource scarcity, huge levels of waste and rising GHG emissions that threaten the prosperity of future generations. CE has the potential to address these issues if the barriers towards its implementation are overcome. This research aims to guide organizations in their path towards CBM implementation, as a way of accelerating CE transition.

2. Theory

2.1. Circular Business Model

Business models are strategies defining how companies create, deliver, transfer, and capture value (Urbinati et al., 2017). In a CBM these strategies are aligned with CE principles as guidelines for business model design (Pieroni et al., 2019). Organizations aiming to implement CBM need to then rethink the practices related to their Value Logic framework (Richardson, 2005). Such a task will involve of a change in value proposition (target offer and consumers); value creation and delivery (activities, resources, partners and channels of distribution); and value capture (cost and revenue) (Henry et al., 2020). According to (Geissdoerfer et al., 2020) in a CBM, value proposition's key elements are 'take-back schemes' referring to strategies such as repair and remanufacture which increase lifetime; value creation and delivery aims to make customer relationships longer and focus on the use phase to create new revenue streams; and value capture is characterized by "recurrent revenues, increased profit margins and new pricing mechanisms" (p.21).

The identified way to conceptualize and implement CBMs is through CBM innovation (CBMI) (Geissdoerfer et al., 2020), which are the processes in which organizations implement CE strategies in their business model (Henry et al., 2020) to obtain sustainable competitive advantages. These strategies associated to the implementation of CBMs vary along literature. Bocken & Konietzko, (2022) mention 'resource-preserving activities' like reuse, refurbishment, remanufacturing, recycling, and regeneration. Other strategies are ranked in terms of circularity in the so-called R-framework, where the number of R's differs from 3Rs (reduce, reuse, recycle) to 10 R's, the latter being an attempt to reduce confusion in the ranking by combining the most common retention of value options (Reike et al., 2018). Others like (Geissdoerfer et al., 2020), after studying 14 definitions of CBM, categorize these strategies into cycling, extending, intensifying, and dematerializing.

However, there are different ways of implementing CBM implementation in an organization. When implementation affects the core business model by replacing the existing one with a CBM, it's called a CBM transformation; or, in the case of Circular Start-ups, their core business model would initially be created based on circular principles (Geissdoerfer et al., 2020). However, it doesn't always affect their entire business model, as in some cases the existing BM is maintained while an additional CBM is created (CBM diversification) or an existing CBM is acquired by the organization (CBM acquisition) (Geissdoerfer et al., 2020).

Incumbents and start-ups face different barriers when implementing a CBM as circular start-ups can include the CBM components from scratch, while incumbents need to overcome path-dependencies and organizational lock-ins (Guldmann & Huulgaard, 2020). A study from these authors reveals that while incumbents on average face barriers at all internal and external levels (organizational, market, institutional, and value chain) they do not face barriers at an employee level, and rather depend on the resources available, their ambition, and the stakeholder's involvement (Guldmann & Huulgaard, 2020).

The process behind the implementation of these strategies can be considered dynamic as it requires changes on "how an organization and its ecosystem create, deliver, and capture

value”(Bocken & Konietzko, 2022, p.1) aiming to adapt to environments that are constantly changing. Such ‘dynamic capabilities’ are considered key for business model innovation (Teece, 2018 ; Bocken & Geradts, 2020), requiring organizations to have the ability to “integrate, build, and reconfigure internal and external competences to address rapidly changing environments” (Teece et al., 1997, p.516). According to Fernandez de Arroyabe et al. (2021) the implementation of CE in an organization requires the alignment of its capabilities with the dynamic process of innovation, where ‘capabilities’ refers to the ability companies have to mobilize resources using organizational processes towards achieving a goal.

Bocken & Konietzko (2022) propose an adapted version of Teece (2018)’s dynamic capabilities to measure CBMI, resulting in four stages: (1) visioning, (2) sensing, (3) seizing, and (4) transforming. They are defined as follows:

Visioning refers to creating a joint starting point for innovation by creating a viewpoint about what the future should look like (Bocken & Konietzko, 2022).

Sensing refers to “scanning the market to identify and assess unmet needs and new business opportunities” (Bocken & Konietzko, 2022, p.2).

Seizing refers to “mobilizing organizational resources to seize new opportunities and develop their business case” (Bocken & Konietzko, 2022, p.2).

Transforming refers to “the continuous renewal of the organization, to remain competitive in fast changing environments” (Bocken & Konietzko, 2022, p.2).

2.2. Maturity model

There are different definitions of what maturity models represent, but they generally refer to steps or stages organizations go through to achieve desired objectives (Steinhöfel et al., 2022; Igartua et. al, 2018). It is considered a tool to measure the progress of an organization (Igartua et. al, 2018) by placing it in comparison with best practices (Becker et al., 2009). According to Wendler (2012) the objective behind a maturity model is to enable benchmarking and facilitate guidelines for improvement. This allows organizations to define the steps needed to gain a competitive advantage and to see where they stand in comparison to others. It is possible to measure and predict these stages of organizational change because they are understood to follow predictable patterns (Igartua et al., 2018).

The way maturity models are structured consists of a number of levels of maturity used to measure the organization’s performance (Demir, 2018). This performance is described by showing the desired characteristics at each level building upon each other (Steinhöfel et al., 2022). Each level is different, self-explanatory, easy to understand, and has its own organizational purpose (Demir, 2018; Igartua et al., 2018).

Different authors are including innovation in their maturity models (Demir, 2018; Enkel et al., 2011; Essmann & du Preez, n.d.; Igartua et al., 2018; Steinhöfel et al., 2022) as they claim that once innovation is at the core of organizations’ corporate strategies and culture, the highest levels of maturity can be reached (Demir, 2018). According to the same author, innovation takes dynamic lens covering “the entire process of strategic planning from visionary leadership to execution” (Demir, 2018, p.5).

The components of a maturity model are often multi-dimensional, ranging from three to eleven dimensions of maturity, each of them having different descriptions (Steinhöfel et al., 2022). Levels of maturity also vary, but typically range from four to six levels in increasing order of maturity. Steinhöfel et al. (2022) provide seven different examples of maturity models showing the existing differences in dimensions and levels (see Appendix A).

According to Rohrbeck (2010) to be included in the model, categories or dimensions should meet the following requirements: (1) Detectable within any company independently of its structure, size or industry; (2) Measurable at a capability level; (3) Explanatory power, being linked through literature to the subject of study, in this case CBM implementation.

As an example, Demir (2018)'s maturity model aims to link innovation to strategic management and has seven dimensions: Leadership; Planning & executing; Processes and tools; Structures and model; People and culture; Performance management; and Innovation. These dimensions are scored following six levels ranging from 0-Undefined; 1- Initial; 2- Planned; 3- Performed; 4-Optimized; 5- Excellent. A visualization of Demir (2018)'s maturity model is included in Appendix B.

Maturity models are a valuable tool for organizations. According to Steinhöfel et al. (2022) the value of these models has three purposes: First, maturity models are considered a diagnostic tool measuring an organization's maturity in terms of the assessed objective. Secondly, it provides best-practices as guidelines for improvement which can help organizations reach the next level. Finally, it can facilitate comparison with other companies as a benchmarking tool (de Bruin et al., 2005; Röglinger & Pöppelbuß, 2011). These aspects lead to a competitive advantage and better results for organizations implementing maturity models (Igartua et al., 2018).

2.3. Conceptualization of the model on CBM implementation

The core categories from where the research departs are the commonly known Dynamic capabilities (DC) proposed by Teece (2018) to design and implement a business model and applied to Circular Business Models by Bocken & Konietzko (2022), where visioning is included into the DC of sensing, seizing, and transforming. These concepts arise from a literature review on CBM implementation practices and, having revised literature on maturity models, are translated into CBM implementation stages to be able to link CBM implementation with maturity model dimensions. The implementation stages and the required capabilities obtained when responding to the first sub-question, correspond to the model's vertical axis. The horizontal axis corresponds to the maturity levels which need to be described by answering the second sub question. Levels of maturity are classified into four levels: the lowest level is called 'not implemented' and it is meant for organizations that haven't yet arrived at the stages of transforming or seizing; the first level is called 'poorly implemented'; the second level is called 'sufficiently implemented'; and the top level is called 'fully implemented' referring to the highest level of CBM implementation in which the CBM is embedded within corporate culture and strategies.

Each dimension of maturity shows a description of the performance to reach per level. The definition of this performance is part of the conceptual contribution and aims to depart from

the capabilities (processes/practices/skills) required at each of the implementation stages by Bocken & Konietzko (2022) and develop into practices applicable for any type of company, following Rohrbeck R (2010)'s requirements to build a maturity model.

To illustrate some examples of the capabilities that fit into each of the four mentioned stages of CBM implementation, Table 1 shows some of the practices (with examples) Bocken & Konietzko (2022) provide in Appendix C.

Table 1

Bocken & Konietzko (2022) practices for CBMI

Stage	Practices	Examples
Visioning	Translate vision into strategies	Gain commitment from top management
		Setting CBM priorities
Sensing	Analyse the existing and needed capabilities	Understand your own capabilities
		Investigate capabilities to build or access through collaboration
Seizing	Build internal acceptance and capabilities	Define internal functions and involve staff
	Investigate the viability of emerging new business models	Internal assessment of the business case, profits and costs
Transforming	Embed the new business models in organizational routines	Implementation within normal operations
	Drive cultural change	Experiment

Note: Adapted from "Circular business model innovation in consumer-facing corporations" by Bocken & Konietzko (2022)-Appendix C.

Finally, a scoring technique is developed to assess the level of Maturity according to an organization's level of CBM implementation, by answering the third research sub-question. This part corresponds to the development of the Model, which is later tested empirically with two case studies and refined with feedback to improve its validity (see Figure 1)

3. Methods

3.1 Research design

The goal of this study is to build a comprehensive tool to measure the maturity of an organization in terms of its level of CBM implementation. The main contribution to addressing this goal is building a maturity model based on qualitative research exploring the main capabilities necessary for implementing a CBM in organizational structures. The methodology used for developing the model is based on an integrative literature review which is used when developing a new framework in an emerging topic by combining relevant perspectives to build upon the existing theory (Snyder, 2019; Torraco, 2005). According to Torraco (2005) this kind of literature review is used when exploring new emerging topics like "new forms of organizations" (p.3), which are closely linked to the necessary organizational changes involved in CBM implementation. For such study, Bocken & Konietzko (2022) and Santa-Maria et al. (2022) were taken as the foundation to identify the main capabilities needed for CBM

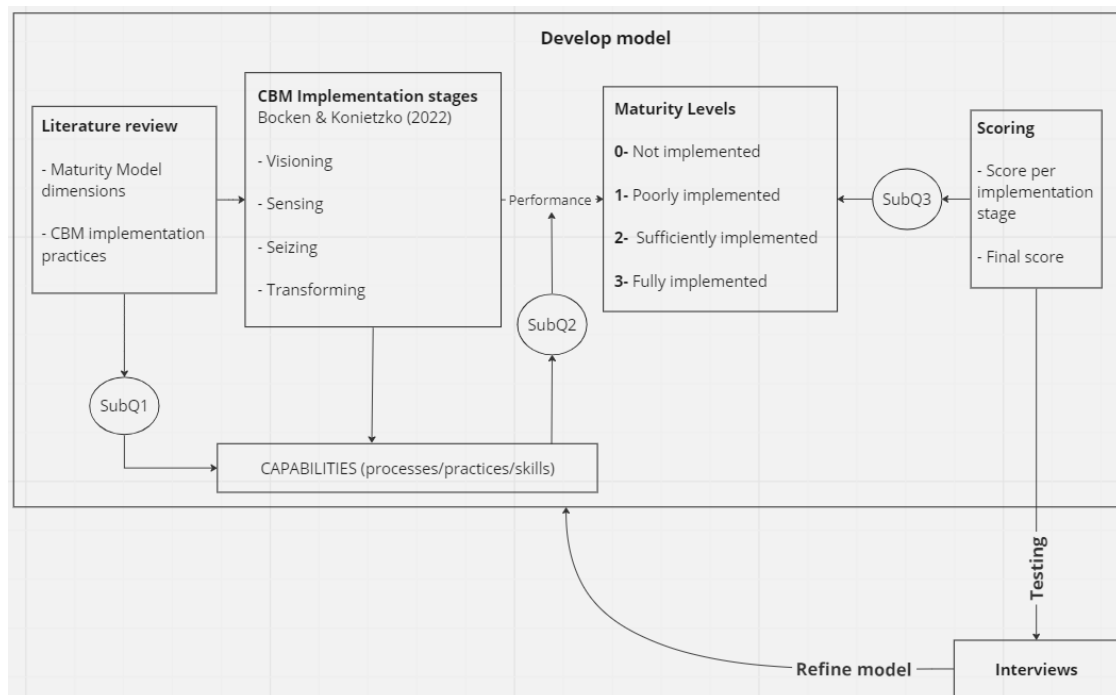
implementation, to later validate these by finding in literature other authors identifying the same capabilities needed for CBM implementation. These were also triangulated by conducting semi-structured interviews to test the model empirically. A multiple case study was chosen, as the main requirement when developing a maturity model is to make it applicable for any organization no matter its size or industry (Rohrbeck, 2010) For this reason, a maximum variation sample was employed as a type of purposive sampling approach, which involved selecting one start-up and one incumbent that were implementing a CBM. This way, it is considered that by including the extremes, the average organizations would be represented (Lungu et al., 2007).

Research follows a deductive design, in which theoretical propositions are based on a literature review, and then applied to the data collection and analysis (Pearse, 2019). For this study, the theory from Bocken & Konietzko (2022) and Santa-Maria et al. (2022) were used to guide the research and develop the model which was later tested with two case studies to provide an empirical view. The use of a deductive procedure in qualitative research is understood to strengthen research findings (Hyde, 2000). The steps taken along the research process follow three main prompts: developing the model; testing the model; and refining the model (see Figure 1).

3.1.1. Conceptual Framework

Figure 1

Conceptual framework



Note: Own elaboration of figure showing how the maturity model for CBM implementation will be developed, tested, and refined.

3.2. Developing the model

3.2.1. Data Analysis

This step is the main contribution of the research and is designed in such a way to allow the model to be developed by answering the following three research sub-questions.

1st SQ: "What organizational capabilities are needed for CBM implementation?"

To answer this question, Bocken & Konietzko (2022)'s dynamic capabilities and their corresponding CBM implementation stages were taken as the foundation. This paper was used as the main reference as it adds a new stage of implementation called 'visioning' to the ones proposed by Teece (2018). On the other hand, Santa-Maria et al. (2022) despite not including the visioning stage, has also been considered relevant when identifying the required capabilities, as it helps compensate for the limitations of Bocken & Konietzko (2022)'s approach, which focused only on consumer-facing corporations. Furthermore, this broader view is necessary when developing a benchmarking tool that can be used by all types of organizations (Rohrbeck, 2010). Once the main capabilities required for the implementation of a CBM are identified, these are assigned to their corresponding stage of implementation (visioning, sensing, seizing, or transforming). Sometimes Bocken & Konietzko (2022) and Santa-Maria et al. (2022) place these capabilities at different levels of implementation, as in the case of "Support from top management" where the former places such capability at the first level (visioning), whereas the latter does so at the last level (*reconfiguring*). However, as previously mentioned, Bocken & Konietzko (2022) stages were taken as the main reference and the capabilities were assigned accordingly. The procedure to assign capabilities to each implementation stage is presented in Appendix C, and is described as follows:

Each implementation stage was observed independently, and the capabilities identified by Bocken & Konietzko (2022) and Santa Maria et al. (2022) were put together per stage to see which capabilities both authors had in common. The capabilities of the two papers were first compared on the basis of the names used and then expanded by also considering the descriptions given to the capabilities by each author. A color code was used to recognize capabilities that were similar, whereby those that matched were considered the main capabilities required for the implementation of a CBM. Appendix C shows the capabilities per implementation stage identified by each author and the outcome of how they were grouped into the final capabilities included in the model. The color-coding and the letters (from A to D) match implementation stages with each capability; whereas the numbers assigned to each letter correspond to the way capabilities were grouped.

Finally, to validate these capabilities, an integrative literature review was conducted aiming to find other authors from the same field identifying such capabilities for CBM implementation. The following terms were introduced in Google Scholar and Elsevier's Scopus data bases: "Circular business model implementation"; "Circular business model" AND "capabilities" OR "Dynamic capabilities"; "Circular business model" AND "corporate practices"; "Circular business model" AND "visioning"; "Circular business model" AND "transformation"; "Circular business model" AND "Top management"; "Circular business model" AND "culture"; "Circular business model" AND "Lifecycle"; "Circular business model" AND "experimentation". The literature found to validate the above-mentioned capabilities is presented in Appendix D.

2nd SQ "How can these capabilities translate into levels of maturity?"

First, desk research was conducted to gain a better understanding of how maturity models are structured and designed, so that the levels of maturity per capability could be best described.

Four levels of maturity were established, considering these typically range from 4 to 6 levels (Steinhöfel et al., 2022), because it allows to include a level 0 for the companies that haven't yet arrived at the stages of seizing and transforming.

Then, the performance at each of the levels of maturity per capability was defined based on the integrative literature review conducted to validate the identified capabilities. The reference papers shown in Appendix D were used to build a definition of the highest level of maturity attributed to each capability, which corresponds to level 3- "Fully implemented". The conceptual contribution was to design each level based on the definition developed for level 3, and to descend gradually to the lowest level of maturity. The descriptions included per level are presented in Findings, section 4.

3rd SQ "How do different CBM score in terms of their level of maturity?"

The idea is that the Maturity of an organization in terms of CBM implementation can range from 0 to 3, being 3 the highest level of CBM implementation. Each of the maturity model dimensions (capabilities) will get a score ranging from 0-3 according to their performance at each level.

The final grading consists of a combination of two parameters. First, each Implementation stage is weighed according to the proportion of capabilities contained at each stage (B). For example, visioning stage has 3 capabilities, which corresponds to 21% of the overall 14 capabilities included in the model (A). The second parameter aims to take into account the increasing level of complexity of the implementation stages, assuming that each implementation stage requires 5% more complexity than the previous stage (C). To calculate the weight of each implementation level according to Parameter 2, the weight of visioning needs to be calculated, considering the number of stages is 4 and the overall % of cumulated complexity is 30 $\rightarrow x = \frac{(1-\frac{30}{100})}{4}$; $x = 17.5\%$

Continuing this non-linear grading, an average of the values resulting from both parameters represent the weight each implementation stage has within the model $(D) = \frac{(B)+(C)}{2}$

In parallel, an average of the scores obtained per implementation stage is calculated $(E) = \frac{\Sigma \text{score per capability}}{\# \text{capabilities}}$ and is later used to calculate the final grade by multiplying each score (E) with the weight per stage (D) and summing up all the stages to obtain the final grade shown in yellow in Table 2.

Table 2*Scoring methodology*

Implementation stages	# of Capabilities (A)	Parameter 1 (B)	Parameter 2 (C)	Final weight (D)	Average Scoring (E)	Final grade (F)
VISIONING <i>Developing a Circular vision Circularity at the core of the organization Support from top management</i>	3	21,43%	17,50%	19,46%		
SENSING <i>Knowledge generation Analyzing the existing and required capabilities Use of environmental management tools and circular KPIs Adopting a Lifecycle perspective External Sensitivity (consumer insights)</i>	5	35,71%	22,50%	29,11%		
SEIZING <i>Collaboration with stakeholders Designing and implementing the CBM- Testing/Piloting Cross-functional teams</i>	3	21,43%	27,50%	24,46%		
TRANSFORMING <i>Embedding the new business models in organizational routines Experimentation or the capacity to quickly adapt to changes Ecosystem orchestration</i>	3	21,43%	32,50%	26,96%		
Totals	14					

Note. Own elaboration of a scoring methodology (see section 3.2.1. for more detail).

3.3. Testing the model

3.3.1. Case Selection

Following the deductive design of research, the capabilities found in literature were tested empirically using two case studies. The criteria for case selection were as follows. First, the scope of the research was limited to organizations from the Netherlands, as it is considered to be a hotspot for CE and innovation, which could lead to richer results. The second criterion was that the organizations included were required to have started implementing some kind of CBM in their organization. Third, the selected companies had to share the same sector to be able to draw more insightful conclusions. The chosen sector was the denim industry, as it is one of the largest sectors within the textile industry, manufacturing over 7.7 billion meters in over 15 countries, with issues related to pre- and postconsumer waste as well as air, water, and noise pollution (Amutha, 2017). Thus, following the maximum variation sample approach described in section 3.1, a Dutch incumbent and a start-up from the denim industry were selected.

Finding the companies meeting such criteria, involved consulting the Ellen MacArthur Foundation website (Ellen MacArthur Foundation, n.d.) where the start-up was one of the highlighted examples of circularity in the Netherlands. The incumbent was identified through the website of Circle Economy (Circle Economy, n.d.)

3.3.2. Data collection

The method to test the model involved conducting a 60-minute semi-structured interview per company, where questions were planned in advance following an interview guide to ensure

comparability between interviews, and where the interviewees could elaborate on specific matters through the use of open-ended questions (Alsaawi, 2014). Qualitative semi-structured interviews help evaluate participant's experiences and are considered one of the most widely used data collection methods (Evans & Lewis, 2017). Additionally, interviewees received a list of key concepts to familiarize themselves with terms such as "CBM", "value proposition, capture, creation and delivery", "types of CBM strategies" and "first and second order learning." A representative from the sustainability department from each of the organizations took part in the recorded interviews. It was considered that a representative from the Sustainability department would have the sufficient experience and knowledge to understand the process the company had gone through to implement the corresponding CBM, assuming that they possessed a holistic view necessary in qualitative data analysis (Ravindran, 2019). The positions held by chosen representatives were Sustainability Project Manager, for the incumbent, and Denim Designer and Sustainability Manager in Textiles for the start-up.

The interview guide was designed to assess validation on the maturity model developed and to obtain a score according to the level of CBM implementation each organization had. The idea was to have open-ended discussions where the interviewee could provide feedback about the structuring, quality, and comprehensibility of the model. The interview guide consisted of 14 questions and the way it was structured followed four stages, starting broadly with an opener asking the interviewee's relation to CBM implementation at their company. This was followed by questions about the identified capabilities, starting with an overview of more content-specific information. The same procedure was then followed with questions about the maturity levels. Finally, the interview ended with a grading, in which the interviewee ranked its company according to the levels of maturity per capability described, also providing some feedback during the process. The whole interview guide can be found in Appendix F. The main purpose of conducting the interviews was drawing conclusions on the effectiveness of the tool and receiving feedback to refine the model.

3.3.4. Data Analysis

The data analysis for testing the model consisted of analyzing the conducted online interviews with representatives of each company. Data analysis in deductive qualitative research is not so commonly used and there is little guidance (Pearse, 2019). While techniques such as deductive thematic analysis and pattern matching aim to identify data patterns (Pearse, 2019), this study aimed to obtain feedback, structure it, and refine the model including not only the patterns but also relevant feedback related to the content, structuring, and applicability of the model.

The conducted interviews were recorded, transcribed, and later coded manually. The decision of coding the interviews manually was made since there was no need to identify patterns, but rather to structure their feedback according to the prompts from the interview guide, which were: "Clearly understood", "Missing or inaccurate", "Increment per level well developed", "Differentiation per level fair", and "Easy to position your company".

3.4. Refining the model

Developing the model is considered an iterative process, which requires refining the model with feedback from interviews to improve the effectiveness of the maturity model. Considering there are only two case studies included in this particular instance, the feedback

from both was accounted for when refining the model. To refine the model, the interviews were manually coded according to the categories that received improvement-related comments. The categories arose from the interview guide where questions were made related to if it was clearly understood; if it was considered relevant; if there was anything missing or inaccurate; if the capabilities were detectable among any type of company; if each level was different, self-explanatory, easy to understand and with its own organizational purpose; if the increment was well developed; if the differentiation per level was fair; and finally, if it was easy to implement within their company. Table 25 shows the included categories according to feedback received.

3.5. Confidentiality

Considering the interviews were recorded, only the interviewer had access to the recordings and no sensitive data was included in the study. The names of participants and their corresponding company were not included, only mentioning their position at their company, the sector and the CBM the company was implementing. Additionally, participants signed a form of informed consent.

4. Findings

4.1. Preliminary maturity model for CBM Implementation

A preliminary version of the maturity model is shown in Appendix E based on the methodology described in section 3.1.1. This model was used to conduct the interviews and is later refined in section 4.2.2., including the feedback provided by the companies subject to the two case studies. The maturity model shows 14 identified capabilities, the descriptions corresponding to each of the four levels of maturity per capability, and how these are reorganized into their corresponding implementation stage according to section 3.1.1 from the Method section (see Appendix C). This section corresponds to the conceptual contribution of the research, which consists of compiling theory from leading authors in the field to develop best practices that form the highest level of maturity (3-Fully implemented). It also indicates when descriptions of each maturity level stem from literature and when they are self-developed based on gradual descent from a best practice.

VISIONING

Table 3

Preliminary: Developing a circular vision

Maturity Levels	Description
<i>0-Not implemented</i>	No vision is developed regarding circularity.
<i>1-Poorly implemented</i>	Circular vision is only focused on the short-term, creating momentum for CBM experimentation (Susur & Engwall, 2022), but not looking at the long term.
<i>2-Sufficiently implemented</i>	Circular vision is focused on the long term but is only supported by representatives of CSR or sustainability departments.
<i>3-Fully implemented</i>	Long term vision involves representatives from multiple departments (Bocken & Konietzko, 2022), understanding the existing problems, setting common goals, and articulating the expectations regarding circularity (Puglieri et al., 2022; Susur & Engwall, 2022)

Note: Own elaboration of table showing descriptions per level of maturity attributed to the capability 'Developing a circular vision' for the preliminary model. Includes insights from Susur & Engwall (2022), Bocken & Konietzko (2022), Puglieri et al. (2022). See preliminary model in Appendix E.

Table 4

Preliminary: Circularity at the core of the organization

Maturity Levels	Description
<i>0-Not implemented</i>	Neither circularity nor innovation are at the core strategy of the organization.
<i>1-Poorly implemented</i>	The organization supports innovation and sustainability, but not as a core strategy.
<i>2-Sufficiently implemented</i>	The organization supports innovation and has circular ambitions, but these are not translated into core strategies.
<i>3-Fully implemented</i>	The organization supports innovation and continuous improvement (Santa-Maria et al., 2022) and sets competitive strategies for circularity at the core of their business (Bocken & Konietzko, 2022; Puglieri et al., 2022)

Note: Own elaboration of table showing descriptions per level of maturity attributed to the capability 'Circularity at the core of the organization' for the preliminary model. Includes insights from Santa-Maria et al. (2022), Bocken & Konietzko (2022), Puglieri et al. (2022). See preliminary model in Appendix E.

Table 5

Preliminary: Support from top management

Maturity Levels	Description
<i>0-Not implemented</i>	There is no support from top or middle management, who influence the culture from top to bottom (Qazi & Appolloni, 2022) and thereby block the implementation of circular solutions.
<i>1-Poorly implemented</i>	Middle management is aware of the potential of CE through the implementation of CBM in their organization.
<i>2-Sufficiently implemented</i>	Vision and corporate culture are supported by middle management (Eisenreich et al., 2022), who consider making personnel changes if the linear mindset is too deeply rooted in middle management (Hofmann & Jaeger-Erben, 2020).
<i>3-Fully implemented</i>	Vision and corporate culture are supported by top management (Bocken & Konietzko, 2022; Eisenreich et al., 2022; Qazi & Appolloni, 2022) providing the required financial resources and development of competencies (Eisenreich et al., 2022; Qazi & Appolloni, 2022; Santa-Maria et al., 2022) to accelerate the process and to adopt a CE guiding strategy (Eisenreich et al., 2022).

Note: Own elaboration of table showing descriptions per level of maturity attributed to the capability ‘Support from top management’ for the preliminary model. Includes insights from Qazi & Appolloni (2022), Eisenreich et al. (2022), Hofmann & Jaeger-Erben (2020), Santa-Maria et al. (2022), Bocken & Konietzko (2022), Puglieri et al. (2022). See preliminary model in Appendix E.

SENSING

Table 6

Preliminary: Knowledge generation

Maturity Levels	Description
<i>0-Not implemented</i>	Circular Economy is not understood nor explained within the organization.
<i>1-Poorly implemented</i>	Neither Environmental impact nor circularity are considered during knowledge generation.
<i>2-Sufficiently implemented</i>	Environmental impact is taken into consideration when generating new ideas, but only through first-order learning (Susur & Engwall, 2022).
<i>3-Fully implemented</i>	There is understanding of Circular Economy (Puglieri et al., 2022) and knowledge about circularity and environmental impact is generated (Bocken & Konietzko, 2022) through first and second order learning processes by involving social actors and networks that exchange their insights (Susur & Engwall, 2022).

Note: Own elaboration of table showing descriptions per level of maturity attributed to the capability ‘Knowledge generation’ for the preliminary model. Includes insights from Susur & Engwall (2022), Bocken & Konietzko (2022), Puglieri et al. (2022). See preliminary model in Appendix E.

Table 7

Preliminary: Analyzing the existing and required capabilities

Maturity Levels	Description
<i>0-Not implemented</i>	Current capabilities and skills still support linearity. The business model, its value creation, delivery, and capture are not mapped (Frishammar & Parida, 2019).
<i>1-Poorly implemented</i>	Current business model’s strengths and weaknesses are mapped, but there is no analysis of the capabilities required for CBM implementation.
<i>2-Sufficiently implemented</i>	Current business model’s strengths and weaknesses are mapped, and the shortcomings and opportunities towards the triple bottom line are being analyzed for further implementation (Frishammar & Parida, 2019).
<i>3-Fully implemented</i>	Current business model’s capabilities, strengths, and weaknesses are understood and mapped (Puglieri et al., 2022) and the capabilities required for CBM implementation, e.g., terms of reverse logistics or circular product design (Bocken & Konietzko, 2022) have been identified.

Note: Own elaboration of table showing descriptions per level of maturity attributed to the capability ‘Analyzing the existing and required capabilities’ for the preliminary model. Includes insights from Bocken & Konietzko (2022), Puglieri et al. (2022), Frishammar & Parida (2019). See preliminary model in Appendix E.

Table 8

Preliminary: Use of environmental management tools and circular KPIs

Maturity Levels	Description
<i>0-Not implemented</i>	No environmental management tools are used and there are no KPIs oriented at circularity within the organization.
<i>1-Poorly implemented</i>	The organization is starting to explore the use of some environmental management tools, but there are no circular KPIs in place.
<i>2-Sufficiently implemented</i>	Environmental management tools are used to assess impacts and performance, but there are still no circular KPIs in place.
<i>3-Fully implemented</i>	The organization does sustainability checks using environmental management tools like LCA, ISO14001 and Sustainability Reporting (Bocken & Konietzko, 2022; Santa-Maria et al., 2022) to check the corporate ecological performativity (Hofmann & Jaeger-Erben, 2020) and assess impacts and areas of improvement (Puglieri et al., 2022). There are also KPIs on circularity to monitor how the organization becomes more circular over time (Santa-Maria et al., 2022).

Note: Own elaboration of table showing descriptions per level of maturity attributed to the capability 'Use of environmental management tools and circular KPIs' for the preliminary model. Includes insights from Bocken & Konietzko (2022), Puglieri et al. (2022), Hofmann & Jaeger-Erben (2020), Santa-Maria et al. (2022). See preliminary model in Appendix E.

Table 9

Preliminary: Adopting a lifecycle perspective

Maturity Levels	Description
<i>0-Not implemented</i>	The organization follows a take-make-dispose behavior proper of a linear economy.
<i>1-Poorly implemented</i>	The organization has started understanding the life cycle concept and becoming aware of its potential.
<i>2-Sufficiently implemented</i>	The organization starts performing LCAs to understand the environmental impacts at each stage of a product's lifecycle and to integrate outcomes into the decision-making process.
<i>3-Fully implemented</i>	The organization considers the environmental and social impacts and possibilities throughout the entire lifecycle of a product or service, Cradle-to-Cradle (Santa-Maria et al., 2022), which refers to the extraction of raw materials, the production, transport, use, and end-of-life phases (Bocken et al., 2016). This involves adapting the design for reuse, repair, recycle or refurbishment (Hofmann & Jaeger-Erben, 2020; Santa-Maria et al., 2022) and considering reverse logistics and recovery processes along the entire value chain (Bocken & Konietzko, 2022; Eisenreich et al., 2022; Puglieri et al., 2022; Santa-Maria et al., 2022).

Note: Own elaboration of table showing descriptions per level of maturity attributed to the capability 'Adopting a lifecycle perspective' for the preliminary model. Includes insights from Bocken et al. (2016), Bocken & Konietzko (2022), Puglieri et al. (2022), Eisenreich et al. (2022), Santa-Maria et al. (2022), Hofmann & Jaeger-Erben (2020). See preliminary model in Appendix E.

Table 10

Preliminary: External sensitivity -consumer insights

Maturity Levels	Description
<i>0-Not implemented</i>	There is no customer analysis.
<i>1-Poorly implemented</i>	Customers are only considered as a source of income, and their needs and behavior are not taken into consideration when designing the business model.
<i>2-Sufficiently implemented</i>	The organization is beginning to analyze customers' needs, but their behavior in relation to circularity is not yet analyzed and consumers are not involved in decision making.
<i>3-Fully implemented</i>	The organization understands customer needs, their behavior and desirability on take-back schemes or other aspects related to value proposition, creation, delivery, and capture of the new CBM (Bocken & Konietzko, 2022; Frishammar & Parida, 2019; Santa-Maria et al., 2022). There is also a focus on customer engagement by making them participants in the innovation process (Bocken & Konietzko, 2022; Santa-Maria et al., 2022).

Note: Own elaboration of table showing descriptions per level of maturity attributed to the capability 'External sensitivity -consumer insights' for the preliminary model. Includes insights from Bocken & Konietzko (2022), Frishammar & Parida (2019), Santa-Maria et al. (2022). See preliminary model in Appendix E.

SEIZING

Table 11

Preliminary: Collaboration with stakeholders

Maturity Levels	Description
<i>0-Not implemented</i>	The relationship with stakeholders is informal, and there is no collaboration nor coordination.
<i>1-Poorly implemented</i>	Collaboration with stakeholders is more structured, through meetings or working groups, but still does not cover the entire value chain.
<i>2-Sufficiently implemented</i>	Collaboration with stakeholders starts to be integrated along the value chain, through product design or supply chain management.
<i>3-Fully implemented</i>	Strategic alliances with stakeholders are established along the entire value chain (Eisenreich et al., 2022), through collaboration, to access complementary capabilities (Bocken & Konietzko, 2022), resource exchanges (Susur & Engwall, 2022) and to co-create solutions to achieve collective goals (Hofmann & Jaeger-Erben, 2020; Santa-Maria et al., 2022).

Note: Own elaboration of table showing descriptions per level of maturity attributed to the capability ‘Collaboration with stakeholders’ for the preliminary model. Includes insights from Bocken & Konietzko (2022), Santa-Maria et al. (2022), Eisenreich et al., (2022), Susur & Engwall (2022), Hofmann & Jaeger-Erben (2020). See preliminary model in Appendix E.

Table 12

Preliminary: Designing and implementing the CBM- testing/piloting

Maturity Levels	Description
<i>0-Not implemented</i>	The new CBM is not tested within nor outside the organization.
<i>1-Poorly implemented</i>	Customer desirability and the feasibility for the organization are tested using design thinking. This includes testing materials and product design, as well as understanding customers’ willingness to pay (Bocken & Konietzko, 2022).
<i>2-Sufficiently implemented</i>	Customer desirability and feasibility are now tested outside the company through experimentation and piloting (Bocken & Konietzko, 2022).
<i>3-Fully implemented</i>	In addition to testing desirability and feasibility, the viability (no losses) of the new circular business model is now also tested (Bocken & Konietzko, 2022). The environmental and social impact need to be integrated into the value proposition of the new CBM (Bocken & Konietzko, 2022; Santa-Maria et al., 2022). Testing and experimenting are collaborative with key partners to scale it up (Bocken & Konietzko, 2022).

Note: Own elaboration of table showing descriptions per level of maturity attributed to the capability ‘Designing and implementing the CBM- testing/piloting’ for the preliminary model. Includes insights from Bocken & Konietzko (2022), Santa-Maria et al. (2022). See preliminary model in Appendix E.

Table 13

Preliminary: Cross-functional teams

Maturity Levels	Description
<i>0-Not implemented</i>	There is no flexibility and different departments do not exchange perspectives on how to improve the new CBM.
<i>1-Poorly implemented</i>	The staff is taking on the internal functions required for the new interdisciplinary teams (Santa-Maria et al., 2022), but there are still no experts on circularity.
<i>2-Sufficiently implemented</i>	Interdisciplinary teams are taught to explore areas of CE and, through mutual learning, eliminate some of the linear thinking (Hofmann & Jaeger-Erben, 2020).
<i>3-Fully implemented</i>	Flexible and interdisciplinary teams actively participate in the innovation process of developing and redefining the CBM by incorporating diverse perspectives to the decision making (Hofmann & Jaeger-Erben, 2020; Qazi & Appolloni, 2022; Santa-Maria et al., 2022). This is done by combining expertise in different areas such as technical, sustainability, legal, commercial, or financial viability (Santa-Maria et al., 2022), as well as CE experts along the entire value chain (Eisenreich et al., 2022)

Note: Own elaboration of table showing descriptions per level of maturity attributed to the capability ‘Cross-functional teams’ for the preliminary model. Includes insights from Santa-Maria et al. (2022), Hofmann & Jaeger-Erben (2020), Qazi & Appolloni (2022), Eisenreich et al. (2022). See preliminary model in Appendix E.

TRANSFORMING

Table 14

Preliminary: Embedding the new circular business models in organizational routines

Maturity Levels	Description
<i>0-Not implemented</i>	Day-to-day operations are only based on linear processes and routines.
<i>1-Poorly implemented</i>	The CBM is considered a one-time project or initiative.
<i>2-Sufficiently implemented</i>	The CBM and its principles start to be incorporated into ongoing operations in a more natural way than a one-time project, and required resources are provided.
<i>3-Fully implemented</i>	The CBM is integrated into day-to-day operations and to regular information channels (Bocken & Konietzko, 2022). It also prioritizes projects that fit within the organization’s strengths, while improving them by bringing together the right capabilities and resources (Santa-Maria et al., 2022).

Note: Own elaboration of table showing descriptions per level of maturity attributed to the capability ‘Embedding the new circular business models in organizational routines’ for the preliminary model. Includes insights from Bocken & Konietzko (2022), Santa-Maria et al. (2022). See preliminary model in Appendix E.

Table 15

Preliminary: Experimentation or the capacity to quickly adapt to changes

Maturity Levels	Description
<i>0-Not implemented</i>	There are no spaces for experimentation in the organization and the CBM is not ready to adapt to changes in its context.
<i>1-Poorly implemented</i>	The organization understands the potential of experimentation to reduce uncertainty and risks, and as a way of scaling up the CBM.
<i>2-Sufficiently implemented</i>	The organization is building spaces for experimentation to overcome the routines around the linear economy (Susur & Engwall, 2022)
<i>3-Fully implemented</i>	The organization has created spaces to test and evaluate new game rules through experimentation (Hofmann & Jaeger-Erben, 2020) which is a driver for sustainability and innovation (Bocken & Konietzko, 2022) and to decrease the risk and uncertainty associated with the new CBM (Santa-Maria et al., 2022). The organization learns and adjusts as an ongoing process, to quickly adapt to changes related to the CBM (Frishammar & Parida, 2019; Santa-Maria et al., 2022) and to prepare the organization for scaling up the CBM (Bocken & Konietzko, 2022; Santa-Maria et al., 2022).

Note: Own elaboration of table showing descriptions per level of maturity attributed to the capability ‘Experimentation or the capacity to quickly adapt to changes’ for the preliminary model. Includes insights from Bocken & Konietzko (2022), Santa-Maria et al. (2022), Eisenreich et al. (2022), Susur & Engwall (2022), Hofmann & Jaeger-Erben (2020), Frishammar & Parida (2019). See preliminary model in Appendix E.

Table 16

Preliminary: Ecosystem orchestration

Maturity Levels	Description
<i>0-Not implemented</i>	There is no internal and external alignment at the organization as there are no positions in charge of the ecosystem orchestration.
<i>1-Poorly implemented</i>	There are management positions in charge of coordinating and aligning different departments inside the organization regarding roles and processes, but they still lack an ecosystem approach.
<i>2-Sufficiently implemented</i>	These management positions now incorporate incentives and culture alignment inside the company, reinforcing the “people side” of change (Santa-Maria et al., 2022, p.25).
<i>3-Fully implemented</i>	Professionals in organizational change-management coordinate and manage internal alignment regarding roles and responsibilities, culture, processes, and incentives (Frishammar & Parida, 2019; Santa-Maria et al., 2022) as well as coordinating strategic partners in a transparent and flexible way (Hofmann & Jaeger-Erben, 2020; Santa-Maria et al., 2022).

Note: Own elaboration of table showing descriptions per level of maturity attributed to the capability ‘Ecosystem orchestration’ for the preliminary model. Includes insights from Santa-Maria et al. (2022), Hofmann & Jaeger-Erben (2020). See preliminary model in Appendix E.

4.2. Case I. Incumbent

The first case study consists of an incumbent from the denim industry that was founded in the 90’s and ventured into sustainability in 2006, aiming to reduce the impact from soil, water and air pollution, chemicals, wastewater, waste, raw materials, energy and water use.

4.2.1. Types of CBM

According to the interview with the Sustainability Project Manager, the incumbent is implementing a program to offer customers to have their jeans repaired for free, which would correspond to the strategy that Geissdoerfer et al. (2020) call ‘*extending*’ through repair. Also in this category, the organization implemented a marketing campaign to encourage customers to “wear the garment until its last drop” (Incumbent) and thus bring awareness related to extending the lifetime of jeans. Another type of CBM the incumbent is implementing is related to what Geissdoerfer et al. (2020) call ‘*cycle*’ as the company encourages customers to return their jeans, which are later downcycled into furniture or art.

They also have a 2030 target of ensuring 20% of their collection follows the criteria of a Cradle-to-Cradle (C2C) certificate. In terms of circularity, the C2C certifies that products are designed

to be able to be cycled and have their use phase extended (Cradle to Cradle Products Innovation Institute, n.d.).

Finally, they implement the circular strategy that Geissdoerfer et al. (2020) call *'intensifying the use phase'* through the sharing economy, as they have set up secondhand stores as outlets for their customer's used jeans (see Table 17).

Table 17

CBM Strategies implemented by the incumbent

CBM Strategies by Geissdoerfer et al. (2020)	Descriptions from Geissdoerfer et al. (2020)	CBM strategies by Incumbent
Cycling	Recycling materials and energy through reuse, remanufacturing, refurbishing, and recycling	Downcycle
Extending	Extension of the use-phase of products through long-lasting design, marketing, maintainance, and repair	Free repair service + marketing campaign
Intensifying	The use phase is intensified through sharing economy solutions	Secondhand stores
Dematerializing	Service and software solutions replace product utility- PaaS	

Note: Own elaboration of table comparing the names and definitions of CBM strategies proposed by Geissdoerfer et al. (2020) with examples of strategies the incumbent from this study is implementing

4.2.2. Feedback

The overall feedback from the incumbent was positive on the quality and understanding of the model, however only constructive feedback to improve the model was included in the report. Feedback was categorized into five categories: 1) Clearly Understood; 2) Missing or inaccurate; 3) Increment per level well developed; 4) Differentiation per level fair; 5) Easy to position within your company. These categories originated from the interview guide, where the main comments from both companies were grouped into the above-mentioned categories (See Table 18)

The first category includes all the comments related to issues that were unclear when reading the descriptions at each level of maturity. The interviewee asked, "what do you mean between short term and long term" for the 'Developing a vision' capability. Then, for the 'Circularity at the core of the organization' capability, it was unclear for the interviewee whether sustainability (and circularity) were part of the company's core strategy or if it was rather a part of a specific department's strategy like, for example, the marketing department being aligned with the sustainability department. Then, for the 'Knowledge generation' capability it was unclear for the interviewee if when mentioning environmental impact, it referred to the impact of operations or of products. Later, for the 'Ecosystem orchestration' capability, it was unclear for the interviewee when reading the name of the capability if the concept of ecosystem referred to the entire textile industry or just to the ecosystem within the company.

The second category refers to what was noticed to be missing or inaccurate. The interviewee noticed that for the capability called 'Analyzing the existing and required capabilities' there was no mention of CBM in level 2, while it was mentioned in all the other levels. The remaining comment corresponds to the capability called '*Experimentation or capacity to quickly adapt to changes*' where it was mentioned that it was inaccurate in which phase of the product the experimentation was happening, whether it was "experimentation in the design" or "experimentation in the customer experience" as he mentioned that "you could have experimentation in one part of the company but not in the other".

The third category shows when there is a big gap between the descriptions at one level and in the following one or in between the extremes. For example, for the capability 'Knowledge generation' the interviewee mentions that level 1 and level 3 are the extremes and that the gap becomes too big. Similarly, for the 'Cross-functional teams' capability he mentions "again here, it jumps from 0 to all the best you can get." The interviewee also mentions that having a circularity expert along the entire value chain seems too ambitious and mentions, instead, the possibility of "having external help from consultants."

The fourth category arises from asking the interviewee if it was fair to position their company at one level instead of another, and it shows comments where the interviewee finds 2 levels too similar. For the incumbent this was the case for 'Collaboration with stakeholders' where levels 1 and 2 were found to be too similar, as when the interviewee mentions "what is the difference between 1 and 2? because both have started some work within the value chain, but it is the product design that makes the difference."

The fifth and last category was introduced after the interviewee gave its company a grade per capability or when the interviewer noticed difficulties when grading. In this category, the overall feedback suggested having an extra level 4 (5 levels instead of 4), as the interviewee often found himself being in between 2 levels. Related to this feedback, the interviewee also mentioned in 'Knowledge generation' that one may meet some of the requirements of level 3 but not all of them, therefore suggesting to integrate a level between the second and the third.

Table 18

Feedback from the incumbent

Implementation stages	Capabilities	Clearly understood	Missing or inaccurate	Increment per level well developed	Differentiation per level fair	Easy to position your company
VISIONING	Develop a vision	Difference between short term and long term (A) Part of the Sustainability Strategy or corporate strategy? (A)				
	Circularity at the core of the organization					
	Support from top management					
SENSING	Knowledge generation	Environmental impact of the product or of the operations? (A)		Big gap between 1 and 3 (A)		Maybe you don't meet all the criteria in number 3, but you meet some so you cannot check it (A)
	Analyze the existing and needed capabilities		Missing CBM in level 2 (A)			
	Use of environmental management tools and circular KPIs					
	Adopting a Lifecycle perspective					Can awareness be considered level 3? (A)
	External Sensitivity (consumer insights)					
SEIZING	Collaboration with stakeholders				Levels 1 and 2 are too similar (A)	
	Designing and implementing the CBM- Testing/Piloting					
	Cross-functional teams			Gap between 0 and 3 is too high (A)		
TRANSFORMING	Embed the new CBMs into organizational routines					Include another level, to make it from 0 to 4 (A)
	Experimentation or capacity to quickly adapt to changes		Experimentation in which phase of the product? (A)			
	Ecosystem orchestration	What do you consider the ecosystem? (A)				

Note: Own elaboration of table showing a simplified version of the feedback provided by the incumbent in this study.

4.2.3. Scoring

The last part of the interview guide consisted of asking the interviewee to position their company at one of the four levels of maturity per capability, according to the descriptions provided in the model. The scores per capability of the incumbent are shown in Table 19. According to the methods described in section 3.1.1. for developing the grading, an average of these scores is calculated and included in Table 20 with the symbol (E). Such averages are then used to calculate the final grade with the corresponding weight for each implementation stage (F).

Table 19*Incumbent's average scoring for CBM implementation maturity per stage of implementation*

Implementation stages	Capabilities	Score	Average scoring (E)
VISIONING	Develop a vision	3	2,33
	Circularity at the core of the organization	2	
	Support from top management	2	
SENSING	Knowledge generation	2	2,20
	Analyze the existing and needed capabilities	2	
	Use of environmental management tools and circular KPIs	2	
	Adopting a Lifecycle perspective	3	
	External Sensitivity (consumer insights)	2	
SEIZING	Collaboration with stakeholders	1	1,33
	Designing and implementing the CBM-Testing/Piloting	1	
	Cross-functional/ Interdisciplinary teams	2	
TRANSFORMING	Embed the new business models in organizational routines	2	2,00
	Experimentation or capacity to quickly adapt to changes	2	
	Ecosystem orchestration	2	

Note. Own elaboration of table according to the incumbent's grades when testing the preliminary model

Table 20*Incumbent's final grade*

Implementation stages	# of Capabilities (A)	Parameter 1 (B)	Parameter 2 (C)	Final weight (D)	Average Scoring (E)	Final grade (F)
VISIONING	3	21%	17,5%	19%	2,33	0,45
SENSING	5	36%	22,5%	29%	2,20	0,64
SEIZING	3	21%	27,5%	24%	1,33	0,33
TRANSFORMING	3	21%	32,5%	27%	2,00	0,54
Totals	14					1,96

Note. Own elaboration of table showing the final grade of the incumbent according to the developed methodology for grading the model

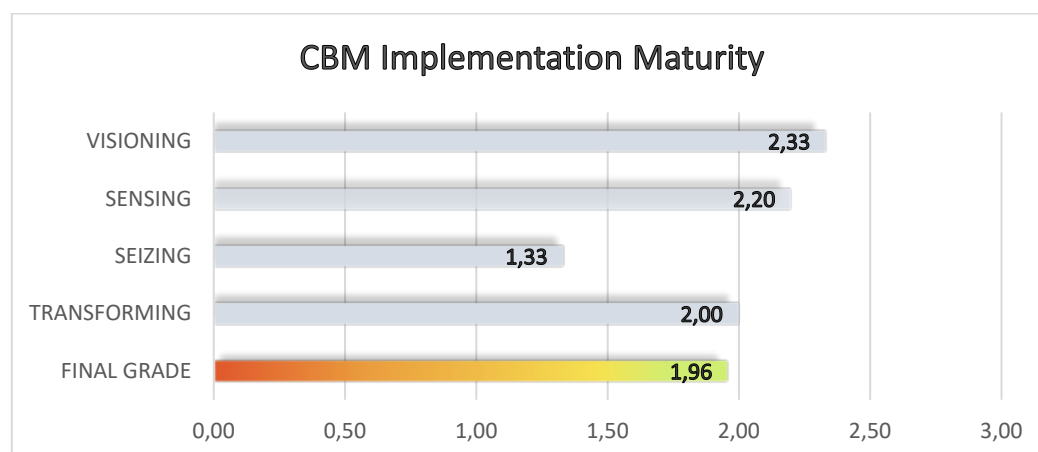
The incumbent's final grade was 1.96 out of 3, which is very close to level 2- Sufficiently implemented. The highest level of maturity corresponds to scoring a 3. When looking at the detailed scores per implementation stage (see Figure 2,) all of the implementation stages except for seizing score 2 or above, which allows to identify that the main area of improvement corresponds to 'mobilizing organizational resources to seize new opportunities'. The lowest scores in the implementation stage of seizing correspond to 'Collaborating with stakeholders'

and ‘Testing and Piloting the new CBM’ (see Table 19). According to the Interviewee, the reason for placing their company in level 1 for ‘Collaboration with stakeholders’ was because “not all the players in the supply chain are involved,” which he also explains it is generally complex in the textile industry. For the capability ‘Designing and implementing the CBM-Testing/Piloting’ the corresponding score is explained because they are only using internal capabilities to test the CBM, without testing customer desirability and the feasibility and viability of the new CBM outside the organization.

The model also allows the organization to identify their strongest areas, which correspond to the capabilities scoring 3. This is the case of ‘Developing a vision’ and ‘Adopting a lifecycle perspective’. The interviewee explained that they score 3 in the capability ‘Adopting a lifecycle perspective’ as they have the Cradle-to-Cradle Certificate (Cradle to Cradle Products Innovation Institute, n.d.); however, the interviewee also emphasized that it was “not yet running at its full capacity” as they don’t have all their products and materials certified but they have the awareness and they are “starting to design for reuse, repair, and recycle”.

Figure 2

Incumbent’s grades per implementation stage and final grade



Note: Own elaboration of figure showing the grades of the incumbent according to the preliminary model. The progress is shown with colors, reaching green after level 2-Sufficiently implemented.

4.3. Case II. Circular Start-up

4.3.1. Types of CBM

The chosen denim start-up was circular from its origins in 2012. For this reason, the interviewee stated that circularity is a priority for them: “there is no financial border (...) we want to be as circular as possible, so there are no excuses.”. They are a B Corp Certified company, which “requires from them continuous improvement.”

According to the interviewee, they aim to “have as little virgin content as possible” and to achieve this, one of their main circular strategies consists of recycling, both upcycling into new jeans and downcycling into furniture, which corresponds to the ‘cycling’ CBM strategy according to (Geissdoerfer et al., 2020).

Another CBM strategy, which differentiates the start-up from the incumbent, is that they also offer substituting their product for a service through leasing, corresponding to the CBM

strategy of ‘dematerializing’ (Geissdoerfer et al., 2020). As part of the strategy named by Geissdoerfer et al. (2020) as ‘extending’, they offer a repair service and they design for ensuring jeans’ durability (see Table 21).

Table 21

CBM Strategies implemented by the start-up

CBM Strategies by Geissdoerfer et al. (2020)	Descriptions from Geissdoerfer et al. (2020)	CBM strategies by Start-up
Cycling	Recycling materials and energy through reuse, remanufacturing, refurbishing, and recycling	Upcycling and downcycling
Extending	Extension of the use-phase of products through long-lasting design, marketing, maintainance, and repair	Repair service
Intensifying	The use phase is intensified through sharing economy solutions	
Dematerializing	Service and software solutions replace product utility- PaaS	Leasing jeans

Note: Own elaboration of table comparing the names and definitions of CBM strategies proposed by Geissdoerfer et al. (2020) with examples of strategies the start-up from this study is implementing

4.3.2. Feedback

In order to make the results comparable between the two case studies and to draw conclusions, the same categories were used to code feedback from the start-up: 1) Clearly Understood; 2) Missing or inaccurate; 3) Increment per level well developed; 4) Differentiation per level fair; 5) Easy to position your company.

The category ‘Clearly understood’ only includes feedback for one capability, ‘*Embedding the new circular business models in organizational routines*’ since the interviewee didn’t understand the meaning and implications of “in a more natural way” and suggested to replace it with “everyday decisions or on a regular base decisions.”

The next category with feedback was if the ‘increment was well developed’ where the feedback was only directed to the capability ‘Designing and implementing the CBM-Testing/Piloting’ where the interviewee found the gap too high between levels of maturity 0 and 1.

The fourth category ‘Differentiation per level fair’ shows 5 capabilities where the descriptions of two levels of maturity are too similar (see Table 22). For capability ‘Circularity at the core of the organization’ the interviewee found too similar that level 1 corresponds to “(...) but it is not a core strategy” and level 2 is “(...) but these are not translated into core strategy.” Then, for capability ‘Knowledge generation’ the interviewee finds levels 0 and 1 too similar and for ‘Analyzing the existing and required capabilities’ the levels being too similar are 2 and 3.

Finally, for the category ‘Easy to position your company’ the start-up specified that they don’t follow a Cradle-to-Cradle, but a Cradle to Gate instead. However, they were able to position their company at the highest level according to the preliminary model. The underlying feedback here relies on distinguishing between Cradle to Grave, Cradle to Gate and Cradle to

Cradle, while placing these at different levels of maturity according to how many stages of a product’s lifecycle they cover.

Table 22

Feedback from the start-up

Implementation stages	Capabilities	Clearly understood	Missing or inaccurate	Increment per level well developed	Differentiation per level fair	Easy to position your company
VISIONING	Develop a vision					
	Circularity at the core of the organization				Levels 2 and 3 are too similar (B)	
	Support from top management					
SENSING	Knowledge generation				Levels 0 and 1 are too similar (B)	Maybe you don't meet all the criteria in number 3, but you meet some so you cannot check it (A)
	Analyze the existing and needed capabilities				Levels 2 and 3 are too similar (B)	
	Use of environmental management tools and circular KPIs				Levels 1 and 2 are too similar (B)	
	Adopting a Lifecycle perspective					
	External Sensitivity (consumer insights)					
SEIZING	Collaboration with stakeholders					
	Designing and implementing the CBM-Testing/Piloting			Gap between 0 and 1 is too high (B)		
	Cross-functional teams					
TRANSFORMING	Embed the new CBMs into organizational routines	What do you mean "in a more natural way"? (B)				
	Experimentation or capacity to quickly adapt to changes				Levels 2 and 3 are too similar (B)	
	Ecosystem orchestration					

Note: Own elaboration of table showing a simplified version of the feedback provided by the start-up

4.3.3. Scoring

The scores per capability as well as the average score per implementation stage are shown in Table 23. The Circular Start-up scores a 3 in most of the capabilities, with a few exceptions. First, for the capability ‘Adopting a Lifecycle perspective’ the start-up scores a 2 as they do Cradle-to-Gate, instead of Cradle-to-Cradle. This means that they only look at the environmental impact until the denim garment is produced, while not considering the impact at the use or the End-of-Life phases (EoL). However, the interviewee does mention that they are “aware of the impact at the customer stage” and that they “try to educate them”. In the same line, the capability ‘External sensitivity (customer insights)’ also scores a 2, as customers’ needs are not considered in the design process. However, the interviewee also mentioned that this is not within their area of expertise. Finally, ‘Collaboration with stakeholders’ also scores a 2, as, according to the interviewee, the relationship with stakeholders doesn’t happen on a regular basis.

According to the grading, the circular start-up could be considered a best practice.

Table 23*Start-up average scoring for CBM implementation maturity per stage of implementation*

Implementation stages	Capabilities	Score	Average scoring (E)
VISIONING	Develop a vision	3	3,00
	Circularity at the core of the organization	3	
	Support from top management	3	
SENSING	Knowledge generation	3	2,60
	Analyze the existing and needed capabilities	3	
	Use of environmental management tools and circular KPIs	3	
	Adopting a Lifecycle perspective	2	
	External Sensitivity (consumer insights)	2	
SEIZING	Collaboration with stakeholders	2	2,67
	Designing and implementing the CBM-Testing/Piloting	3	
	Cross-functional/ Interdisciplinary teams	3	
TRANSFORMING	Embed the new business models in organizational routines	3	3,00
	Experimentation or capacity to quickly adapt to changes	3	
	Ecosystem orchestration	3	

Note. Own elaboration of table according to the start-up's grades when testing the preliminary model

The overall score of the circular start-up is a 2.8 out of 3 (see Table 24). The grade corresponds to level 2- Sufficiently implemented, however the implementation stages of visioning and transforming have the highest score 3- Fully implemented (see Figure 3). The areas for improvement are mainly related to the relationship with their customers and with their stakeholders, aiming to better understand their customers' needs (External sensitivity (customer insights)) and to have an impact on the use-phase (Adopting a Lifecycle perspective) and, eventually, to build strategic alliances with their stakeholders along the entire value chain.

Table 24

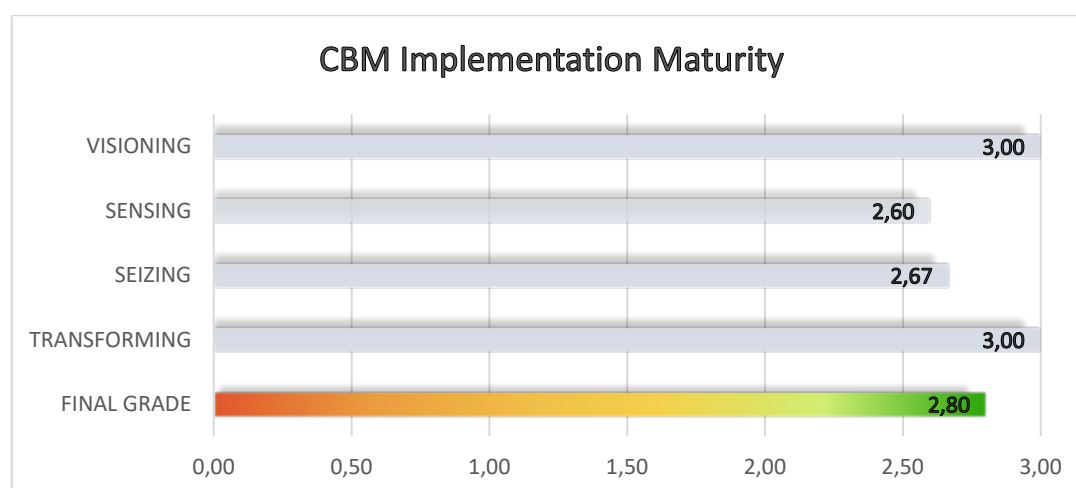
Start-up's final grade

Implementation stages	# of Capabilities (A)	Parameter 1 (B)	Parameter 2 (C)	Final weight (D)	Average Scoring (E)	Final grade (F)
VISIONING	3	21%	17,5%	19%	3,00	0,58
SENSING	5	36%	22,5%	29%	2,60	0,76
SEIZING	3	21%	27,5%	24%	2,67	0,65
TRANSFORMING	3	21%	32,5%	27%	3,00	0,81
Totals	14					2,80

Note. Own elaboration of table showing the final grade of the start-up according to the developed methodology for grading the model

Figure 3

Start-up's grades per implementation stage and final grade



Note: Own elaboration of figure showing the grades of the start-up according to the preliminary model. The progress is shown with colors, reaching green after level 2-Sufficiently implemented.

4.4. Interim conclusion

Overall feedback for the model was positive in terms of meeting the main requirements when building a maturity model according to Rohrbeck (2010), which includes making the model self-explanatory, easy to understand, as well as clear and detectable in any company, regardless of its structure, size or industry. However, both case studies revealed the need to reformulate the descriptions of many of the levels of maturity in order to make them more precise, with an organizational purpose of their own and a distinct differentiation in the increments per level, which are main requirements when designing maturity levels according to Demir (2018) and Igartua et al. (2018) (see section 2.2).

The new refined version of the model will not be tested again, so the final grade per company will remain as the one showed in sections 4.2 and 4.3 for the incumbent and the start-up respectively. This is considered relevant to acknowledge, as feedback revealed a need to re-write the maturity level descriptions, which could potentially reduce the grades obtained by the case studies. These grades were significantly high, which may indicate that the model overlooked certain practices for CBM implementation and calls for a refinement.

4.5. Model refinement

The feedback from both companies was then combined to refine the descriptions per level and improve the model. Table 25 shows the combined feedback and the corresponding adjustments made, which are explained in more detail in this section. The feedback per company can be differentiated in Table 25 by showing an (A) when the feedback was provided by the incumbent and a (B) when it came from the start-up. The new adjusted descriptions are shown in section 4.6. Only the capabilities with feedback are shown in this section, which corresponds to 12 capabilities out of 14.

Visioning

Developing a vision: the feedback from the incumbent suggested specifying the difference between the short and long term. According to literature, it is considered unsustainable “when present progress occurs at the expense of future generations” (Verma, 2019, p.2), which promotes awareness of taking future generations into account when making today's decisions. Nevertheless, in practice, companies aim to be aligned with the Paris Agreement which sets short and mid-term targets for 2025 and 2030 respectively, and places long-term strategies for 2050 (Falduto & Rocha, 2020).

Circularity at the core of the organization: to reduce confusion, all the four levels were adjusted clarifying that the goal is to have circularity integrated at *the core of the company's corporate strategy*, and not as a strategy within specific departments. Also, this feedback was combined with the one from the start-up about the similarities between levels 2 and 3, in such a way that the new description from level 2 now refers to having the circular strategy only within specific departments, to make it more accurate. The previous description from level 2 is now included in level 1.

Sensing

Knowledge generation: for clarification, it is mentioned that the environmental impact considered during knowledge generation refers to the product or service, as circularity aims to look at the lifecycle perspective of a product, from the extraction of raw materials, the production phase, the use phase until the end of its lifecycle.

In order to also reduce the gap between levels 1 and 3, as well as differentiating levels 0 and 1, the description from the first level became the one for level 0 and level 1 became a step in between not knowing about circularity and first-order R&D processes for circularity.

Analyzing the existing and required capabilities: levels 2 and 3 are too similar according to the start-up, and the incumbent recalls not including ‘CBM’ in level 2. To integrate all feedback simultaneously, the description of level 2 was rewritten, substituting the “triple bottom line analysis” with “collaboration with external partners” which according to (Bocken & Konietzko, 2022) can help obtain the required capabilities in terms of logistics, learning how their partner's CBM works physically or even involving social actors like NGO's.

Use of environmental management tools and circular KPIs: according to the start-up, levels 1 and 2 are too similar. The main change at this capability is broadening the scope to sustainability-oriented instruments, which according to Santa-Maria et al. (2022) , not only

includes the implementation of environmental management tools but also “Guidance from sustainability frameworks such as SDGs, FSSD, C2C, Doughnut and Biomimicry” (p.21).

Adopting a Lifecycle perspective: the feedback from the start-up helped reshape the concept of lifecycle into the system boundaries in LCA of Cradle-to-Gate, Cradle-to-Grave, and Cradle-to-Cradle (C2C). This way, the highest level (C2C) involves closing the loop by addressing all the phases of a product’s lifecycle, while designing to eliminate the waste (Ecochain, n.d.). As middle ground, Cradle-to-Grave measures the impact at each phase of a product’s lifecycle considering its disposal (Ecochain, n.d.). Finally, Cradle-to-Gate is the lowest stage, as it only considers the environmental impact of a product from the extraction of raw materials until it is produced, which omits the impacts from distribution, use, and end-of-life phases (Ecochain, n.d.). All the levels were adjusted according to such LCA system boundaries.

Seizing

Collaboration with stakeholders: according to the incumbent, levels 1 and 2 were too similar. In order to distinguish them, the different levels of collaboration along the value chain were redefined for clarification.

Designing and implementing the CBM- Testing/Piloting: According to the start-up, the gap between 0 and 1 was too high. Hence, all the levels were adjusted starting by testing the feasibility of the new CBM inside the corporation, then customer desirability inside and outside the organization and, finally, sustainability was tested in practice according to Bocken & Konietzko (2022). Also, to make it shorter, the capability received the new name of ‘Testing/Piloting the new CBM’.

Cross-functional teams: In order to reduce the gap between 0 and 3, and considering the incumbent mentioned having external help as an alternative to inhouse CE experts, levels 1 and 2 were combined and transformed into a new level 1; whereas level 2 now mentions the possibility of having external expert support.

Transforming

Embedding the new CBMs into organizational routines: the start-up suggested replacing “in a more natural way” with “on a regular basis”.

Regarding the incumbent's comment on including another level to the model, it was decided not to include it as this could be solved by readjusting the levels where the gap was too big in a way that each level became more differentiated to include more features.

Experimentation or the capacity to quickly adapt to changes: the incumbent wanted to understand in which area of the company experimentation took place and the start-up considered levels 2 and 3 were too similar. To incorporate both feedbacks, more detail was included in all the descriptions based on Bocken & Konietzko (2022) which differentiate between experimentation through purposeful interactions or through experimental projects, as well as retrieving relevant information about changes in the organization’s context. The name of the capability was also shortened into ‘Experimentation to quickly adapt to changes’.

Ecosystem orchestration: the boundaries of the concept “ecosystem” were clarified, specifying it refers to the ecosystem within the company.

Table 25

Combined feedback from both case studies with improvement suggestions

		Clearly understood	Improvement	Missing or inaccurate	Improvement	Increment per level well developed	Improvement	Differentiation per level fair	Improvement	Easy to position your company	Improvement
VISIONING	Develop a vision	Difference between short term and long term (A)	<i>Clarify period</i>								
	Circularity at the core of the organization	Part of the Sustainability Strategy or corporate strategy? (A)	<i>Clarify it refers to aligning Sustainability with corporate strategy</i>					Levels 2 and 3 are too similar (B)	<i>new level 2 with departmental circular strategy</i>		
	Support from top management										
SENSING	Knowledge generation	Environmental impact of the product or of the operations? (A)	<i>Clarify it refers to product</i>			Big gap between 1 and 3 (A)	<i>Reduce the gap</i>	Levels 0 and 1 are too similar (B)	<i>Differentiate</i>	Maybe you don't meet all the criteria in number 3, but you meet some so you cannot check it (A)	<i>Make the increment noticeable from the previous level</i>
	Analyze the existing and needed capabilities			Missing CBM in level 2 (A)	<i>Adjust Level 2</i>			Levels 2 and 3 are too similar (B)	<i>Differentiate</i>		
	Use of environmental management tools and circular KPIs							Levels 1 and 2 are too similar (B)	<i>Differentiate</i>	Cradle to gate (B)	<i>Adjust according to LCA system boundaries</i>
	Adopting a Lifecycle perspective										
External Sensitivity (consumer insights)											
SEIZING	Collaboration with stakeholders							Levels 1 and 2 are too similar (A)	<i>Differentiate</i>		
	Designing and implementing the CBM- Testing/Piloting					Gap between 0 and 1 is too high (B)	<i>Reduce gap</i>				
	Cross-functional teams			External help instead of CE experts	<i>Level 2 now includes iexternal help</i>	Gap between 0 and 3 is too high (A)	<i>Reduce gap</i>				
TRANSFORMING	Embed the new CBMs into organizational routines	What do you mean "in a more natural way"? (B)	<i>replace by "on a regular basis"</i>							Include another level, to make it from 0 to 4 (A)	<i>not necessary</i>
	Experimentation or capacity to quickly adapt to changes			Experimentation in which area of the company? (A)	<i>More detail per level on the types of experimentation required</i>			Levels 2 and 3 are too similar (B)	<i>Differentiate</i>		
	Ecosystem orchestration	What do you consider the ecosystem? Is it the entire textile industry or is it the ecosystem within the company? (A)	<i>Clarify on the description it means "within the company"</i>								

4.6. Maturity model 2.0

The feedback from both the incumbent and the start-up were incorporated in the new improved version of the model. Feedback from sections 4.2.2. and 4.3.2. were combined (see Table 25) and the capabilities were refined accordingly (see section 4.5). The overall result of the improved model 2.0 is presented in this section and shown in Table 40. This section sheds light on the process behind refining the descriptions from the preliminary model based on feedback received from the case studies.

VISIONING

Table 26

Model 2.0: Developing a circular vision

Maturity Levels	Description
<i>0-Not implemented</i>	No vision is developed regarding circularity.
<i>1-Poorly implemented</i>	Circular vision is only focused on the short-term, pursuing immediate short-term gains.
<i>2-Sufficiently implemented</i>	Circular vision is focused on the long term (beyond 2050) but is only supported by representatives of CSR or sustainability departments.
<i>3-Fully implemented</i>	Long term vision (beyond 2050) involves representatives from multiple departments (Bocken & Konietzko, 2022), understanding the existing problems, setting common goals, and articulating the expectations regarding circularity (Puglieri et al., 2022; Susur & Engwall, 2022)

Note: Own elaboration of table showing descriptions per level of maturity attributed to the capability 'Developing a circular vision' for the maturity model 2.0. Includes insights from Susur & Engwall (2022), Bocken & Konietzko (2022), Puglieri et al. (2022), as well as the feedback from the interviews. See maturity model 2.0 in Table 40.

Table 27

Model 2.0: Circularity at the core of the organization

Maturity Levels	Description
<i>0-Not implemented</i>	Neither circularity nor innovation are considered in the organization's core corporate strategy.
<i>1-Poorly implemented</i>	The organization supports innovation and has circular ambitions, but not as their core corporate strategy.
<i>2-Sufficiently implemented</i>	The organization supports innovation and incorporates circularity within the strategy of specific departments, but not in their core corporate strategy.
<i>3-Fully implemented</i>	The organization supports innovation and continuous improvement (Santa-Maria et al., 2022) and sets competitive circular strategies at the core of their corporate strategy (Bocken & Konietzko, 2022; Puglieri et al., 2022)

Note: Own elaboration of table showing descriptions per level of maturity attributed to the capability 'Circularity at the core of the organization' for the maturity model 2.0. Includes insights from Santa-Maria et al. (2022), Bocken & Konietzko (2022), Puglieri et al. (2022), as well as the feedback from the interviews. See maturity model 2.0 in Table 40.

Table 28*Model 2.0: Support from top management*

Maturity Levels	Description
<i>0-Not implemented</i>	There is no support from top or middle management, which influences the culture from top to bottom (Qazi & Appolloni, 2022) and blocks the implementation of circular solutions.
<i>1-Poorly implemented</i>	Middle management is aware of the potential of CE through the implementation of CBM in their organization.
<i>2-Sufficiently implemented</i>	Vision and corporate culture are supported by middle management (Eisenreich et al., 2022), even considering making personnel changes if a linear mindset is too deeply rooted in middle management (Hofmann & Jaeger-Erben, 2020)
<i>3-Fully implemented</i>	Vision and corporate culture are supported by top management (Bocken & Konietzko, 2022; Eisenreich et al., 2022; Qazi & Appolloni, 2022) providing the required financial resources and development of competencies (Eisenreich et al., 2022; Qazi & Appolloni, 2022; Santa-Maria et al., 2022) to accelerate the process and to adopt a CE guiding strategy (Eisenreich et al., 2022).

Note: Own elaboration of table showing descriptions per level of maturity attributed to the capability 'Support from top management' for the maturity model 2.0. Includes insights from Qazi & Appolloni (2022), Eisenreich et al. (2022), Hofmann & Jaeger-Erben (2020), Santa-Maria et al. (2022), Bocken & Konietzko (2022), as well as the feedback from the interviews. See maturity model 2.0 in Table 40.

SENSING**Table 29***Model 2.0: Knowledge generation*

Maturity Levels	Description
<i>0-Not implemented</i>	Neither the environmental impact of products or services nor circularity are understood or explained at the organization.
<i>1-Poorly implemented</i>	Internal knowledge about environmental impact and circularity is developed through educational programs (Santa-Maria et al., 2022)
<i>2-Sufficiently implemented</i>	The environmental impact of their product or service is taken into consideration when generating new ideas, but only through first-order learning (Susur & Engwall, 2022).
<i>3-Fully implemented</i>	CE is understood (Puglieri et al., 2022) and knowledge about circularity and the product or service's environmental impact (Bocken & Konietzko, 2022) is generated through first-and-second-order learning processes by involving social actors and networks that exchange their insights (Susur & Engwall, 2022).

Note: Own elaboration of table showing descriptions per level of maturity attributed to the capability 'Knowledge generation' for the maturity model 2.0. Includes insights from Susur & Engwall (2022), Bocken & Konietzko (2022),

Puglieri et al. (2022), Santa-Maria et al. (2022), as well as the feedback from the interviews. See maturity model 2.0 in Table 40.

Table 30

Model 2.0: Analyzing the existing and required capabilities

Maturity Levels	Description
<i>0-Not implemented</i>	The current capabilities and skills still support linearity. The business model, its value creation, delivery, and capture are not mapped (Frishammar & Parida, 2019).
<i>1-Poorly implemented</i>	The current business model's strengths and weaknesses are mapped, but there is no analysis of the required capabilities for CBM implementation.
<i>2-Sufficiently implemented</i>	Current business model strengths and weaknesses are mapped, and there is collaboration with external partners to help acquire the required capabilities for the new CBM (Bocken & Konietzko, 2022)
<i>3-Fully implemented</i>	The current business model capabilities, strengths, and weaknesses are understood and mapped (Puglieri et al., 2022) and the capabilities needed for CBM implementation, e.g., in terms of reverse logistics or circular product design (Bocken & Konietzko, 2022) have been identified.

Note: Own elaboration of table showing descriptions per level of maturity attributed to the capability 'Analyzing the existing and required capabilities' for the maturity model 2.0. Includes insights from Bocken & Konietzko (2022), Puglieri et al. (2022), Frishammar & Parida (2019), as well as the feedback from the interviews. See maturity model 2.0 in Table 40.

Table 31

Model 2.0: Use of sustainability-oriented instruments

Maturity Levels	Description
<i>0-Not implemented</i>	No environmental management tools are used and there are no KPIs oriented at circularity at the organization.
<i>1-Poorly implemented</i>	The organization starts following sustainability guidance frameworks like the "SDGs, Cradle-to-Cradle design or Doughnuts Economics" (Santa-Maria et al., 2022, p.21).
<i>2-Sufficiently implemented</i>	Along with the frameworks, environmental management tools are used to see the impacts and ecological performance along the entire value chain, but there are still no circular KPIs in place.
<i>3-Fully implemented</i>	The organization does sustainability checks using environmental management tools like LCA, ISO14001 and Sustainability Reporting (Bocken & Konietzko, 2022; Santa-Maria et al., 2022) to check the corporate ecological performance (Hofmann & Jaeger-Erben, 2020) and see the impacts and areas of improvement (Puglieri et al., 2022). There are also KPIs on circularity to check whether the organization has become more circular over time (Santa-Maria et al., 2022).

Note: Own elaboration of table showing descriptions per level of maturity attributed to the capability ‘Use of sustainability-oriented instruments’ for the maturity model 2.0. Includes insights from Bocken & Konietzko (2022), Puglieri et al. (2022), Hofmann & Jaeger-Erben (2020), Santa-Maria et al. (2022), as well as the feedback from the interviews. See maturity model 2.0 in Table 38.

Table 32

Model 2.0: Adopting a lifecycle perspective

Maturity Levels	Description
<i>0-Not implemented</i>	The organization follows a take-make-dispose behavior proper from the linear economy, without measuring the impacts at each lifecycle stage.
<i>1-Poorly implemented</i>	The organization performs Cradle-to-Gate LCAs, understanding the impact of their products only until these are produced, thus neglecting the impact from the distribution, use, and EoL stages (Ecochain, n.d.)
<i>2-Sufficiently implemented</i>	The organization falls short of a Cradle-to-Cradle (C2C) design performing only Cradle-to-Grave LCAs, which looks at the entire lifecycle of a product yet assumes its EoL as waste rather than closing the loop through recycling (Ecochain, n.d.)
<i>3-Fully implemented</i>	The organization considers the environmental and social impacts and possibilities throughout the entire lifecycle of a product or service, eliminating waste throughout Cradle-to-Cradle (Santa-Maria et al., 2022). This involves adapting the design for reuse, repair, recycle or refurbishment (Hofmann & Jaeger-Erben, 2020; Santa-Maria et al., 2022) and considering reverse logistics, recovery processes and tracing of materials along the entire value chain (Bocken & Konietzko, 2022; Eisenreich et al., 2022; Puglieri et al., 2022; Santa-Maria et al., 2022).

Note: Own elaboration of table showing descriptions per level of maturity attributed to the capability ‘Adopting a lifecycle perspective’ for the maturity model 2.0. Includes insights from Ecochain (n.d), Bocken et al. (2016), Bocken & Konietzko (2022), Puglieri et al. (2022), Eisenreich et al. (2022), Santa-Maria et al. (2022), Hofmann & Jaeger-Erben (2020), as well as the feedback from the interviews. See maturity model 2.0 in Table 38.

Table 33*Model 2.0: External sensitivity -consumer insights*

Maturity Levels	Description
<i>0-Not implemented</i>	There is no customer analysis.
<i>1-Poorly implemented</i>	Customers are only considered as a source of income, and their needs and behavior are not taken into consideration when designing the business model.
<i>2-Sufficiently implemented</i>	The organization is beginning to analyze customers' needs, but their behavior in relation to circularity is not yet analyzed and consumers are not involved in decision making.
<i>3-Fully implemented</i>	The organization understands customer needs, their behavior and desirability on take-back schemes or other aspects related to value proposition, creation, delivery, and capture of the new CBM (Bocken & Konietzko, 2022; Frishammar & Parida, 2019; Santa-Maria et al., 2022). There is also a focus on customer engagement by making them participants in the innovation process (Bocken & Konietzko, 2022; Santa-Maria et al., 2022).

Note: Own elaboration of table showing descriptions per level of maturity attributed to the capability 'External sensitivity -consumer insights' for the maturity model 2.0. Includes insights from Bocken & Konietzko (2022), Frishammar & Parida (2019), Santa-Maria et al. (2022), as well as the feedback from the interviews. See maturity model 2.0 in Table 38.

SEIZING

Table 34*Model 2.0: Collaboration with stakeholders*

Maturity Levels	Description
<i>0-Not implemented</i>	The relationship with stakeholders is informal, and there is no collaboration nor coordinated efforts.
<i>1-Poorly implemented</i>	Collaboration with stakeholders is more structured through meetings or working groups, but only covers a small part of the value chain.
<i>2-Sufficiently implemented</i>	Collaboration with stakeholders starts to be integrated along the entire value chain, working on "understanding the needs of key stakeholders" (Santa-Maria et al., 2022, p.11).
<i>3-Fully implemented</i>	Strategic alliances are built with stakeholders along the entire value chain (Eisenreich et al., 2022) through collaboration to access complementary capabilities (Bocken & Konietzko, 2022), resource exchanges (Susur & Engwall, 2022) and to co-create solutions to achieve collective goals (Hofmann & Jaeger-Erben, 2020; Santa-Maria et al., 2022).

Note: Own elaboration of table showing descriptions per level of maturity attributed to the capability 'Collaboration with stakeholders' for the maturity model 2.0. Includes insights from Bocken & Konietzko (2022), Santa-Maria et al. (2022), Eisenreich et al., (2022), Susur & Engwall (2022), Hofmann & Jaeger-Erben (2020), as well as the feedback from the interviews. See maturity model 2.0 in Table 38.

Table 35*Model 2.0: Testing/piloting the new CBM*

Maturity Levels	Description
<i>0-Not implemented</i>	Feasibility of the new CBM is tested within the organization. It involves testing materials and product design (Bocken & Konietzko, 2022).
<i>1-Poorly implemented</i>	Customer desirability is tested using design thinking, which involves understanding customers' willingness to pay (Bocken & Konietzko, 2022).
<i>2-Sufficiently implemented</i>	Customer desirability, feasibility and viability (no losses) are now tested outside the company through experimentation and piloting (Bocken & Konietzko, 2022).
<i>3-Fully implemented</i>	In addition to testing the desirability, feasibility, and viability of the new circular business model, the sustainability is tested in practice (Bocken & Konietzko, 2022). The environmental and social impact need to be integrated into the value proposition of the new CBM (Bocken & Konietzko, 2022; Santa-Maria et al., 2022). Testing and experimenting are collaborative with key partners to enable scaling it up (Bocken & Konietzko, 2022).

Note: Own elaboration of table showing descriptions per level of maturity attributed to the capability 'Testing/piloting the new CBM' for the maturity model 2.0. Includes insights from Bocken & Konietzko (2022), Santa-Maria et al. (2022), as well as the feedback from the interviews. See maturity model 2.0 in Table 40.

Table 36*Model 2.0: Cross-functional teams*

Maturity Levels	Description
<i>0-Not implemented</i>	There is no flexibility and different departments do not exchange perspectives on how to improve the new CBM.
<i>1-Poorly implemented</i>	Staff is motivated to explore areas of CE and, through mutual learning (Hofmann & Jaeger-Erben, 2020), start taking on the internal functions required of new cross-functional teams. (Santa-Maria et al., 2022).
<i>2-Sufficiently implemented</i>	The new cross-functional teams are supported by external expert support, like "Cradle-to-Cradle experts" (Santa-Maria et al., 2022, p.8).
<i>3-Fully implemented</i>	Flexible and cross-functional teams actively participate in the innovation process of developing and redefining the CBM by incorporating diverse perspectives to decision making (Hofmann & Jaeger-Erben, 2020; Qazi & Appolloni, 2022; Santa-Maria et al., 2022), as well as CE experts along the entire value chain (Eisenreich et al., 2022)

Note: Own elaboration of table showing descriptions per level of maturity attributed to the capability 'Cross-functional teams' for the maturity model 2.0. Includes insights from Santa-Maria et al. (2022), Hofmann & Jaeger-Erben (2020), Qazi & Appolloni (2022), Eisenreich et al. (2022), as well as the feedback from the interviews. See maturity model 2.0 in Table 38.

TRANSFORMING

Table 37

Model 2.0: Embedding the new circular business models in organizational routines

Maturity Levels	Description
<i>0-Not implemented</i>	Day-to-day operations are only based on linear processes and routines.
<i>1-Poorly implemented</i>	The CBM is considered a one-time project or initiative.
<i>2-Sufficiently implemented</i>	The CBM and its principles start to be incorporated into the ongoing operations on a regular basis and the required resources are gradually provided. It is not considered a one-time project.
<i>3-Fully implemented</i>	The CBM is integrated into the day-to-day operations of the organization and its regular information channels (Bocken & Konietzko, 2022). It also prioritizes projects that fit within the organization's strengths, while improving them by bringing together the right capabilities and resources (Santa-Maria et al., 2022).

Note: Own elaboration of table showing descriptions per level of maturity attributed to the capability 'Embedding the new circular business models in organizational routines' for the maturity model 2.0. Includes insights from Bocken & Konietzko (2022), Santa-Maria et al. (2022), as well as the feedback from the interviews. See maturity model 2.0 in Table 40.

Table 38

Model 2.0: Experimentation to quickly adapt to changes

Maturity Levels	Description
<i>0-Not implemented</i>	The organization gathers information about changes in its sector related to new technologies and competitors (Bocken & Konietzko, 2022) to reduce uncertainty and risks.
<i>1-Poorly implemented</i>	As well as gathering information, the organization focuses on having strategic interactions with "experts, potential customers, and partners" (Bocken & Konietzko, 2022, p.3)
<i>2-Sufficiently implemented</i>	The organization also promotes amongst its employees' freedom to experiment with new ideas, as well as testing the new CBM outside the company (Bocken & Konietzko, 2022).
<i>3-Fully implemented</i>	The organization has created spaces to test and evaluate new game rules through experimentation (Hofmann & Jaeger-Erben, 2020) and to decrease the risk and uncertainty associated with the new CBM (Santa-Maria et al., 2022). The organization learns and adjusts as an ongoing process, to quickly adapt for changes when embedding the CBM (Frishammar & Parida, 2019; Santa-Maria et al., 2022) and to prepare the organization for scaling up the CBM (Bocken & Konietzko, 2022; Santa-Maria et al., 2022).

Note: Own elaboration of table showing descriptions per level of maturity attributed to the capability ‘Experimentation to quickly adapt to changes’ for the maturity model 2.0. Includes insights from Bocken & Konietzko (2022), Santa-Maria et al. (2022), Eisenreich et al. (2022), Hofmann & Jaeger-Erben (2020), Frishammar & Parida (2019), as well as the feedback from the interviews. See maturity model 2.0 in Table 40.

Table 39

Model 2.0: Ecosystem orchestration

Maturity Levels	Description
<i>0-Not implemented</i>	There is no internal nor external alignment at the organization, as there are no positions in charge of its ecosystem’s orchestration.
<i>1-Poorly implemented</i>	There are management positions in charge of coordinating and aligning different departments inside the organization regarding CBM roles and processes, yet the strategic partners are not coordinated (Santa-Maria et al., 2022).
<i>2-Sufficiently implemented</i>	Management positions now incorporate incentives and culture alignment inside the company, reinforcing the “people side” of change (Santa-Maria et al., 2022, p.25).
<i>3-Fully implemented</i>	Professionals in organizational change management coordinate and manage internal alignment concerning roles and responsibilities, culture, processes, and incentives (Frishammar & Parida, 2019; Santa-Maria et al., 2022) as well as coordinating strategic partners in a transparent and flexible way (Hofmann & Jaeger-Erben, 2020; Santa-Maria et al., 2022).

Note: Own elaboration of table showing descriptions per level of maturity attributed to the capability ‘Ecosystem orchestration’ for the maturity model 2.0. Includes insights from Santa-Maria et al. (2022), Hofmann & Jaeger-Erben (2020), as well as the feedback from the interviews. See maturity model 2.0 in Table 40.

Table 40

Maturity model for CBM implementation 2.0

Impleme ntation stages	Capabilities	Levels of Maturity			
		0- Not implemented	1- Poorly implemented	2- Sufficiently implemented	3- Fully implemented
VISIONING	Developing a Circular vision	No vision is developed regarding circularity	Circular vision is only focused on the short-term, pursuing immediate short-term gains.	Circular vision is focused on the long term (beyond 2050) but is only supported by representatives of CSR or sustainability departments.	Long term vision (beyond 2050) involves representatives from multiple departments.
	Circularity at the core of the organization	Neither circularity nor innovation are considered in the organization's core corporate strategy.	The organization supports innovation and has circular ambitions, but not as their core corporate strategy.	The organization supports innovation and incorporates circularity within the strategy of specific departments, but not in their core corporate strategy.	The organization supports innovation and continuous improvement and sets competitive circular strategies at the core of their corporate strategy.
	Support from top management	There is no support from top or middle management.	Middle management is aware of the potential of CE through the implementation of CBM in their organisation.	Vision and corporate culture are supported by middle management, making personnel changes if a linear mindset is too deeply rooted.	Vision and corporate culture is supported by top management to accelerate the process, providing the required financial resources and the development of competencies to adoption a CE guiding strategy.
SENSING	Knowledge generation	Neither the Environmental impact of products or services nor circularity are understood or explained at the organization.	Internal knowledge about environmental impact and circularity is developed through educational programs.	The environmental impact of their product or service is taken into consideration when generating new ideas, but only through first-order learning.	CE is understood and knowledge about circularity and the product or service's environmental impact is generated through first-and-second-order learning processes by involving social actors and networks that exchange their insights.
	Analyzing the existing and required capabilities	The current capabilities and skills still support linearity. The business model, its value creation, delivery and capture are not mapped.	The current business model strengths and weaknesses are mapped, but there is no analysis of the required capabilities for CBM implementation.	Current business model strengths and weaknesses are mapped, and there is collaboration with external partners to help acquire the required capabilities for the new CBM	The current business model capabilities, strengths and weaknesses are understood and mapped and the capabilities needed for CBM implementation, e.g., in terms of reverse logistics or circular product design, have been identified.
	Use of sustainability-oriented instruments	No environmental management tools are used and there are no KPIs oriented at circularity at the organization.	The organization starts following sustainability guidance frameworks like the SDGs, Cradle-to-Cradle design or Doughnuts Economics.	Along with the frameworks, environmental management tools are used to see the impacts and ecological performance along the entire value chain, but there are still no circular KPIs in place.	The organization does sustainability checks using environmental management tools like LCA, ISO14001 and Sustainability Reporting to check the corporate ecological performance and see the impacts and areas of improvement. There are also KPIs on circularity to check whether the organization has become more circular over time.
	Adopting a Lifecycle perspective	The organization follows a take-make-dispose behavior proper from the linear economy, without measuring the impacts at each lifecycle stage.	The organization performs Cradle-to-Gate LCAs, understanding the impact of their products only until these are produced, thus neglecting the impact from the distribution, use, and EoL stages	The organization falls short of a Cradle-to-Cradle (C2C) design performing only Cradle-to-Grave LCAs, which looks at the entire lifecycle of a product yet assumes its EoL as waste rather than closing the loop through recycling.	The organization considers the environmental and social impacts and possibilities throughout the entire lifecycle of a product or service, eliminating waste throughout Cradle-to-Cradle (C2C). This involves adapting the design for reuse, repair, recycle or refurbishment and considering reverse logistics, recovery processes and tracing of materials along the entire value chain.
	External Sensitivity -consumer insights	There is no customer analysis.	Customers are only considered as a source of income, but their needs and behavior are not taken into consideration when designing the circular business model.	The organization is beginning to analyze customers' needs, but their behavior in relation to circularity is not yet analyzed and consumers are not involved in decision making.	The organization understands customer needs, their behaviour and desirability on take-back schemes or other aspects related to value proposition, creation, delivery and capture of the new CBM. There is also a focus on customer engagement by making them participants in the innovation process.

Table 40

(Continued)

SEIZING	Collaboration with stakeholders	The relationship with stakeholders is informal, and there is no collaboration nor coordinate efforts.	Collaboration with stakeholders is more structured through meetings or working groups, but only covers a small part of the value chain.	Collaboration with stakeholders starts to be integrated along the entire value chain, working on understanding the needs of key stakeholders.	Strategic alliances are built with stakeholders along the entire value chain through collaboration to access complementary capabilities, resource exchanges and to co-create solutions to achieve collective goals.
	Testing/Piloting the new CBM	Feasibility of the new CBM is tested within the organization. It involves testing materials and product design.	Customer desirability is tested using design thinking, which involves understanding customers' willingness to pay.	Customer desirability, feasibility and viability (no losses) are now tested outside the company through experimentation and piloting.	In addition to testing the desirability, feasibility and viability of the new circular business model, the sustainability is tested in practice. The environmental and social impact needs to be integrated into the value proposition of the new CBM. Testing and experimenting are collaborative with key partners to enable scaling it up.
	Cross-functional teams	There is no flexibility and different departments do not exchange perspectives on how to improve the new CBM.	Staff is motivated to explore areas of CE and, through mutual learning, start taking on the internal functions required of new cross-functional teams.	The new cross-functional teams are supported by external expert support, like Cradle-to-Cradle experts.	Flexible and cross-functional teams actively participate in the innovation process of developing and redefining the CBM by incorporating diverse perspectives to decision making, as well as CE experts along the entire value chain.
TRANSFORMING	Embedding the new CBMs into organizational routines	Day-to-day operations are only based on linear processes and routines.	The CBM is considered a one-time project or initiative.	The CBM and its principles start to be incorporated into the ongoing operations on a regular basis and start providing the needed resources. It is not considered a one-time project.	The CBM is integrated into the day-to-day operations of the organization and its regular information channels. It also prioritizes projects that fit within the organisation's strengths, while improving them by bringing together the right capabilities and resources.
	Experimentation to quickly adapt to changes	The organization gathers information about changes in its sector related to new technologies and competitors, to reduce uncertainty and risks.	As well as gathering information, the organization focuses on having strategic interactions with experts, potential customers, and partners.	The organization also promotes amongst its employees freedom to experiment with new ideas as well as testing the new CBM outside the company.	The organization has created spaces to test and evaluate new game rules through experimentation and to decrease the risk and uncertainty associated with the new CBM. The organization learns and adjusts as an ongoing process, to quickly adapt for changes when embedding the CBM and to prepare the organization for scaling up the CBM.
	Ecosystem orchestration	There is no internal nor external alignment at the organization, as there are no positions in charge of its ecosystem's orchestration.	There are management positions in charge of coordinating and aligning different departments inside the organization regarding CBM roles and processes, yet the strategic partners are not coordinated.	Management positions now incorporate incentives and culture alignment inside the company, reinforcing the "people side" of change.	Professionals in organizational change management coordinate and manage internal alignment for CBM concerning roles and responsibilities, culture, processes and incentives as well as coordinating strategic partners in a transparent and flexible way.

5. Discussion

CBMs are gaining relevance among companies as a way of adopting CE, thus acquiring responsibility for the mitigation of the social and environmental impact of their activities. The present study gathered the main capabilities required for CBM implementation, which were used to develop a maturity model to grade companies in terms of their CBM implementation maturity (see Table 40). Following the paper's structure, the discussion is also divided into the phases of developing, testing, and refining the model.

Developing the model

There were 14 capabilities found when answering the first research sub-question, which aimed to identify the practices an organization needs to follow when implementing a CBM. These were categorized into the four implementation stages of visioning, sensing, seizing, and transforming as a way to link CBMs with the Dynamic Capabilities' lens and the theory on maturity models. Such capabilities needed to be (1) detectable in any company, independent of its structure, size or industry; (2) measurable on a capability level; (3) and linked through literature to the element of study (CBM) (see section 2.2).

The first phase of visioning refers to building a starting point for innovation and comprises three capabilities validated by five out of the nine authors in the field (see Appendix D). Such capabilities are: 'Developing a vision'; having 'Circularity at the core of the organization'; and getting 'Support from top management', all of which correspond to a new layer identified by Bocken & Konietzko (2022) as fundamental for the implementation of a CBM. It serves as a starting point given that establishing a vision and goals can provide direction and guidance during any transition. Including a visioning stage was thus considered relevant, as having a circular vision and supporting innovation at the core of a company's strategies was mentioned by 6 other authors from the field (see Appendix D).

Appendix C shows how the reference paper by Santa-Maria et al. (2022) doesn't include this implementation stage, following the theory on DC, thus resulting in a rearrangement of the capability they named as 'Leadership and change management capabilities' from reconfiguring the visioning stage. However, having support from top management is a crucial step, according to research, as it can accelerate or block innovation (Santa-Maria et al., 2022) by influencing the adoption of circular strategies (Eisenreich et al., 2022), contributing to the allocation of the necessary resources (Santa-Maria et al., 2022) and therefore affect company culture from top to bottom (Qazi & Appolloni, 2022). Having such support at an initial stage can act as a mandate, unlocking many of the organizational barriers that are commonly encountered in the adoption of a CBM.

Following up with more findings, the implementation phase of sensing, which aims to scan the market for unmet needs, comprises five capabilities validated by seven of the nine field-based authors gathered for this study (see Appendix D). Such capabilities consist of 'Knowledge generation'; 'Analyzing the existing and required capabilities'; 'Use of sustainability-oriented instruments'; 'Adopting a Lifecycle perspective'; and 'External Sensitivity -consumer insights'. Linking all these capabilities to the implementation stage of sensing was straightforward as both Santa-Maria et al. (2022) and Bocken & Konietzko (2022) identified similar capabilities at this stage, except for 'Keep track of sustainability during testing' which was associated to the sensing stage by Bocken & Konietzko (2022) (see Appendix C). The sensing stage helps a company understand and map their current strengths and weaknesses for the implementation

of a CBM, as well as to develop new expertise on circularity while measuring the sustainability performance at each stage of their product or service's lifecycle. Together with developing these capabilities inhouse, companies also need to understand consumer's needs and the desirability of their CBMs which involves a change in the way consumers interact with products due to take-back schemes or products becoming services (Bocken & Konietzko, 2022).

The capabilities found for the implementation stage of seizing new opportunities and developing the business model were validated by eight out of nine authors in the field (see Appendix D). Grouping the capabilities found by Bocken & Konietzko (2022) and Santa-Maria et al. (2022) resulted more challenging, as Bocken & Konietzko (2022) associated seven capabilities to this stage and Santa-Maria et al. (2022) only three (see Appendix C). However, the capabilities Bocken & Konietzko (2022) found at this stage were too specific for B2C corporations and three of those capabilities included steps for testing the CBM, which is a fundamental capability for validating the desirability, feasibility, and viability to scale up the CBM. At this stage, the company also needs to build cross-functional teams that can incorporate their multidisciplinary knowledge combined with a circular perspective into decision making (Hofmann & Jaeger-Erben, 2020; Santa-Maria et al., 2022). 'Collaboration with stakeholders' was the capability most commonly found in literature, as it was validated by seven out of the eight authors mentioned in this stage. This can be explained because collaboration contributes accessing complementary resources and fosters interactions through exchanging knowledge and commitment (Susur & Engwall, 2022). This is especially relevant to building strategic alliances with actors involved in the value chain, as CBM implementation may require slowing the resource loops by increasing the durability of goods or closing the loops through recycling or remanufacturing (Hazen et al., 2020). In this sense, relationships with suppliers may change by choosing only the ones who are strategically aligned with the organization's environmental and social values, which is what the incumbent (in this study) does by having a 'Supplier Code of Conduct'.

The three remaining capabilities found in this study correspond to the highest implementation stage of transforming (by a continuous renewal of the organization) and are validated by five out of the nine relevant authors in the field (see Appendix D). Such capabilities are: 'Embedding the new CBMs into organizational routines'; 'Experimentation to quickly adapt to changes'; and 'Ecosystem orchestration'. When grouping these capabilities, the challenge was set again by Bocken & Konietzko (2022) who, being very B2C-oriented, mention techniques for scaling such as "scaling up from one store to many"(p.13), which may not apply to companies that do not base their activity on having physical stores. Also, two capabilities from Santa-Maria et al. (2022) were considered to correspond to the stages of seizing and visioning instead (see Appendix C). In terms of the found capabilities, both authors relate 'Embedding the new CBMs into organizational routines' to prioritizing materials or projects already existing in the organization or fitting the capabilities already existing, rather than relying solely on collaboration or funding, mitigating what could initially result in a barrier to implementation. Experimentation, on the other hand, is the most validated capability in this stage, as it enables replacing established linear practices and daily routines within the company (one of the main barriers towards CBM implementation) as well as testing the CBM outside the organization. Bocken & Konietzko (2022) mention practices such as "retrieving relevant information about changes in technology, markets, and competitors, providing freedom to employees to explore new ideas, and accepting failure and mistakes while experimenting"(p.3). Finally 'Ecosystem orchestration' serves to align all the previous capabilities needed for a CBM by helping coordinate internally roles and responsibilities, processes, culture and incentives (Frishammar

& Parida, 2019; Santa-Maria et al., 2022), as well as ensuring a transparent and trust-building communication with suppliers and consumers (Hofmann & Jaeger-Erben, 2020; Santa-Maria et al., 2022) to avoid “a risk of green-washing” or a “conflict of interest and unequal power” (Santa-Maria et al., 2022, p.11).

It is interesting to compare these results with the 8-Test Framework developed by the company SystemiQ (SystemiQ, 2022) as it is directed at companies seeking how to organize for circularity and is therefore based upon discussions with strategy and organizational change practitioners, rather than based on theory. Such framework also identifies best practices to transform business models into circular ones through leadership and organizational approaches, based on 10 case studies from companies at different levels of CE maturity and from different sectors. However, when comparing it to the Model developed in this study, the 8-Test Framework lacks a grading mechanism, a differentiation by levels of maturity, and does not include the implementation stages required when aiming to align organizational capabilities with innovation (see section 2.1). A comparison between these two models can thus provide insights into the practical applicability of the model by contrasting a theory-based model with an empirical framework, while providing additional practical examples.

Table 41 illustrates this comparison showing that the eight tests from SystemiQ’s framework match twelve of the capabilities found in this study, leaving only two capabilities unmatched. However, the names of the tests do not give a complete overview of their content and some capabilities identified in this study only show up when digging deeper into the content within the framework, making them easy to miss when looking at the big picture. Test 2 from the 8-Test Framework helps exemplify this statement, as it would apparently only link to the capabilities ‘Analyzing the existing and required capabilities’ and ‘Use of sustainability-oriented instruments’ when mentioning “benchmarking current CE performance, targets and objectives”(SystemiQ, 2022, p.8) However, when going deeper into the content of the test, it also reveals connections with other capabilities from this study by referring to understanding “changing customer preferences”(p.10) (External Sensitivity); “analyzing internal capabilities and external factors”(p.10) (Analyzing the existing and required capabilities); developing circular strategies aligned with the day-to-day of the business (Embedding the new CBMs into organizational routines), set “near- and longer-term objectives [...] aligned with the wider corporate strategy”(p.10) (Circularity at the core of the organization + Developing a Circular vision); and finally “use of existing tools [...] for measuring organization-wide circularity performance”(p.10) (Use of sustainability-oriented instruments). Which is why providing a clear list of capabilities with their corresponding maturity level descriptions is considered an improvement over the 8-Test Framework.

On the other hand, such framework provides specific examples and practices that could help improve the maturity model proposed in this study by making it more applicable, considering its lack of practical examples (see Table 41). The first test provides guidance by exemplifying how leaders can align the circular vision to their currently existing one and how they can make it more appealing. The second test from the 8-Test Framework suggests establishing scenarios or transition pathways to translate the vision into the company’s core strategy, linking to the second capability from the maturity model in this study. Also, the framework provides a specific existing example of a circularity measuring tool for organizations to evaluate their overall circularity performance, which is the Ellen MacArthur’s Circulytics tool. Test three provides relevant examples of governance elements, which in this study are summarized by top- and middle-management, referring to figures such as an ‘executive steering committee’

whereby the CE program is directed by “leaders from both internal and market-facing organizational units” (SystemiQ, 2022, p.12), as well as ‘executive sponsors’ and ‘CE program management’. Another relevant example is mentioned in test 5 where the framework recommends “tailoring performance indicators to CBMs to (...) decouple revenue from production volume” (SystemiQ, 2022, p.13). Test 6 provides examples of how to hinder measuring innovation within a company through circularity innovation contests or a “circularity-specific framework to align, develop and evaluate initiatives and measure success” (SystemiQ, 2022, p.14). Related to talent acquisition and development, which connects with the capability of ‘Knowledge generation’ from this study, the 8-Test Framework suggests creating CE training programs or having CE ambassadors for each department. Finally, the last example they provide suggests “participating in coalitions or aligning public affairs activities”(SystemiQ, 2022, p.16) to enhance collaboration.

The remaining capabilities ‘Adopting a lifecycle perspective’ and ‘Experimentation to quickly adapt to changes’ are not directly stated in the 8-Test Framework, however they play a fundamental role in CBMs. On the one hand, strategies for circularity need to look at the lifecycle of products and services, with special attention to the design process as a starting point for circularity. On the other hand, experimentation is a main driver for innovation as it contributes to replacing existing practices and linear routines (Bocken & Konietzko, 2022; Susur & Engwall, 2022), while setting a culture of ongoing learning and adjustment of the CBM (Frishammar & Parida, 2019).

Table 41

8-Test Framework against maturity model 2.0

8-Test Framework	CBM Maturity Model capabilities	Examples from 8-Test Framework
Strategy		p.10
Test 1: link to the company vision & mission and provide a north star with respect to circularity (underlying vision & mission alignment)?	Support from top management	<i>"leaders can highlight the potential of CE to help organisations tackle multiple challenges at once, from supply chain disruptions and increased resource price volatility to climate action"</i>
	Developing a Circular vision	
Test 2: link to a clear CE transformation strategy (e.g. benchmarking current CE performance, CE targets and objectives)?	Circularity at the core of the organization	<i>"scenarios and transition pathways can help to understand how different CE principles can increase value creation and/or retention, and to identify what is needed"</i>
	Use of sustainability-oriented instruments	<i>"companies can use existing tools, such as Circulytics"</i>
	Analyzing the existing and required capabilities	
	External Sensitivity (consumer insights)	
	Embedding the new CBMs into organizational routines	
	Developing a Circular vision	
Structure		p.12
Test 3: set up effective governance structures (executive steering committee, executive sponsorship, CE programme management)?	Support from top management	<i>"An executive steering committee, executive sponsors and CE programme management"</i>
Test 4: improve transparency and clarity regarding key roles & responsibilities (e.g. role clarity, boxes & lines)?	Cross-functional teams	<i>"A strong nucleus team that drives the CE programme and is well connected to other teams across the organisation should (...) identify and align strategic CE initiatives, coordinate implementation, and manage internal and external stakeholders. In addition, there needs to be a cross-functional team with dedicated resources"</i>
	Ecosystem orchestration	
Process		p.13 &14
Test 5: translate strategy into targets and objectives that support change (KPIs, performance management)?	Circularity at the core of the organization	<i>"businesses should optimise performance indicators for an outcomes-based approach, by setting metrics that decouple revenue from production volume"</i>
Test 6: allow effective end-to-end execution of initiatives (e.g. process from concept to deployment, resources, systems alignment)?	Testing/Piloting the new CBM	<i>"through internal matchmaking platforms or by posing CE-related innovation challenges" or "implement a company-wide, circularity-specific framework to align, develop and evaluate initiatives and measure success"</i>
People	p.15 &16	p.15 &16
Test 7: consider talent and capability development needed to achieve CE targets (recruitment, training & development, embedding CE into culture)?	Knowledge generation	<i>"prioritising CE-related skills and knowledge in job openings" + "develop their own CE training programmes to upskill those already in the organisation" + "developing an internal community of CE leaders who function as ambassadors within their departments"</i>
Test 8: allow the company to embed itself as progressive player in a wider circular ecosystem (e.g. partnerships)?	Collaboration with stakeholders	<i>"actively participating in coalitions (...) or aligning public affairs activities allows companies shape national CE agendas"</i>
	Remaining capabilities	
	Adopting a Lifecycle perspective	
	Experimentation to quickly adapt to changes	

Note: Comparison between 8-Steps Framework (SystemIQ, 2022) and matching capabilities from CBM maturity model developed in the present study.

Testing the model

To test the model, five categories guided the interviews, thus developing a common foundation for all. Such categories referred to either the content or the structure of the levels. The most repeated feedback pointed out two adjacent levels being either too similar or too far apart, related to the structuring categories of 'differentiation per level fair' and 'increment well developed'. Such feedback was very useful in improving the model, as the different levels need to follow a consistent degree of progression in order for the company to understand its current situation and plan its move up to the next level. For instance, if there is too much difference between a given current level and the next level of maturity, the organization may feel that it is unattainable or will be lacking guidance on how to reach such level.

In terms of the amount of feedback provided, the next most relevant category was "clearly understood" where feedback from the case studies shed light into content that was not clear enough. Here, feedback from the incumbent showed that the descriptions might be assuming content that was not generally understood from the context. For instance, when asking if the capability 'Circularity at the core of the organization' was related to the sustainability strategy or to the corporate strategy, it proved that these are not always aligned in companies, and that sometimes circularity is only a strategy within the sustainability department of an organization.

The category with the least feedback was the one asking whether it was easy for the case studies to position their company at a level according to the descriptions. The intention behind the question was to test the applicability of the model to different types of organizations. Such lack of feedback indicated both case studies were able to rank their company according to the preliminary model; however, the feedback previously mentioned regarding levels being too similar or too far apart shows the need for improvement to make it easier for companies to position themselves at a certain maturity level.

Along with these categories, companies were asked to grade their company according to the descriptions per level of maturity, allowing them to obtain not only an overall performance grade, but also a grade per capability and per implementation stage. Such evaluation enriches the results by enabling organizations to identify the areas for improvement, by first showing their strongest and weakest implementation stages, to further identify their least developed capabilities along with descriptions indicating how these can be improved. The grades per implementation stage can already indicate the order in which the organization should start to examine its weaknesses. If their first stages of visioning and sensing are graded low, they should first focus on developing their internal culture and capabilities before trying to improve external engagement or scaling up their CBM. According to research performed by Bocken & Konietzko (2022), the transforming phase is commonly the least developed stage in CBM implementation as it aims "to understand what capabilities to keep, change or source via others" (p.10). However, grades obtained by the two case studies show that transformation was not the least developed stage. In the case of the start-up, this could be explained by the fact that Bocken & Konietzko (2022) only consider incumbents in the process of implementing CBMs, while the start-up in this study was created based on circular principles. To draw conclusions on the expected development of the different stages of implementation, future research requires testing this model with a larger number of start-ups, both circular-born and those implementing different typologies of CBMs (see section 2.1).

In the case of the incumbent, the transforming stage is the second least developed one, after the seizing stage, which might be due to a possible stronger culture of circularity than in case studies by Bocken & Konietzko (2022), as the capabilities from this stage refer to having a culture of experimentation, internal alignment for CBM and having the CBM integrated into day-to-day operations. Nevertheless, it could still be in line with Bocken & Konietzko (2022)'s findings, showing a smaller level of maturity for transformation than for the rest of stages.

As mentioned in section 2.1, incumbents may face more barriers than start-ups in implementing a CBM due to organizational lock-in and path dependencies. The start-up in the present study was born circular, while the incumbent was in the process of transforming towards circularity, whereby the rating of the latter was lower than that of the start-up; which, according to this study, could be considered a best practice. Overall, the grades obtained reflect the different levels of maturity and ambitions of the two organizations. However, both case studies obtained considerably high grades, which could be explained by the trade-off of assuming universality in the model, overlooking at the number, type or impact of the CBM being implemented. This is further discussed in limitations section 5.1.

Refining the model

Feedback from both the start-up and the incumbent allowed improving the model by refining 12 out of 14 capabilities, which contributed to making it more grounded and applicable for different types of organizations. While all comments were included in the refinement of the model, it is worth highlighting one from the start-up as it completely reshaped the capability 'Adopting a life cycle perspective' by mentioning that they only performed Cradle-to-Gate (C2G) LCAs. The preliminary model did not differentiate between the existing system boundaries in an LCA, neglecting the different impacts that arise from conducting a C2C LCA which looks at the entire life cycle of a product, while designing to avoid waste, in contrast to a C2G LCA that omits impacts after the production phase. Descriptions from the preliminary model positioned the start-up and the incumbent at the highest level for this capability, when the incumbent is certified C2C (which is the highest scope of a LCA), while the start-up only looks the lowest scope of a LCA.

The refined version of the model now shows clear and differentiated descriptions providing a roadmap into best-practices for the implementation of a CBM, as well as a more consistent gradual increment along the maturity levels of every capability encountered. The resulting 2.0 maturity model (see Table 40) can thus be considered a useful benchmarking tool for companies to assess their progress in implementing CBMs against their baseline, as well as to compare themselves with other companies based on a comprehensive grade. Such guidance in terms of know-how has been requested by policymakers, strategic management scholars, and practitioners (Galvão et al., 2022; SystemiQ, 2022; Urbinati et al., 2017)) aiming to implement CBM in corporations, and this model attempts to answer such question while providing a tool for benchmarking the degree of implementation. Assmann et al. (2023) call for the need of benchmarks and best practices to promote the adoption of CBMs, by turning competition (which is currently seen as a barrier) into a driver for transition. Organizations using this benchmarking tool can thus gain a competitive advantage and rank their position in comparison to others, strategically planning their next steps by identifying their weakest

capabilities and improving them through the best practices offered at the highest maturity level of the model.

Policymakers can also benefit from this tool by testing it with as many organizations as possible to encourage continuous improvement and thus gather reliable information to draw conclusions on adoption rates and to set targets.

The maturity model developed to measure CBM implementation can thus contribute to the adoption of CBMs by providing organizations with the required guidance, enabling them to become active stewards of the transition towards a CE.

5.1. Limitations

The model developed in the present study to measure the progress in CBM implementation complies with the requirements of a maturity model; however, more work is needed to ensure that it is useful and relevant to organizations so that it reaches the potential to support the uptake of CBMs by providing a means to measure the baseline and progress.

The first limitation of this study relates to including only two case studies to test and refine the model. Although it follows a maximum variation sample approach, in order to make the model more applicable and reliable, more companies of different sizes should be included in testing the model. This study assumes that the average is represented by including extremes. However, due to the model's universality, information from a larger sample could prevent an oversimplification of the capabilities' descriptions.

Secondly, both case studies obtained considerably high grades. The reason might be explained, once again, as a trade-off for the universal nature of the model. By considering it should be applicable to any type of company, regardless of its size or sector, it does not elaborate on the specific type, number or impact of the CBM being implemented. As a consequence, no conclusions can be drawn regarding a company's overall circularity according to the grade obtained; but rather, the model can be used to grade a company's performance and progress in the path towards implementing a CBM as a driver to CE adoption.

Lastly, the main references for building the model were Bocken & Konietzko (2022) and Santa-Maria et al. (2022) papers which both look at larger companies and do not include the start-up perspective. Although the validity of the model was empirically tested with a start-up, the identified capabilities arise from studies about incumbents and larger consumer-facing corporations. However, the developed model may still apply for start-ups, they could position its business at a certain level of maturity without being compromised by its content not being suitable for a start-up.

5.2. Future Research Suggestions

Considering the potential this model offers, the limitations in terms of validity and applicability could be lessened by including the theoretical perspective of the start-up when identifying the capabilities or practices necessary to implement a CBM. This might be achieved by designing research with the aim of identifying these practices as part of the dynamic capabilities' lens, which could reshape the capabilities or performance per level of maturity described in this model. Alternatively, these capabilities could be refined by including the study about the required skills for CBM implementation in start-ups from Straub et al. (2023). The model could also be tested with different organization types, exploring specifically whether it applies to start-ups as much as incumbents or whether new capabilities need to be brought in to accurately reflect the view of start-ups.

Another suggestion for future research in order to draw better conclusions could be differentiating by type and number of CBM being implemented at an organizational level, as potential additional layers of the model. Along with this differentiation, it might be valuable to monitor how each type of CBM affects and transforms the value proposition, creation, delivery, and value capture, to eventually include this value logic in a new version of the maturity model (see the work from Geissdoerfer et al. (2020) and Urbinati et al. (2017) as reference). To explore this further, performance could also be compared in terms of the environmental impact for each type of CBM. For instance, the two case studies analyzed in this paper are implementing different types of CBMs, even differentiated within the CBM strategies proposed by Geissdoerfer et al. (2020) (see Table 40), which could be reflected in the grading of the model according to the specific environmental impacts of each type of CBM.

Table 42

CBM strategies from incumbent vs. start-up

CBM Strategies by Geissdoerfer et al. (2020)	Descriptions from Geissdoerfer et al. (2020)	CBM strategies by Incumbent	CBM strategies by Start-up
Cycling	Recycling materials and energy through reuse, remanufacturing, refurbishing, and recycling	Downcycling	Upcycling and downcycling
Extending	Extension of the use-phase of products through long-lasting design, marketing, maintainance, and repair	Free repair service + marketing campaign	Repair service
Intensifying	The use phase is intensified through sharing economy solutions	Secondhand stores	
Dematerializing	Service and software solutions replace product utility- PaaS		Leasing jeans

Note: Own elaboration of table comparing the CBM strategies from both case studies in comparison with the proposed strategies by Geissdoerfer et al. (2020).

6. Conclusion

The aim of this research was to develop a maturity model to measure the implementation of CBM in corporations. This maturity model is intended to serve as a diagnostic tool for companies to measure their CBM maturity in terms of the progress made against a baseline, as well as to provide the necessary guidance for improvement through best practices while acting as a benchmarking tool to compare themselves against other similar organizations. The implementation of a CBM refers to circular strategies defining or reshaping how the organization creates, delivers, captures and transfers value, which in this study takes the form of cycling, extending, intensifying and dematerializing the value chain.

The proposed research question '*How can organizations measure their maturity in terms of CBM implementation?*' was answered through the three proposed research sub-questions that guide the process into developing the model by identifying the main organizational capabilities needed for the implementation of CBMs, their corresponding levels of maturity and a grading mechanism. The model was developed based on an integrative literature review following a deductive research design, identifying 14 capabilities needed for CBM implementation. Such capabilities were then categorized into the four implementation stages of visioning, sensing, seizing, and transforming as per Bocken & Konietzko (2022) and Santa-Maria et al. (2022), and later validated with nine other papers from authors in the field. Best practices were derived from this literature and the conceptual contribution consisted of building four levels of maturity descending from such best practices. Finally, a grading mechanism was developed assuming an increasing level of complexity through the four implementation stages. To improve its applicability and validity, the model was tested with two interviews made to an incumbent and a start-up, following a maximum variation sample approach to triangulate the results; and, finally, the model was refined by incorporating feedback into an improved 2.0 Model.

Both selected case studies are in the denim industry and are in the process of implementing different types of CBM. The start-up was born circular, while the incumbent started their journey towards circularity in 2016. Following a maximum variation sample approach, insights from both interviews were assumed to represent company averages, making the model more applicable. However, a wider range of companies, of various sizes, in different industries, and with varied levels of maturity should allow to draw better conclusions on the model's validity. Further testing is also encouraged, both theoretical and empirical, as to whether the capabilities found are applicable to start-ups or whether new ones need to be brought in to refine the model to make it more inclusive (considering it is theoretically based on capabilities found at incumbents.)

Findings show a higher score for the start-up than for the incumbent, which is reasonable considering the former was created with the purpose of being circular and has not needed to overcome organizational lock-ins, as the incumbent still does. However, both case studies scored considerably high, suggesting a trade-off between the universality of the model and its applicability. Future research could explore the specific type, number and impact of the CBMs being implemented to improve the applicability of the model and the validity of the grading in drawing conclusions.

The present study contributes to theory by gathering the main practices companies need to follow when implementing a CBM and translating them into best practices. Such practices come in the form of capabilities with four levels of performance, which finds an intersection between the Dynamic Capabilities lens, CBM, and maturity models' theory. Compared to existing theory on CBM implementation through a dynamic capabilities' lens, this study takes a practical approach by providing a grade of maturity that would serve as an indicator of the progress an organization under study has made in terms of CBM implementation. The assumed increasing level of complexity promotes the continuous improvement of its business model through circular practices and, by providing a grade at each stage of implementation, the organization can identify its weakest areas and focus its efforts on improving its performance according to suggested best practices.

Developing such an indicator is considered a valuable tool for companies as it allows them to monitor their progress, improve their decision making, and enhance their accountability by being able to reflect their commitment towards circularity in a more transparent way. Furthermore, it also serves as a benchmarking tool that can be used to compare their performance against competitors implementing CBMs and therefore a chance to obtain competitive advantage.

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Appendix A

Dimensions and Maturity Levels of maturity models from Steinhöfel et al. (2022)

Table 2.					
Author/s	Model Name	Dimensions of maturity		Maturity levels	
		Dimensions	Descriptors	Levels	Descriptors
Demir (2018)	Strategic Management Maturity Model for Innovation (S3M-I)	7 (Multi-d.)	(1) Leadership (2) Planning & executing (3) Processes & tools (4) Structure & model (5) People & culture (6) Performance management (7) Innovation	6	0: Undefined 1: Initial 2: Planned 3: Performed 4: Optimized 5: Excellent
Enkel et al. (2011)	Open Innovation Maturity Framework (OIMF)	3 (Multi-d.)	(1) Climate for innovation (2) Partnership capacity (3) Internal processes	5	1: Initial/Arbitrary 2: Repeatable 3: Defined 4: Managed 5: Optimizing
Easmann and Du Preez (2009)	Innovation Capability Maturity Model (ICMM)	8 (Multi-d.)	Innovation Capability Construct (1) Innovation process (2) Knowledge and competency (3) Organizational support Organizational Construct (4) Strategy and objectives (5) Functions and processes (6) Organisation and management (7) Data and information (8) Customers and suppliers	5	1: Ad hoc innovation 2: Defined innovation 3: Supported innovation 4: Aligned innovation 5: Synergised innovation
Carlson and Gupta (2014)	Business Innovation Maturity Model (BIMM)	1 (One-d.)	Not explicitly stated	5	1: Sporadic 2: Idea 3: Managed 4: Nurtured 5: Sustained
Igartua et al. (2018)	Innovation Maturity Model (IM2)	11 (Multi-d.)	(1) Strategy (2) Competitiveness (3) Manufacturing excellence (4) Innovation (5) Value propositions and business model (6) Internationalization (7) Advanced management (8) Digitalization (9) Sustainability (10) People (11) Territory	5	1: Unaware 2: Aware 3: Manage 4: Defined 5: Performance
Rübel et al. (2018)	Maturity Model for Business Model Management in Industry 4.0	9 (Multi-d.)	(1) Key partners (2) Key activities (3) Key resources (4) Value Proposition (5) Customer relationship (6) Channels (7) Customer segment (8) Cost structure (9) Source of income	5	1: Implicit 2: Defined 3: Validated/ standardized 4: Analyzed 5: Optimized

Table 2: Dimensions and Maturity Levels of Maturity Models

Note: From “Framing a maturity model for business model innovation” by Steinhöfel, E., Hussinki, H., & Breunig, K. J. (2022). Framing a maturity model for business model innovation. *Journal of Business Models*, 10(2), 110–128. <https://doi.org/10.54337/jbm.v10i2.7024>

Appendix B

A Strategic Management Maturity Model for Innovation by Demir (2018)

	Level 0: Undefined	Level 1: Initial	Level 2: Planned	Level 3: Performed	Level 4: Optimized	Level 5: Excellent
Leadership	No organizational awareness of strategic leadership	Knowledge exists, but no owner and sponsor for strategic management activities	An employee is assigned to strategic projects and activities	A team performs strategic activities; the team leader engages with other department managers	A particular office leads strategic management activities effectively; leaders and employees fully engage in strategic management processes	Strategic leadership encourages innovation at all levels; leaders transform the business and culture to become more innovative
Planning & Executing	No organizational awareness of strategic planning	No strategic plan; some goals and objectives are defined	Strategic planning is the responsibility of one person and a strategic plan is prepared every 4-5 years	A structured and interactive strategic planning process exists; actions plans are developed	Strategic plan/actions plans are revised regularly; strategic initiatives are updated	Strategy drives all critical organizational decisions; innovation is an important agenda of the strategic plan
Processes & Tools	No process and tools for strategic management activities	Some ad-hoc reports and tools are used, but processes are undocumented	A few key processes are documented; some basic tools are used for strategic planning and management	All strategic management processes are mapped out and analyzed, and strategy drives process improvements	All strategic processes are redesigned for continuous innovation; advanced tools/methods are used for strategic planning and innovation management	There is a structured innovation management process; strategy guides selection of tools and technologies; all tools/systems are integrated into strategies
Structure & Model	Organizational structure and business model are unknown	Chaotic organizational structure; some components of business model are known	Functional organizational structure is created; business model is defined	Rigid structure (hierarchy is important; tall organization); business model is not innovative; structure and model do not support strategies	Organizational structure and business model are redesigned to foster innovation and empower strategies; flat organization with low hierarchy	Organizational structure and business model are fully integrated into strategies; a unique/innovative business model; an agile structure
People & Culture	No common values and personas	Values are undefined; an organizational culture is not formed yet	People share a common vision and values are understood; innovation is a critical value	Vision, goals, and values are communicated; organizational culture is fully formed but culture is not linked to strategy; bureaucratic culture	Organizational culture is redesigned to support innovation strategies; less bureaucracy, a more adhocratic culture is forming	Organizational culture fully integrated into strategies; culture is innovation focused; people are encouraged to come up with new ideas
Performance Management	No assigned performance indicators	Few performance indicators are identified but no available data	All performance indicators and metrics are identified; no KPI for innovation	Strategic indicators are measured data collected, and overall performance is managed at a broad level; KPIs are designed for innovation activities	Strategic indicators are revised according to performance results; innovation performance is managed at all levels	Systems are implemented for disruptive innovation; performance of radical innovation is measured daily basis
Innovation	Innovation is not a priority	Random innovations, not results of a structured approach	Innovation management process is defined but no tool and method are used for innovation	Innovation initiatives are started; structured innovation tools/techniques/methods are used at some organizational levels; mostly incremental innovation takes place	People fully engage in innovation activities at all levels; some radical innovations; semi-innovative organization; gap between strategy and innovation	Innovation initiatives are well aligned with corporate strategies; fully innovative organization; disruptive innovation is part of DNA

Note: From “A Strategic Management Maturity Model for Innovation” by Demir, F. (2018). A Strategic Management Maturity Model for Innovation. *Technology Innovation Management Review*, 8(11), 13–21. <https://doi.org/10.22215/timreview/1196>

Appendix C

Implementation stages	Bocken & Konietzko (2022) Capabilities	Santa-Maria et al. (2022) Capabilities	Capabilities included in the model
Visioning (A)	Develop a vision with representatives from multiple departments (A1) Focus on the long term and set goals and ambitions (A1)		Develop a vision (A1)
	Setting circularity at the core of the company to make it a driver (A2)		Circularity at the core of the organization (A2)
	vision supported by top-level management (A3)		Support from top management (A3)
	Create a mandate Negotiation of an innovation budget		
Sensing (B)	Generate ideas (B1)	Knowledge creation (B1)	Knowledge generation (B1)
	Analyze the existing and needed capabilities (B2)		Analyze the existing and needed capabilities (B2)
		Use of sust. Oriented instruments (B3)	Use of environmental management tools and circular KPIs (B3)
	Formulate hypotheses and RQ (B4)	Adopting holistic perspectives (B4)	Adopting a Lifecycle perspective (B4)
	Gain consumer insight (B5)	External Sensitivity (B5)	External Sensitivity - consumer insights (B5)
Seizing (C)	Collaborate to access complementary capabilities (C1)	Engaging and collaborating with stakeholders (C1)	Collaboration with stakeholders (C1)
	Test the desirability of new business models (C2)	Delineating sustainable solutions and BMs (C2)	Designing and implementing the CBM- Testing/Piloting (C2)
	Investigate the viability of emerging new business models (C2)		
	Plan the pilots (C2)		
	Build internal acceptance and capabilities (C3)		Cross-functional/ Interdisciplinary teams (C3)
	Keep track of the sustainability during the testing (B3)	Supporting a sustainability and innovation-oriented organizational culture (A3)	
	Adapt the product design (B4) Test alone/without partners Engage in corporate incubator activities		
Transforming (D)	Embed the new business models in organizational routines (D1)	Co-specialization of assets (D1)	Embed the new business models in organizational routines (D1)
	Drive cultural change (D2)		Experimentation or capacity to quickly adapt to changes (D2)
		Trust-building communication (D3) Ecosystem orchestration (D3)	Ecosystem orchestration (D3)
	Use different ways of scaling up (in parallel)	Leadership and change management capabilities (A3)	
		Organizational flexibility (C3)	

Appendix C. Grouping of capabilities methodology to develop the model

Appendix D

Implementation stages	Capabilities	Authors
VISIONING	Develop a vision	Bocken & Konietzko (2022) Susur & Engwall (2022) Puglieri et al. (2022)
	Focus on the long term and set goals and ambitions	Bocken & Konietzko (2022) Qazi & Appolloni (2022) Puglieri et al. (2022) Hofmann & Jaeger-Erben (2020)
	Circularity at the core of the organization	Bocken & Konietzko (2022) Santa Maria et al. (2022) Qazi & Appolloni (2022) Puglieri et al. (2022)
	Support from top management	Bocken & Konietzko (2022) Santa Maria et al. (2022) Eisenreich et al. (2022) Qazi & Appolloni (2022)
SENSING	Knowledge generation	Bocken & Konietzko (2022) Santa Maria et al. (2022) Susur & Engwall (2022) Hofmann & Jaeger-Erben (2020) Puglieri et al. (2022)
	Analyze the existing and needed capabilities	Bocken & Konietzko (2022) Puglieri et al. (2022) Frishammar & Parida (2019)
	Use of sust. Oriented instruments /novel performance indicators	Bocken & Konietzko (2022) Santa Maria et al. (2022) Hofmann & Jaeger-Erben (2020) Eisenreich et al. (2022) Puglieri et al. (2022)
	Adopting a Lifecycle perspective	Santa Maria et al. (2022) Bocken & Konietzko (2022) Eisenreich et al. (2022) Hofmann & Jaeger-Erben (2020) Puglieri et al. (2022)
	External Sensitivity (consumer insights)	Bocken & Konietzko (2022) Santa Maria et al. (2022) Frishammar & Parida (2019) Eisenreich et al. 2022
SEIZING	Collaboration with stakeholders	Bocken & Konietzko (2022) Santa Maria et al. (2022) Susur & Engwall (2022) Hofmann & Jaeger-Erben (2020) Eisenreich et al. (2022) Qazi & Appolloni (2022) Hazen et al. (2020)
	Designing and implementing the CBM- Testing/Piloting	Santa Maria et al. (2022) Bocken & Konietzko (2022) Qazi & Appolloni (2022) Puglieri et al. (2022)
	Cross-functional/ Interdisciplinary teams	Bocken & Konietzko (2022) Santa Maria et al. (2022) Hofmann & Jaeger-Erben (2020) Eisenreich et al. (2022) Qazi & Appolloni (2022)
TRANSFORMING	Embed the new business models in organizational routines	Bocken & Konietzko (2022) Santa Maria et al. (2022)
	Experimentation or capacity to quickly adapt to changes	Bocken & Konietzko (2022) Hofmann & Jaeger-Erben (2020) Santa Maria et al. (2022) Susur & Engwall (2022) Frishammar & Parida (2019)
	Ecosystem orchestration	Santa Maria et al. (2022) Frishammar & Parida (2019) Hofmann & Jaeger-Erben (2020)

Appendix D. Authors validating the capabilities to developing the model

Appendix E

Implementation stages	Capabilities	Levels of Maturity			
		0- Not implemented	1- Poorly implemented	2- Sufficiently implemented	3- Fully implemented
VISIONING	Developing a Circular vision	No vision is developed regarding circularity	Circular vision is only focussed on the short-term	Circular vision is focused on the long term, but is only supported by representatives of CSR or sustainability departments.	Long term vision involves representatives from multiple departments.
	Circularity at the core of the organization	Neither circularity nor innovation are at the core strategy of the organization.	The organization supports innovation and sustainability, but not as a core strategy.	The organization supports innovation and has circularity ambitions, but these are not translated into core strategies.	The organization supports innovation and continuous improvement and sets competitive strategies for circularity at the core of the business.
	Support from top management	There is no support from top or middle management.	Middle management is aware of the potential of CE through the implementation of CBM in their organization.	Vision and corporate culture are supported by middle management, making personnel changes if the linear mindset is too deeply rooted.	Vision and corporate culture are supported by top management providing the required financial resources and development of competencies to accelerate the process and adopt a CE guiding strategy.
SENSING	Knowledge generation	Circular Economy is not understood nor explained within the organization.	Neither Environmental impact nor circularity are considered during knowledge generation.	Environmental impact is taken into consideration when generating new ideas, but only through first-order learning.	There is understanding CE and knowledge about circularity and environmental impact is generated through first and second order learning processes by involving social actors and networks that exchange their insights.
	Analyzing the existing and required capabilities	Current capabilities and skills still support linearity. The business model, its value creation, delivery and capture are not mapped.	Current business model's strengths and weaknesses are mapped, but there is no analysis of the capabilities required for CBM implementation.	Current business model's strengths and weaknesses are mapped, and the shortcomings and opportunities towards the triple bottom line are being analyzed for further implementation.	Current business model's capabilities, strengths, and weaknesses are understood and mapped and the capabilities required for CBM implementation, e.g. in terms of reverse logistics or circular product design, have been identified.
	Use of environmental management tools and circular KPIs	No environmental management tools are used and there are no KPIs oriented at circularity within the organization.	The organization is starting to explore the use of some environmental management tools, but there are no circular KPIs in place.	Environmental management tools are used to assess impacts and ecological performance, but there are still no circular KPIs in place.	The organization does sustainability checks using environmental management tools like LCA, ISO14001 and Sustainability Reporting to check the corporate ecological performance and assess the impacts and areas of improvement. There are also KPIs on circularity to monitor how the organisation becomes more circular over time.
	Adopting a Lifecycle perspective	The organization follows a take-make-dispose behavior proper of a linear economy.	The organization has started understanding the life cycle concept and becoming aware of its potential.	The organization starts performing LCAs to understand the environmental impacts at each stage of a product's lifecycle and to integrate the outcomes into the decision-making process.	The organization considers the environmental and social impacts and possibilities throughout the entire lifecycle of a product or service, Cradle to Cradle (C2C). This involves adapting the design for reuse, repair, recycle or refurbishment and considering reverse logistics and recovery processes along the entire value chain.
	External Sensitivity (consumer insights)	There is no customer analysis.	Customers are only considered as a source of income, and their needs and behavior are not taken into consideration when designing the circular business model.	The organization is beginning to analyze customers' needs, but their behavior in relation to circularity is not yet analyzed and consumers are not involved in decision making.	The organization understands customer needs, their behavior and desirability on take-back schemes or other aspects related to value proposition, creation, delivery and capture of the new CBM. There is also a focus on customer engagement by making them participants in the innovation process.
SEIZING	Collaboration with stakeholders	The relationship with stakeholders is informal, and there is no collaboration nor coordination.	Collaboration with stakeholders is more structured through meetings or working groups, but still does not cover the entire value chain.	Collaboration with stakeholders starts to be integrated along the value chain, through product design or supply chain management.	Strategic alliances with stakeholders are established along the entire value chain through collaboration to access complementary capabilities, resource exchanges and to co-create solutions to achieve collective goals.
	Designing and implementing the CBM- Testing/Piloting	The new CBM is not tested within nor outside the organization.	Customer desirability and the feasibility for the organization are tested using design thinking. This includes testing materials and product design, as well as understanding customers' willingness to pay.	Customer desirability and feasibility are now tested outside the company through experimentation and piloting.	In addition to testing desirability and feasibility, the viability (no losses) of the new circular business model is now also tested. The environmental and social impact needs to be integrated into the value proposition of the new CBM. Testing and experimenting are collaborative with key partners to scale it up.
	Cross-functional teams	There is no flexibility and different departments do not exchange perspectives on how to improve the new CBM.	The staff is taking on the internal functions required for the new cross-functional teams, but there are still no experts on circularity.	Cross-functional teams are taught to explore areas of CE and, through mutual learning, eliminate some of the linear thinking.	Flexible and cross-functional teams actively participate in the innovation process of developing and redefining the CBM by incorporating diverse perspectives to the decision making, as well as CE experts along the entire value chain.
TRANSFORMING	Embedding the new CBMs into organizational routines	Day-to-day operations are only based on linear processes and routines.	The CBM is considered a one-time project or initiative.	The CBM and its principles start to be incorporated into ongoing operations in a more natural way than a one-time project, and required resources are provided.	The CBM is integrated into day-to-day operations and to regular information channels. It also prioritizes projects that fit within the organization's strengths, while improving them by bringing together the right capabilities and resources.
	Experimentation or the capacity to quickly adapt to changes	There are no spaces for experimentation in the organization and the CBM is not ready to adapt to changes in its context.	The organization understands the potential of experimentation to reduce uncertainty and risks and as a way of scaling up the CBM.	The organization is building spaces for experimentation to overcome the routines around the linear economy.	The organization has created spaces to test and evaluate new game rules through experimentation and to decrease the risk and uncertainty associated with the new CBM. The organization learns and adjusts as an ongoing process, to quickly adapt for changes in the context embedding the CBM and to prepare the organization for scaling up the CBM.
	Ecosystem orchestration	There is no internal and external alignment for CBM at the organization as there are no positions in charge of the ecosystem orchestration.	There are management positions in charge of coordinating and aligning different departments inside the organization regarding CBM roles and processes, but they still lack an ecosystem approach.	These management positions now incorporate incentives and culture alignment inside the company, reinforcing the "people side" of change.	Professionals in organizational change management coordinate and manage internal alignment for CBM regarding roles and responsibilities, culture, processes and incentives as well as coordinating strategic partners in a transparent and flexible way.

Appendix E. Preliminary Maturity Model

Appendix F

Interview Guide

Thank you for taking the time to help me improve my research. I am conducting my Master Thesis on Measuring Circular Business Model implementation in organizations through building a maturity model. I want to present the model I have developed based on relevant authors in the field of circularity like Nancy Bocken or Santa Maria. These authors have identified the main capabilities an organization needs to implement a CBM and have structured them into different implementation stages. To create my model, I have combined 2 increasing axis that combined give guidance on the requirements an organization needs to follow to obtain the highest level of CBM implementation. On the left axis you can see the implementation stages which depart from the Dynamic Capabilities commonly known for being a pillar of competitive advantage and business model innovation. *Visioning is about creating a joint starting point for innovation by creating a viewpoint about what the future should look like. Sensing refers to scanning the market and identifying and assessing the market for unmet needs and new business opportunities (Teece, 2018). Seizing is about mobilizing organizational resources to seize new opportunities and develop their business case (Teece, 2018). Transforming is about the continuous renewal of the organization, to remain competitive in fast changing environments.* I've ranked each capability into 4 levels of maturity, meaning that the 3rd level includes the practices needed to obtain the highest level of CBM implementation and in turn the highest level of maturity.

I would like to ask you to go together through the different capabilities, which are also located inside increasing implementation stages, and give me feedback by thinking out loud as if your company was being graded using my model. The questions relate to the structuring, quality and comprehensibility of the model and the idea is that these questions can guide you through your feedback, however, please feel free to comment on any other matters that may arise.

Opener:

- Can you describe the type of CBM your company is implementing?

Capabilities

- When looking at the capabilities identified, are the names clearly understood? Would you make any name more concise?
- Do you consider all the identified capabilities relevant?
- Are you missing any?
- Do you find the identified capabilities detectable among any company independently of its structure, size or industry?

Levels of Maturity

- When reading the description for each level of maturity, are they clearly understood?
- Is there anything missing or inaccurate?
- Do you find each level different, self-explanatory, easy to understand and with their own organizational purpose?
- Is the increment per level well developed?

Grading

- Together with this feedback, I would like to ask you to indicate in which level of maturity (ranging from 0 to 3) for each capability does your company fall into.
- When doing this, do you find the differentiation per level fair?
- Is it easy for you to position your company in a level according to the way it is described in the model?