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A circular economy standard: the origins, method and business applications of the Cradle to Cradle Certified certification

The circular economy has gained considerable traction lately within the corporate and academic world as a new approach for addressing economic, business and environmental issues. This concept aims to reduce and eliminate waste or the wasting of resources, as well as to optimize and to minimize resource use during the production and consumption phases.

For companies which intend to become circular it is crucial to apply internationally accepted standards which provide credible and comparable data on their circular performance. One of these circular standards is the Cradle to Cradle Certified (C2CC) certification, a global label for products that are safe for nature and people, circular and responsibly made. In my paper I discuss the origins, methodologies and the main features of this standard and I also showcase my primary empirical research I did with companies having one or more C2CC product certification(s).

Keywords: sustainability, circular economy, standardization

JEL Codes: L15, M14, Q01, Q50

Egy körforgásos gazdasági szabvány: a Cradle to Cradle Certified minősítés eredete, módszere és üzleti alkalmazásai

A körforgásos gazdaság az utóbbi időben jelentős érdeklődést váltott ki a vállalati és a tudományos körökben, mint a gazdálkodási és környezetvédelmi kérdések egy újfajta megközelítése. Ez a koncepció elsősorban a pazarlás és a hulladékképződés csökkentését és megszüntetését célozza, ugyanakkor a termelés és a fogyasztás során az erőforrás-felhasználás optimalizálását és minimalizálását is magában foglalja, valamint a jelenlegi, ún. lineáris gazdaságot egy körforgásos, zárt láncú rendszerre kívánja alakítani, ahol az anyagok, alkatrészek és termékek egy tervezett és biztonságos rendszerben hasznosulnak újra.

Azon vállalatok számára, melyek tevékenységükkel, folyamataikkal, termékeikkel vagy szolgáltatásaikkal körforgásossá kívánnak válni, kulcsfontosságú feltétel, hogy nemzetközileg elfogadott szabványokat és mérőszámokat alkalmazzanak, amelyek hiteles és összehasonlítható adatokat szolgáltatnak e vállalkozások körforgásos teljesítményéről. Az egyik ilyen körforgásos szabvány a Cradle-to-Cradle Certified®, mely a biztonságos, körforgásos módon és felelősségteljesen készült termékek globális tanúsítványa. A cikkemben bemutatom ennek a szabványnak az eredetét, módszertanát és főbb jellemzőit, valamint ismertetem az elsődleges empirikus kutatásomat, melyet a Cradle-to-Cradle Certified® tanúsítványt már használó vállalatok körében végeztem. A kutatásom fő célja a szabvány használatához kapcsolódó menedzsment és üzleti alkalmazások és tapasztalatok feltárása.

Kulcsszavak: fenntarthatóság, körforgásos gazdaság, szabványosítás

JEL-kódok: L15, M14, Q01, Q50

Introduction

The circular economy (CE) is a relatively new economic, business and technology concept which emerged at the beginning of the 2010s and has attracted significant attention in the past decade, especially after the publication of the Ellen MacArthur Foundation's series of report (*Towards the Circular Economy 1, 2, 3, 2012*). I am not going to elaborate on the introduction of this concept now, as this is not the objective of my paper. The relevant literature is vast and growing and one can find several books, papers and reports on the origins, tenets, objectives and the practice of this economic and social paradigm. I only name some which I consider useful to understand

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the CE, for instance : (Geissdoerfer et al., 2017; Rutkowska–Sulich, 2021; Morsetto, 2020; Nikolaou et al., 2021; Stahel, 2020; Weetman, 2021). It is important to emphasize although the CE is a new concept, it builds on earlier economic, business and technology theories and practices. In a way, CE is a conceptual synthesis and further development of various environmental ecology and green design concepts and theories like the industrial ecology (Graedel–Allenby, 2003), the performance economy (Stahel, 2010), the biomimicry (Benyus, 2009), the cradle to cradle design (McDonough–Braungart, 2002) or the blue economy (Pauli, 2017).

I am convinced that the CE can provide an economic and business framework and tool for a sustainable economic and social system, provided the necessary macro- and microeconomic metrics, standards and regulations are established. Circular standards are indispensable tools to design, verify, compare and create trust for circular products and materials that are safe for the environment and health, as well as can be reused or recycled. Therefore, in my research I chose a special circular economy standard, the Cradle to Cradle Certified (C2CC) which was developed about 15 years ago and is regarded as a trusted and demanding certificate by companies and experts. In this paper first I present the different metrics of the CE, then I follow with the discussion of the main objectives of the cradle to cradle design concept and its standard, the Cradle to Cradle Certified and its standard methodology for the certification process. Subsequently, I provide a brief literature review on the C2CC product innovation management, followed by the presentation of my primary research results which focused on analysing the product innovation process and the ensuing business and management implications and lessons through an empirical study with 13 manufacturing companies having already one or more C2CC product certifications. Finally, I sum up the results of my research and draw some conclusions.

Metrics in the circular economy

With the emergence of the CE concept, companies in the production industries have been increasingly seeking to operationalize it into their product and process design, internal operations, value chain management and business models. Since this concept is a relatively new and still not a precisely defined economic, social and business term with 114 definitions (Kirchherr et al., 2017), companies which intend to become ‘circular’ – either through product development or through their entire operations – often struggle to find the right methods, tools or metrics which are reliable, comparable and operationalizable. At present no standardised metrics yet exist to measure the performance of businesses in their circular economy transition (Verstraeten-Jochemsens, Jacco et al., 2020), but there are several circularity metrics available on the market companies can choose from. The best-known metrics are the Circularity Assessment Tool (*Circularity Assessment Tool*, 2017) by Circle Economy launched in 2017, the Circular Transition Indicators (*Circular Transition Indicators*, 2017) by the World Business Council for Sustainable Development (WBCSD) launched in 2020, the Circulytics (*Circulytics*, 2020) by the Ellen MacArthur Foundation, launched in 2020, the Circelligence (*Circelligence*, 2020) by the Boston Consulting Group, launched in 2020, the GRI 306: Waste 2020 Standard (*GRI 306: Waste 2020 Standard*, 2020) by the Global Reporting Initiative and finally the Cradle to Cradle Certified which I present below in detail.

Verstraeten-Jochemsens et al. (Verstraeten-Jochemsens, Jacco et al., 2020) made a categorization based on the type of indicators these circular metrics are primarily focusing on. According to this categorization there are three type of circularity indicators:

- Headline indicators.
- Performance indicators.
- Process indicators.

Headline indicators show the current state of circularity of the company, product or sector. Typical headline indicators include the circularity of a value chain expressed in percentages or the amount of resources consumed per unit of revenue generated. Performance indicators

give a picture on how a company performs on the parameters that directly influence the headline indicators. These type of indicators can be the waste generated within each step of the value chain, the share of secondary resources used within the organisation's production processes, a recycling rate of a product, or share of the renewable energy. Process indicators focus on the progress of the circular transition process, like share of circular products in the portfolio, customer attitude towards green/sustainable products or the awareness of the employees.

According to this categorization, the C2CC certificate is a standardised metrics that focuses primarily on performance indicators. It requires sharing data and outcomes, where third party support is required (through accredited assessors) and extensive tooling, resources are available. Now let's have a closer look at this particular circular metrics and the idea which inspired it.

The Cradle to Cradle concept

The Cradle to Cradle Certified certificate had evolved from the joint work of William (Bill) McDonough, an American architect and Prof. Dr. Michael Braungart, a German chemist and process engineer who wrote the book *Cradle to Cradle: Remaking the Way We Make Things* in 2002 (McDonough & Braungart, 2002). The book had a huge success because it described in a plain language what went wrong with the way we design and use our man-made products and how we could use the example of nature to fix it. The book's ideas and suggestions have gradually turned into practice, and in the past twenty years lots of products, processes or even entire cities have been based on the Cradle to Cradle principles, like for instance in the city of Venlo, in the Netherlands. The main tenets of the Cradle to Cradle (C2C) concept are:

- Waste equals food (i.e. there is no waste, everything is a nutrient).
- Use current solar income (i.e. energy and material resources are used only to the extent that they can be regenerated).
- Celebrate diversity (i.e. species richness, cultural diversity and innovation).

According to C2C it is highly important to differentiate between biological and technical cycles. In the biological cycle products, components and materials are biologically degradable and can be safely returned to nature, while in the technical cycle products, components and materials are moving in closed loops through several cycles without downgrading (Braungart et al., 2007) (See *Figure 1*).

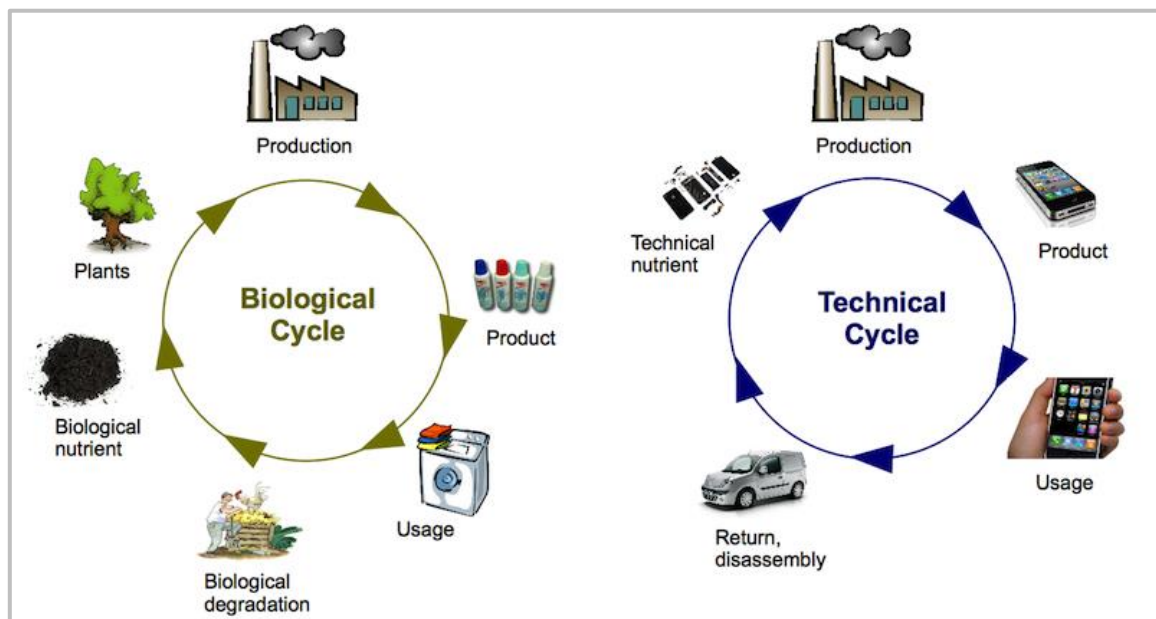


Figure 1: The biological and technical cycle according to the C2C design

Source: <https://www.innochem-online.de/en/about-us/cradle-to-cradle/index.html>

It is also crucially relevant in the C2C concept to design products that are capable for perpetual cycling in the biological and technical cycles and the used components and materials do not contain human or environmental toxic substances or contamination. Therefore, material toxicity should be strictly identified and safe alternatives have to be developed (Schmitt–Erik, 2022).

The C2C book also introduced the idea of eco-effectiveness as an alternative design and production concept to the strategies of zero emission and eco-efficiency. While eco-efficiency and zero emission seek to reduce the unintended negative consequences of processes of production and consumption, eco-effectiveness is a positive agenda for the conception and production of goods and services that incorporate social, economic, and environmental benefit. Eco-effectiveness moves beyond zero emission approaches by focusing on the development of products and industrial systems that maintain or enhance the quality and productivity of materials through subsequent life cycles (Braungart et al., 2007).

The Cradle to Cradle Certified

In 2010 the Cradle to Cradle Certified (C2CC) was introduced as a global product design standard and has been continuously developed in the past 12 years. Currently version 4.0 is used in the certification process (*Cradle to Cradle Certified Version 4.0*, 2021). The C2CC product standard is a circular product design certificate which assesses the safety, circularity and responsibility of materials and products across five categories of sustainability performance. These five categories are: material health; product circularity; clean air and climate protection; water and soil stewardship; and social fairness. Material health means preventing technical contamination by banning substances of concern (SoC) which are considered on scientific grounds carcinogenic, mutagenic or reprotoxic. In order to comply with these requirements companies have to specify all material content above the 100-ppm (parts per million) threshold with reference to the Chemical Abstracts Service (CAS) number. Product circularity enables the cycling of the products through regenerative product and process design. Clean air and climate protection cover the promotion/use of renewable energy, and the reduction of harmful emissions. Water and soil stewardship refer to the safeguarding of clean water and healthy soils and finally, social fairness means respecting human rights and contributing to a fair and equitable society.

The C2CC has five performance levels of achievement and each certified product is awarded the lowest achievement level out of the five categories. A product receives an achievement level in each category — Basic, Bronze, Silver, Gold, or Platinum — with the lowest achievement level representing the product’s overall certification level (*Figure 2*).

QUALITY CATEGORY	BASIC	BRONZE	SILVER	GOLD	PLATINUM
MATERIAL HEALTH				✓	
MATERIAL REUTILIZATION			✓		
RENEWABLE ENERGY & CARBON MANAGEMENT		✓			
WATER STEWARDSHIP			✓		
SOCIAL FAIRNESS				✓	
OVERALL CERTIFICATION LEVEL		✓			

Figure 2: The Cradle to Cradle Certified product scorecard, showing a Bronze achievement level

Source: <https://www.c2ccertified.org/get-certified/levels>

The certification process takes place with the involvement of an accredited certification assessment bodies which are private consulting companies or institutions in Europe and in the United States. These assessment bodies provide technical expertise and support in the product design and development process phase. Their role is crucial, because they are both a knowledge and an innovation trustee between the client and its suppliers handling confidential material information. The certification is a very complex and challenging process, which can take months or even years, since not only a new product design has to be developed, but all the different functions of the company needs to be involved and coordinated. Outside of the company the material and component suppliers are also closely involved in the process so that they comply with the strict C2CC material health and circularity requirements. This product innovation ecosystem network is orchestrated by the promoters inside and outside of the company. Hansen and Schmitt (Hansen & Schmitt, 2021) researched extensively this innovation management process in the case of Werner& Mertz company.

Currently (November 2022) the San Francisco and Amsterdam based Cradle to Cradle Products Innovation Institute – an administrator of the C2CC certifications – has a registry of almost 800 active certified products or product lines of more than 200 companies worldwide, out which 351 have Bronze, 251 Silver, 181 Gold and one Platinum level achievement certification.

Literature review

The application of C2C product design in product and process development by companies has been extensively studied by researchers in the past years and in the following I provide an overview of some of the literature. Hansen and Schmitt (2021) analysed a company from an innovation management perspective with regards to C2C product innovation. The authors selected a Germany-based cleaning material production firm (Werner & Mertz, better known for its Frosch brand) and which has several C2CC Gold certifications. The researchers' intention was to analyse how this company overcomes barriers through innovation communities, collaboration mechanisms and intermediation. The paper focuses on the process and implementation of a Cradle to Cradle Product Innovation (CPI) by applying a longitudinal embedded case study and identified eight collaboration mechanisms, promoters within and outside of the company (*Table 1*).

I would like to mention another interesting paper regarding Cradle to Cradle Product Innovation (CPI). Guldmann and Huulgard (2019) described the barriers to CPI and these barriers can be considerable which often make projects or organizations fail. These barriers to circularity are located on four levels:

- Individual barriers.
- Firm-level barriers.
- Value chain barriers.
- Institutional barriers include regulatory cons.

Individual barriers relate to the mindsets of the colleagues, employees within the company who either lack of commitment to understand and to promote CE thinking, or even sometimes resist to changes and can derail the whole process. Firm-level barriers can be the lack of project support from the top or the existing business models and production technologies are often designed for linear product concepts, therefore they can clash with the new, circular system. Value chain barriers are underdeveloped supply networks where suppliers are either unwilling or incapable of providing suitable materials or components. This can lead to changes in the supply chain which eventually can cause delays or disruptions in the process. The lack of customer awareness or insufficient information on CE products can also be a value chain barrier. Institutional barriers cover issues like regulatory constraints, lack of governmental incentives, or low prices of primary raw materials.

Table 1: The C2C promotor collaboration mechanisms to overcome individual, firm, value chain, and institutional barriers

Level	Collaboration mechanism				
	Name	Description	Active promoters	Facet	Barriers (examples) ^a
1. Individual	Providing perspectives	Sharing insights about what a closed-loop production system means in the C2C context and further developing individual skillsets.	- Process, relationship & expert - Universal	Cooperative	- Restrictive mindset - Lack of competences
2. Firm	Getting the power	Addressing higher management levels to gain support for circular innovation projects.	- Universal	Cooperative	- Lacking strategic alignment - Missing management support - Lack of in-house resources - Higher costs of C2C materials
	Synchronizing circular knowledge	Aligning circular knowledge through cross-functional and interorganizational collaboration.	- Process, relationship & expert - Universal - Power - Process	Cooperative	- Lack of or divergent knowledge - Unfitting organizational structure - Functional silos
3. Value chain ^b	Trusteeing of product formulations	Coordinating NDA-secured information sharing of material compositions to achieve required material transparency in the value chain.	- Process, relationship & expert	Coordinative	- Lack of information on material composition and SoC - Fear of IPR infringements
	Developing or replacing suppliers	Sharing knowledge with suppliers to develop their circular capabilities. In case of lacking cooperation in the innovation project, components are omitted or suppliers replaced.	- Universal - Process, relationship & expert	Cooperative	- Absence of C2C conform materials and substitution options - Supply chain inertia - Lack of knowledge in value chain - Contamination of recyclates
	Partnering up for material recovery	Building partnerships with organizations to recover and reprocess products and their inherent components and materials with the goal to keep them circulating in the same value chain (i.e., closed loops).	- Universal - Power - Process, relationship & expert	Cooperative	- Unavailability of quality recyclates - Immature supply/recovery chains - Cost optimized global value chains - Rigid retail specifications and perceived consumer expectations
	Certifying products	Coordinating the verification of overall product compliance with all C2C certification criteria; the resulting quality label informs customers.	- Process - Process, relationship & expert	Coordinative	- Lack of information on SoC - Lack of customer awareness/ acceptance
4. Institutional	Advocating circularity	Advocating favorable framework conditions regarding CE with regulatory bodies and self-regulatory standard-setting bodies.	- Relationship	Cooperative	- Existing regulation favors linearity - Low prices of primary raw materials

Source: Hansen and Schmitt (2021)

I used these two papers' results in my own primary research which I present in the following.

The primary research: online interviews with C2CC companies' executives

The applied research method

In order to get an insight into the actual management, experiences and lessons from applying C2CC, I decided to conduct semi-structured online interviews with the company owners, executives and managers of thirteen companies. These companies are all small and medium sized companies (with an exception of a foundation) operating in various industries based in five European countries and the US, while having a worldwide subsidiary, supply and commercial network. The contacts to these interviewees were provided by Mr. Albin Kälin, the owner and CEO of EPEA Switzerland GmbH, a C2CC accredited assessment company based in Bäch, Switzerland. The online interviews were semi structured, taking in average for about 1,5 hours between February and April 2022. Besides the interviews, I gathered information on these companies from their company websites or from relevant articles, reports or studies publicly available on the internet. This primary empirical research is part of a larger research project as the objective of my doctoral dissertation which will seek to assess and describe the business applications of the C2CC and other circular metrics and standards. In the following, I sum up the main findings and conclusions of my own research according to some main themes I considered relevant. The quotes from the interviews are in quotation marks without names, so the actual interviewee cannot be identified. In *Table 2* an overview of the interviews is shown.

Table 2: The list of the interviews

	Companyname	Industry	Country (HQ)	C2CC product(s) and achievement level	Interviewee's name	Interviewee's position
1	Bauwerk Parkett AG	Parquet and flooring	Switzerland	Silente parquet (Gold)	Christian Steiner	Sustainability Management and Circular Economy
2	Calida Holding AG	Textile	Switzerland	100% Nature (Silver)	Tietje Voss	Director Operations & IT
3	Knauf Gips KG	Building materials	Austria	Acoustic ceilings, tiles, plasterboard systems (Bronze, Silver, Gold)	Dr Willibald Neuherz	R&D and Certification Manager
4	Lanz Natur AG	Cosmetics	Switzerland	'No excuses' (Gold)	Karin Lenz	Owner and CEO
5	Lucart Spa	Paper, consumer hygiene care	Italy	Tissue and air-laid products (Bronze)	Philippe Desmartin	Quality Manager
6	OceanSafe AG	Textile technology	Switzerland	OceanSafe fabrics (Gold)	Matthias Fuchs	Chief Marketing Officer
7	SENS eRecycling Foundation	Recycling	Switzerland	No C2CC product	Roman Eppenberger	Technology and Quality Manager
8	Stefan Hungerentrepreneur	High-tech outdoor products	Germany	Bayonix drinking bottle (Gold)	Stefan Hunger	Owner and Managing Director
9	USM Haller AG	Furniture	Switzerland	Shelving and storage system (Bronze)	Dr Thomas Dienes	Product Development Director

	<i>Companyname</i>	<i>Industry</i>	<i>Country (HQ)</i>	<i>C2CC product(s) and achievement level</i>	<i>Interviewee's name</i>	<i>Interviewee's position</i>
10	VF Corporation	Apparel and footwear	USA	Napapijri (Gold)	Paolo Pezzin	Senior Raw Material Manager
11	Vögeli AG	Printing	Switzerland	Pureprint products (Silver and Gold)	Markus Vögeli	Owner and CEO
12	Werner & Mertz GmbH	Cleaning and care	Germany	Frosch (Gold)	Andreas Brakemeier	Head of Research and New Technologies
13	Wolford AG	Textile (skinwear and legwear)	Austria	Legwear products (Gold)	Andreas Röhrich	Global Director R&D and Sustainability

Source: author's work

Backgrounds and motivations

Before these companies had decided to apply for C2CC for one or more of their product(s) many of them already had various environmental or sustainability standards or product eco-labels, like ISO 14001, EMAS, EU Ecolabel, Oeko-Tex, Blau Engel, etc., but some had no experience with such certifications at all. In general, all interviewees emphasized their companies or its owners' strong commitment and personal dedication to sustainability and environmental consciousness ("Having a product without leaving any trace on the world."). The motivations for acquiring C2CC were diverging: some of them encountered problems with their materials or components from environmental point of view and wanted to make sure that their products only contain 'healthy' (i.e. to humans and nature) materials ("We wanted to have a clean and safe product"). Continuous product development and innovation was also named as a key driver for some interviewees and since C2CC require fundamental change in the product design, supply chain management and business model application ("C2C is the best design for recycling"). Many interviewees regarded C2CC as a tool to measure in a scientifically based method their product improvement or use the certificate as a roadmap to evaluate their own development work. The reduction of raw materials, the use of secondary material and safe recycling of the product were also named as important factors when it came to deciding for applying C2CC.

Among the motivations for choosing C2CC, the business or financial considerations were less emphatic, and as we see later, it was difficult to quantify the direct ramifications for the company's business and financial performance. However, certain reasons, like fulfilling the clients' expectations, having stronger competitive edge, the public procurement or tender requirements were often mentioned as important drivers for the decision.

The certification process

As it was already mentioned, the C2CC certification is often a long and complex process, involving various functions of the company (product design and development, operation, marketing, sales, etc.) and external stakeholders (suppliers, costumers, assessor). During my interviews I asked the interviewees to describe their experiences regarding the process, how they found it, what were the main challenges and the lessons learned.

The answers diverged again, as some companies had no prior experience in any certification ("It was like flying blind"), while some found the process quite smooth and straightforward. The experiences also reflected the targeted certification achievement level, since the higher levels (Gold, Silver) require deeper and stricter requirements for the all five quality categories (material health, material circularity, etc.). However, there was a consensus that out of

the five quality categories, the material health and material circularity proved to be the most challenging for the companies.

The co-ordination with the (material or component) suppliers also proved critical: the lack of trust or cooperation from the suppliers often resulted in rupture of business collaboration and finding new partners. The sensitive or incomplete information on materials or components from the suppliers made the active involvement of the assessor company often indispensable, who acted as a third-party trustee under a strict confidentiality agreement. This corresponds with the main observations of Hansen and Schmitt (2021).

It is also interesting to mention, that the creation of a product development platform (in case of a textile company) involving relevant stakeholders (university, research institute, government innovation agency) proved to be rather useful and could be replicated in other cases.

Business and financial implications

There is less empirical data on the business management and market implications of the use of C2CC, therefore I wanted to get an insight into this area during the interviews. As it was already mentioned above, in most of the cases the business and financial considerations were less relevant when decisions were made to get C2CC, but the product material health improvement, environmental concerns and personal motivations played a more decisive role in the decision. However, in no case did I witness any concrete return on investment calculation on the certification process's direct and indirect costs, but it was mentioned that the retail price of the product had to be increased in order to maintain the expected margin ("The price issue is crucial and it is getting more difficult with the growing energy and raw material prices"). The direct costs are the fees to be paid for the assessor and the certification body (Cradle to Cradle Products Innovation Institute), while the indirect costs are the new materials required for the certified product, the marketing costs and internal human resources costs (man hours).

It was mentioned by only one interviewee that the C2CC product had not delivered the financial success they had expected. As a consequence, for the company's existing products or product lines, a potential threat was also brought up: the cannibalization. Meaning that a new, circular product with a strong marketing and positive environmental features can offset the consumer demand from similar, but linear product(s) of the same company.

Product innovation management

One of the main messages of successful C2C product innovation that without support and engagement from the top (CEO/top executive(s) or owner) no real change can be implemented. (Hansen–Schmitt, 2021) This process requires a visionary and future-oriented attitude and personality in order to get the buy-in from the various functions within the company which can be difficult or sometimes even impossible due to resistance or low motivation. The C2CC and the eco-effectiveness a complex technical standard and concept and make them simple and translate them into the language of different company functions is a real challenge. It is often the role of a designated sustainability professional to educate, engage and convince the stakeholders internally, but externally as well. This role needs deep understanding of the C2C concept as well as dedication and perseverance. One interviewee complained that despite a successful product innovation and certification, the sales team did not buy-in the idea of selling a long-lasting, reusable and recyclable, environmentally friendly product, because they were too focused on high volume sales (linear mindset). But if all the functions' key managers understand this new mindset and see the benefits of the circular, C2CC product, then they will have a new business language which makes improvements in the future much easier. ("Since the certification the company speaks C2C.")

Business model considerations

A new, circular product will not only bring better environmental and health performance, but eventually can have an impact on the business model the company applies. This can be one or more classical circular business models (CBI), described by (Colombo et al., 2021) (De Angelis, 2018). When I asked the interviewees about the possible business model changes the C2C certification brought, in most of the cases they did not mention fundamental consequences with regards to the business model.

However, there were some interesting cases for considerations. For example, although the lifecycle mentality was an important feature of the CE, the re-collection of used bottles (or packaging) was ruled out by a company, because of the logistical challenges and transportation costs. An organization specialized in the recycling of electronic devices eventually turned down a C2C product development plan for a major international coffee machine manufacturer, because of the price competitiveness issues, while an international paper producer company managed to close the loop by recycling toilet papers. The product life extension has been applied by a garment company (for jackets), but renting them did not seem feasible for the time being. The take-back system was also mentioned in some cases: the drinking bottle company offered a 15% discount on a new bottle when an old product was returned, and a lingerie producers also used a discount system in their shops in exchange for used own products (to be recycled).

Metrics and indicators

Making a circular product and process development or measuring a company's circularity achievements has to be measured by a reliable and comparable metrics or indicator. (Pigosso & McAloone, 2021), (Lewandowski, 2016). This is why I asked the interviewees whether they use or intend to use such metrics or indicators. Many of the interviewed companies had already measured their environmental performance, waste (microplastic) emissions, water and chemicals use or carbon footprint before introducing C2C Certified. Life cycle assessment (LCA) was often mentioned as a useful tool to measure the environmental impact of the C2CC products to non-certified ones through the whole product cycle. In the textile industry the HIGG Index was often quoted as a relevant and standardized tool to measure value chain sustainability. One company already use a circular metrics (Circularimeter) to measure circularity and the KPIs (key performance indicators), but no other interviewee mentioned the application of a circular metrics other than C2CC.

Summary and conclusions

In my paper I described the background and main objectives of the cradle to cradle design concept and its standard, the Cradle to Cradle Certified certification. I showed how the standard methodology builds up and the certification process works. I provided a brief literature review on the C2CC product innovation management. In my own research I gave an overview on the result of the interviews with thirteen interviewees of companies which had acquired (or intended to acquire) C2CC certification.

For all the companies the C2CC certification and design thinking was very helpful to better understand what materials and components they use in their products and how they can design circular and healthy products. The certification was also a useful tool and support in their overall sustainability efforts and in reaching these goals. In the product innovation management phase, the strong collaboration and trust with the suppliers and other stakeholders (customers, partners) proved to be of paramount importance. The use of other circularity metrics is very limited by these companies and still there is no really credible and comparable

standard on the market. If there is no support and understanding within the company from all the functions, then the best product C2C design will ultimately fail or will be suboptimal. Therefore, getting the buy-in and involving and informing all the functions internally are critical. Similarly, if the customers do not understand the new product and its circular features then they are not willing to pay extra price, so well explained and targeted information towards them are essential.

My research – although only included twelve companies and one foundation- provided some interesting results and conclusions, but has its limitations. The interviews gave a general insight into the issues I considered important, but were not capable for digging deeper into the precise understanding of the phenomena. The thirteen interviews are statistically not significant to draw a general conclusion and these companies were not selected on a representative sample basis either.

This was my first research in this subject, which I intend to widen and deepen in the future with other companies applying C2CC certification. I also intend to focus more on the business economics aspects of this standard in order to explain and show for managers and scholars how to implement a successful C2CC product innovation management. Comparison and study of similar circular and sustainability standards and metrics with regards to the business implication will also be the part of my future research.

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