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Service Design as a Sustainability Assessment Approach for Circular Business Models

Case: Assessment of Finnish circular companies' business models from the service design perspective

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Abstract

Climate changes, overpopulation, resources overuse and ecological catastrophes require companies to embrace a circular economy and improve existing circular business models (CBMs). Due to their novelty, CBMs have been critiqued concerning their sustainability input at the company level. This paper contributes to the conference theme and session by assessing existing CBMs' sustainability using alternative sustainability assessment approach service design (SD) in three areas: innovation, which is crucial for sustainable business development enabling greater sustainability of CBMs; sustainable customer experiences on a human level allowing progressive organisational sustainability, and transparency in companies' internal and external processes indicating high sustainability processes area. A pilot study assessed 16 Finnish companies with four CBMs in seven industries to answer *how sustainable are CBMs across different industries when adopting SD as a sustainability assessment approach?* The author completed an assessment at the university SD educational process for professionals. It consisted of CBMs analysis adopting various design tools and a redesign conducted at the virtual workshop. Results revealed high sustainability performance in groundbreaking technological innovation (n=8) reinforced with innovative CBM (n=6) and limited sustainability performance in all other areas: limited customer-oriented services and poor user experiences (n=2), unfamiliarity with customer needs (n=9), haziness in the service life cycle (n=6), supply chain (n=4), value chain (n=5), and waste management (n=6). Therefore the short answer to RQ would be that pertinent CBMs are sustainable partly. Finally, the study demonstrates promising results when adopting SD as a sustainability assessment approach; however, the author recommends using other established procedures.

Keywords

circular business models, service design, sustainability assessment, transparency, business innovation

1. Introduction

Climate change, limited resources, overpopulation, and the predominant *take-make-waste* economic principle requires the transition toward circular business models (CBMs), which have been in the Nordic countries since 2015 (Kiørboe, 2015). A circular economy (CE) breaks with the linear use of virgin material resources and transitions towards the economy, which is less dependent on raw materials extraction and more focused on minimising waste (de Wit et al., 2018: p.14). CE currently undertakes only 9.1% of the global economy (de Wit et al., 2018); however, strengthened by pertinent business models (BM), political support, and societal pressure, the CE will become dominant by 2050 (Enkvist & Klevnäs, 2018.).

Companies must adopt CBMs to remain competitive in the market and resilient in uncertain futures. Businesses adopting a CBM benefit from higher resource productivity, reduced resource dependence and expanded growth. They can increase competitiveness and employment and increase innovation (Harmaala 2021). Next, have a more efficient supply chain that recovers or recycles the resources used to create the products, reduces the impact on the environment, lowers operational waste, and uses resources more efficiently (Atasu, Dumas & Van Wassenhove, 2021). However, companies must radically change their internal cultural values to achieve healthy growth (Stoknes, 2021).

Many definitions of 'sustainability assessment' exist depending on the assessment process, subject of assessment, and expected assessment outputs (Therivel, Wilson, Thompson, Heaney & Pritchard 1992; Devuyst 1999). Then, the ones that contribute to the change toward a more sustainable society (Devuyst, 2001) and those that propose alternative concepts definitions of sustainability assessment titled 'assessment for sustainability ' (Pope, Annandale & Morrison-Saunders, 2004). According to Bond, Morrison-Saunders & Pope (2012), a present framing of an impact assessment of sustainability assessment focuses on delivering current and future positive impact. Therefore, it could direct any type of decision-making, profoundly diverse in its form. Bond et al. (2012) believe that sustainability assessment is still in the expansion phase. Along with Bond et al.'s (2012) notion author selected Verheem's (2002) definition of sustainability assessment stating, *"The aim of sustainability assessment is to ensure that ''plans and activities make an optimal contribution to sustainable development*". Although this definition is generic allows the development of no standard sustainability assessment.

The author identified constructive critiques concerning CBMs' sustainability in BM literature. Despite the many benefits of the CE, like service-oriented BMs that can up to 90% reduce environmental impact (Tukker, 2004); however, companies are behind in developing more sustainable business models (SBM) (Ritala, at., 2018). Baumgartner & Rauter (2017) call for tangible strategies and clear guidance in assisting companies in implementing their sustainability initiatives more concretely. The evidence of CBMs' ecological impact is limited (Bocken, Schuit & Kraaijenhagen, 2018). In this pilot study, the author focused on three CBMs' sustainability performance limitations extensively exposed in the SBMs' academic literature:

1.) CBMs' innovation for sustainable development: Schaltegger, Lüdeke-Freund & Hansen (2012) argue that BMs innovation must assist a systemic, ongoing formation of sustainable business cases. Innovation is a subject of SBMs' economic, social and environmental value creation improvements (Rauter, Zimek, Baumgartner & Schöggl, 2019); therefore, sustainable assessment is required to evaluate SBM's innovation to improve these areas. Furthermore, Guldmann & Huulgaard (2019) reported companies'

insufficiency in incremental product and process design improvements to attain sustainable development. Again, current resource consumption and waste generation are unsustainable, resulting in the ecological system's degradation; therefore, a more radical innovation of business operations is needed to result in long term sustainability requesting more sustainable business offerings (Bocken, Short, Rana & Evans, 2013; Boons & Lüdeke-Freund 2013).

2) Customer experiences are increasing sustainability in CBMs: Two years after the Paris agreement, Jain, Aagja & Bagdare (2017), in their customer experience research agenda, emphasised exploring customer experiences concerning social issues, quality of life and sustainability. Signori, Gozzo, Flint, Milfeld, & Satinover-Nichols (2019) stated a new connection emerging between sustainability and customer experience themes; however, it lacks a theoretical foundation. Furthermore, the authors recognised businesses' actions toward sustainable customer experiences; however, better-planned touchpoints could improve businesses' efforts and sustainable communications toward customers, refine strategies and move toward stronger collaborative SBMs by including customer experiences thoroughly. Besides, companies with CBM have limited transitions towards sustainability, omitting user practices, market policies and regulations (Nußholz, 2017; Gaziulusoy & Brezet, 2015; Bradey et al., 2020).

3.) Service life cycle, value and supply chain, and waste management transparency in CBMs: Researchers state that CBM placement in the business logic of Anthropocene resembles incremental rather than fundamental change (Hofmann 2019; Kennedy & Bocken 2020) and leaves significant production and consumption operations challenges unsolved (Boons & Lüdeke-Freund 2013). Moreover, CBMs remain associated with challenging processes and their ecological and social impact, and behaviour change remains unknown (Hofmann 2019; Bocken et al. 2014; Boons & Lüdeke-Freund 2013). Companies with resource efficiency and recycling CBM remain dependent on companies creating waste to collect, sort and transform it into secondary raw material (Tamminen et al., 2020). Nowadays, organisations are requested to improve supply chain transparency to meet regulatory requirements, optimise operations, guarantee high-quality products and ensure sustainable processes (Montecchi, Plangger, & West, 2021). Zhang, Huang, Wen, Pooja, & Shanmugan (2021) exposed CEs' challenging factors like cooperation, trust and transparency required to achieve sustainable outputs, sustainable growth collaboration and cross-organisational openness within networks and value chain. Furthermore, according to Vegter, van Hillegersberg, & Olthaar (2020), to evaluate sustainable business strategies is necessary to measure the concrete performance of all processes in the CBM supply chain.

Furthermore, Prendeville & Bocken (2017) state that radically new SBMs are a systemic driver of change in the industry. Design thinking, sustainable strategic development (Shapira, Ketchie & Nehe, 2017), and service design (SD) have recently become a research priority in business innovation as they can, with their methodological approach, ease a negative impact on the environment (Ostrom et al., 2015). Lee, Oh & Choi (2021) report that although interest in the SD principles or SD methodology application increased in organisations, research on the elements influencing organisational innovation and performance through SD is missing. SD, with its capabilities, can re-design companies' value propositions offerings to make the business economically viable again (Mager et al., 2020; Vink et al., 2021). Prendeville & Bocken (2017), stating that

'Service Design is *the process of planning and organising people, technology and material components to enhance the quality of interactions between customers and providers*.' (p. 293)

Harmaala (2021) states that earlier CBMs' studies have not used the SD methodology, despite being a customer-centric approach, crucial for product, service or BM innovation. Lee et al. 2021 state that

bringing customer experience value while adopting SD methodology enables the development of innovative SBMs, which are recently rapidly extending to private companies. Services being processes in their core; therefore, the SD field developed tools that evaluate, assess and investigate internal and external organisational services life cycle processes, with tools like customer service journey and service blueprint. SD establishes best practices for designing services by enhancing customers' needs and the service providers' competencies. The results are user-friendly services relevant to the customers while being sustainable and competitive for the service providers (ibid).

This paper contributes to the conference theme and session by addressing the research gap, which has not been covered yet, concerning the CBMs' sustainability performance in innovation for sustainable development, customer experiences in increasing sustainability and CBM's transparency of service life cycle, supply and value chain and waste management adopting SD as a sustainability assessment approach. The author believes that has SD the potential as a sustainable assessment approach. Therefore, a pilot study was conducted to answer the research question (RQ):

How sustainable are CBMs across different industries when adopting SD as a sustainability assessment approach?

To answer this RQ author conducted a pilot assessing 16 Finnish companies CBMs utilising the SD as a sustainability assessment approach. With the pilot, the author demonstrates the possibility of sustainability assessment of the CBMs with SD in three areas: CBMs' innovation, customer experiences and internal and external services production processes.

The structure of the paper is as follows: introduction to CBMs, literature review on utilising SD in assessing CBMs sustainability. Following the methodological part of the pilot study presents the research design, cases, methodological approach, and data analysis procedure. The paper concludes with the result section, discussion and conclusions.

1.1 Circular business models

A central point of the company is its BM. A BM is a framework where the idea is turned into a business. It describes how a company makes a profit through innovation and how capital is generated. Furthermore, the BM reflects the relationships between the different elements and thus enables the company's business logic modelling. The BM essential elements are infrastructure, supply, customer and cash flow. Sustainable development, business partners, ecosystem or co-creation, can also be added when required (Osterwalder & Pigneur, 2002).

SBMs and CBMs gained research interest (Dentchev et al. 2018) when the BM emerged as a new analysis unit (Zoot et al. 2011). Moreover, an SBMs entails a broader understanding of value and stakeholders since it *'captures economic value while maintaining or regenerating natural, social and economic capital beyond its organisational boundaries'* (Schaltegger, Hansen, & Lüdeke-Freund, 2016, p: 6). According to Linder & Williander (2017), CBM is a type of SBM (Adams et al., 2016) that integrates environmental and economic value creation by everchanging the business logic from generating profits from one-time sales goods to generating earnings from a frequent flow of reused materials and products over time (Bakker et al., 2014), and by capitalising on the embedded value in used products. Several different CBM classifications exist; in this pilot study, the author adopted Lacy and Rutqvist's (2016) classification, which distinguishes between five circular business models: 1) *circular supply chain* models, which utilise in their production recyclable materials, such as renewable and bio-based materials and energy, to increase recovery rates. Results are easy to repair modular products.; 2) *recovery and recycling* models that collect

and recover materials of end-of-life products, waste, or by-products, which reuse them in their production; 3) *product life extension* models that, with repair and maintenance services, extend the life of existing products in the market, and by upgrading existing components with newer ones improve product performance. Besides, *product life extension* models extend the product's life in the market by reselling them to second and third-hand markets or taking back the product and remanufacturing, restoring, or improving the original product's functionality or remarketing them with a lower price.; 4) *sharing-platform* models, which enable distribution of various products and assets (vehicles, industrial machinery) through co-ownership or co-access mechanisms.; and 5) *product as a service*, models that sell services rather than products, with offering customers to use a product on a subscription basis against fees or usage-based charges, instead of owning it. Selected cases for the pilot study concern 2 to 5.

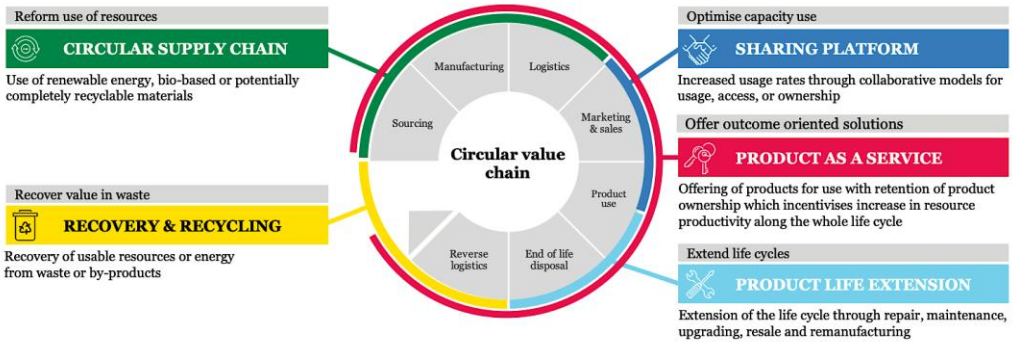

Figure 1. Classification of circular business models. Image source Sitra et al. (2019).

1.2 Service design

Services are critical in transitioning from an extractive *make-take-waste* economy toward a CE. They are inseparable elements of the product-service-systems and shared CBMs (Tamminen et al., 2020). Furthermore, services can unlock the full potential of CBMs with digitalisation and enable the development of radically new supply chain services (ibid).

A critical element in developing new circular services is the design approach, which can, with a problem solving methodological approach, reduce the impact on the environment by 80% in the first stages of the design process and 20% in the implementation stage (European Commission, 2021). The design has recently focused on investigating the transformative role of services to build a more sustainable and equitable society (Sangiorgi, 2010).

With the transition from the manufacturing to the service industry, companies began to adopt SD as an innovative performance approach, enhancing customer experiences and aggregate organisational efficiency (Lee et al., 2021). Lee et al. (2021) report that SD methodology and implementation are amplified in organisations; however, research looking at factors that affect organisational innovation and performance via SD were not. SD methodology considers SD aspects that enhance customer satisfaction, needs and business context that emphasise existing competencies (ibid). Furthermore, SD entails consistency and the implementation complexity between customers and businesses. SD applies approaches to assess customers, products, spaces, and communications processes that affect customers' experience when using the service. It evaluates processes, journeys, interactions, and systems used to conduct customer-centred experiences and capture the stakeholders' needs (Lee et al., 2021). Therefore,

SD can provide customers with holistic and valuable service experiences by addressing challenges through creative and collaborative design tools (ibid).

Lee et al., 2020 indicate that SD assists organisations in obtaining higher productivity by improving or innovating existing services to be more resourceful and operational. SD within the organisation develops strategies, proposes innovative service concepts and solutions, and changes the culture to a more customer than an organisation focused.

Although Schneider et al. (2011) define SD as a reiterative process that can design, assess, measure and redesign services, the author identified limited cases where SD was utilised as an assessment approach. Marquez & Downey (2015) used SD for service assessment and creation in the library environment. Harmaala (2021) adopted SD and BM innovation to develop, test and validate the new CBM. Bocken, Miller & Evans (2016), to assess the CBM environmental impact, developed and employed the rapid circularity assessment approach for evaluating the environmental impact of new CBM ideas. Hoffmann, de Simone Morais, & Teodoro (2020) utilised Life Cycle Assessment to assess the environmental performance of two different types of diapers. Finally, Lüdeke-Freund et al. (2017) propose a sustainability-oriented business model assessment (SUST-BMA).

Prendeville & Bocken (2017) state several synergies between SD and BM innovation. SD with a human-centred approach can foster behavioural change essential for developing SBM innovation. SD can create new concepts focused on value co-creation with an iterative process, resulting in meaningful and holistic customer experiences (Sierra-Pérez, 2021). SD enables value co-creation with various actors, stakeholders, decision-makers, and policymakers by understanding their needs, wishes, requirements, and context. SD utilises a set of tools: personas, customer service journey, service blueprints, storyboards, stakeholders map, experience prototyping in a co-design setting (Yu & Sangiorgi, 2014). Giga map, a rich picture and service ecology when dealing with complexity (Sustar & Mattelmäki, 2017). This way, SD can foster systemic innovation (Sangiorgi & Junginger, 2015) on the ecosystem level (Vink et al., 2021). Finally, positioning user experiences at its core can lead to innovative services, sustainable behavioural change and environmental sustainability (Sierra-Pérez, 2021).

2. Methodology

2.1 Design of research

The pilot sustainability assessment process lasted from April to June 2020 and from January to March 2021 and had two parts: the first part, the analysis of CBM with reporting and the second part, the redesign of CBM. In the first part, an analysed sample contained 16 Finnish companies with four different CBM, selected from the SITRA's website of Finland's circular companies (Sitra, 2020). Selected company cases were analysed as a part of an online introductory SD course for professionals at Aalto Open University. The second redesign part of the case companies' services happened at the virtual workshop adopting a circular venture template or Circularity Deck template (Konietzko, Bocken & Hultink, 2020). The qualitative data analysis had two stages: first, collecting qualitative data from the Blogger and study case by case utilising within-case analysis (Eisenhardt, 1989) to gain familiarity with the individual case data; and second, analysing collected text utilising cross-case pattern search using divergent techniques (ibid), to look beyond particular case by identifying categories of the prevailing themes and search for within *unique themes* for case similarities and differences.

2.2 Cases

The representative case selection of circular companies was made from the Finnish Innovation Fund - Sitra's website (2020) of the best Finnish circular companies (Eisenhardt, 2007). A selected set of cases consisted of 16 different Finnish companies from nine industries: transport, lightning, construction, renewable energy, textile industry, chemical, ecological composites, IT, and retail. The selected case companies' size spanned from start-ups in the early stages of their circular production (n=6), SMEs (n=5), to global enterprises (n=5). Selected companies had the following CBM: 1) *resource efficiency and recycling* (n=4); *product life extension* (n=3); *sharing platforms* (n=5); and *product as a service* (n=4) (for more info, see table 1).

Company code	Company Size	Established	First circular solution	Share of circularity in BM	Type of CBM	Production / service process	Industry
C3	local start-up	2016	2018	90%	Resource efficient and recycling	Turning industrial surplus materials into low carbon construction materials	Construction technology, Repurpose
C5	start-up	2016	2018	100%	Resource eficiency and recycling	Processing used alkaline batteries to produce fertalisers	Manufacture of basic non-organic chemicals
C6	start-up	2015	2017	100%	Resource eficiency and recycling	Composite products from recycled materials	Ecological composites
C12	medium - local	2007	2015	100%	Resource eficiency and recycling	Intelligent waste-sorting with robot	Waste-sorting technology
C1	start-up	2016	2016	100%	Product life extension	A marketplace for used smart phones	Resell
C13	medium / global	1944	no data	no data	Product life extension / Product as a service	Children clothes build to last	Textile retail
C14	medium	1997	1997	100%	Product life extension / Product as a service	IT equipment life-cycle, management as a service	IT equipment life-cycle management
C2	medium - global	2015	2016	100%	Sharing platforms	Mobility as a service	Transportation
C4 + C17	medium - global	2005	2018	100%	Sharing platforms / Product life extension	A cloud-based platform for worldwide leasing service of production facilities	Wholesale trade in metal product industry, Reselling
C7	medium - local	2003	2017	no data	Product life extension / Sharing platforms	Reselling second-hand products	Resale of military and outdoor equipment
C9	medium	2000	2016	0.25%	Sharing platforms	Rentable solutions for temporary needs	Internet services, Renting
C8	medium	1985	2014	30-40%	Product as a service	Lighting as a service	Lighting
C15	start-up	2014	2014	100%	Product as a service	Smart solar power systems as a service	Renewable electricity sales
C16	start-up	1981	2018	100%	Product as a service	Solar power	Energy services and energy production
C19	medium / global	2010	2017	50%	Product as a service	Compressed air as a service	Oil-less compressors for industry

Table 1: Overview of company cases.

2.3 Methodological approach

The case companies' CBMs sustainability assessment was conducted during three online SD courses for professionals with 2 ECTS at Aalto Open University, Finland. Alongside adopting a particular set of design tools in case analysis, for five weeks, professionals received lectures covering SD and CE, systemic design, strategic design, value co-creation, co-design, and human-centred design, experience design theoretical themes and explanation of two CE theories. Finally, participants also read a selection of supporting academic publications weekly.

The first sustainability assessment part aimed to understand the company's CBM and related products/services from different perspectives to identify possible improvements addressed in the virtual co-creative workshop. During the pilot study, professionals were divided into six groups with 3-4 members. Each group assessed one company case by adopting a set of design tools from system design (service ecology, stakeholder map), strategic design (Planet Centred Design tools by Vincit, strategy foresight), SD (persona, blueprint, customer service journey), experience design (customer service

experiences journey), and value co-creation (value mapping tool by Nesta). Furthermore, in the case assessment, professionals applied two theoretical models: the concept of planetary boundaries associated with CE strategies (Desing et al., 2020) and changing values in different economic systems (Brand & Rocchi, 2011). Participants reported their CBM sustainability assessment findings in weekly blog post assignments on a private Google Blogger website. The numerous implemented tools enabled assessment of the cases service life cycle, internal organisational processes from start to end, circular services back and front stage operations, communications with customers, the quality of customer experiences, customers' segments and companies' future strategic developments. Professionals gathered cases data from companies' websites, online sustainability reports, blog posts and social media. Some professionals contacted the companies but with limited success.

In the second redesigning services co-design workshop, companies' cases services propositions were redesigned. New SD concepts were developed at a 4-hour virtual workshop, adopting a redesigned circular venture template by IDEO or Circularity Deck template (See figure 4) consisting of five circular strategies at three different levels: product/service, BM, and ecosystem addressing identified issues in the analysis stage (Konietzko, Bocken & Hultink, 2020).

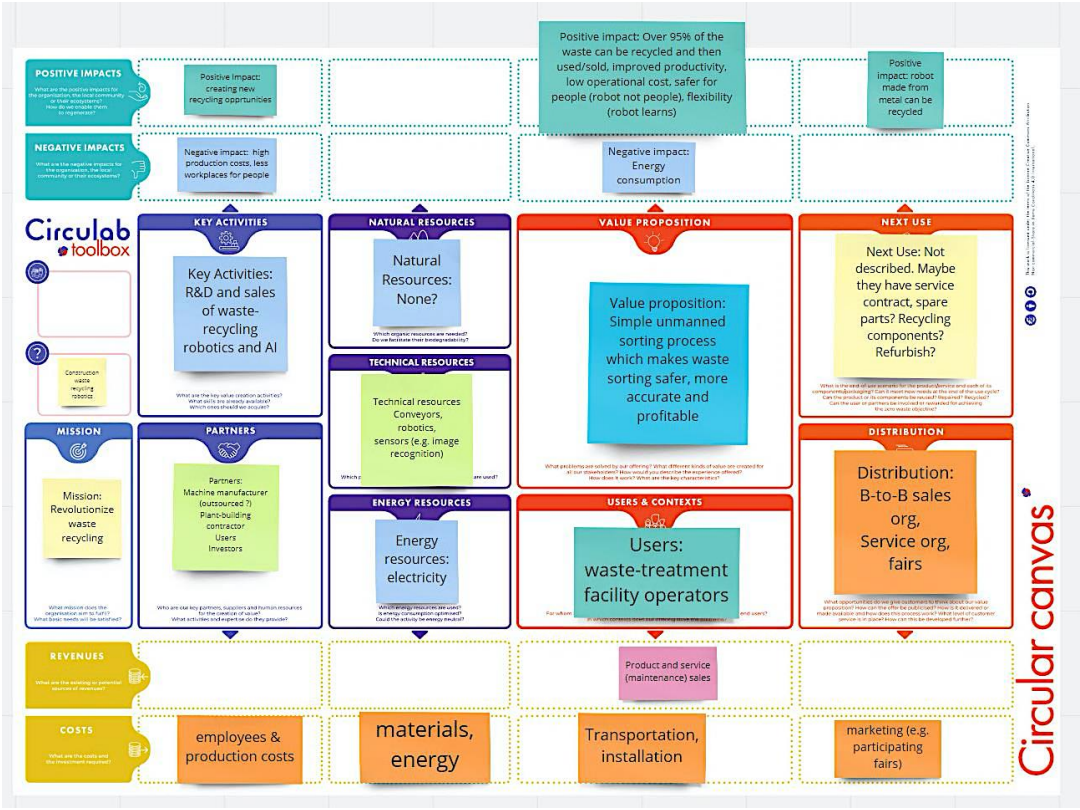

Figure 2: Example of a CBM template application when analysing the C12 company case.

First, products/services level innovation developed new products/service concepts propositions (for example, improving customer service experiences touchpoints). Second, business-level innovation redesigned companies' service offerings, including new CBMs proposals (for example, instead of selling lightning equipment, offer lightning as a service). Last, professionals proposed new collaborations and interactions on the ecosystem level to achieve better outcomes, such as asymmetrical collaborations of sharing experiences, data, and knowledge. Due to the limited pace author presents in the result section only the most relevant results concerning companies' CBMs.

2.4 Data analysis procedure

The data analysis procedure had the following stages: First, the individual case text was transferred from Blogger into Microsoft Word with belonging templates (Figure 2) and Excel tables excluding templates. This way, organised data-enabled within-case analysis and cross-case pattern search (Eisenhardt, 1989). Second, when analysing both text formats, *unique themes* were identified and transferred into the Mural – an online whiteboard application divided into three levels product/service, BM and ecosystem. Then, the author extracted the *neutral statements* and *positive statements* from the text and placed them close before identifying *unique themes*. Lastly, the *unique themes of SD concepts* were identified and placed on the Mural, following the *SD concepts* (see Figure 3). Mural enabled the cross-case pattern visualisation between different *unique themes* and *unique themes of SD concepts.*

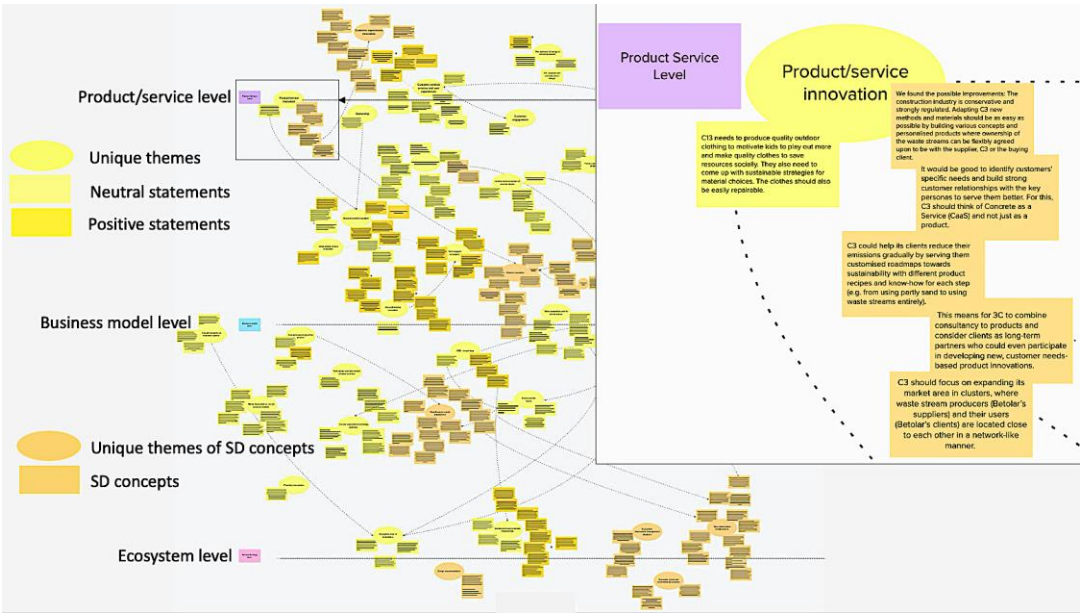

Figure 3: The cross-case pattern visualisation of *unique themes, statements* and *unique themes of SD concepts* and SD concepts placed in three levels.

3. The Results

This section reports results on three CBMs' sustainability performance themes exposed in the SBMs' literature, which the author aimed to validate in the pilot for the following reasons:

1. CBMs innovativeness is critical for higher sustainability performance (Schaltegger et al., 2012); furthermore, conceptual transformation and internal process improvement positively impact service innovation (Lee et al., 2021). Signori et al. 2019 claim that sustainability can be improved through innovation and explicit business functions. Adopting a sustainable strategy in the company can lead to competitive advantage and significant economic profit. Therefore, companies are increasingly adopting sustainability in their SBM. SD can improve existing and innovate services, which are more resourceful and operationally sustainable (Lee et al., 2021).

2. Customer experiences are crucial for increasing sustainability in CBMs (Signori et al., 2019). SD's ultimate goal is to provide holistic customer experiences (Lee et al., 2021), which can be systematically evaluated with SD tools. Sustainable customer experiences can create holistic value due to customer engagement resulting in sensation, feelings, reasonings and behaviours, arousing sustainable stimuli based on economic, social and environmental sustainability (Signori et al.2019).

3. Transparency of the company's internal (service life cycles processes) and external service processes (the supply and value chain, waste management) was selected due to SD's ability to visualise, assess and investigate internal and external organisational services life cycle processes with various SD process tools (Lee et al., 2021). Specifically, professionals highlighted these themes in terms of explicit low transparency and, therefore, a limited level of sustainability.

Furthermore, these themes provide a structure for companies' CBMs' sustainability assessment, specifically when adopting the SD approach. Moreover, professionals highlighted these themes as unique and provided neutral or positive statements when assessing CBMs' sustainability. Each *unique theme* is presented with subthemes and demonstrated with professionals' views from their blog posts.

1. Technological innovation

When considering technological innovation author followed Boons & Lüdeke-Freund's (2013, p:14) definition of when it is beneficial for sustainability performance:

"Thus, sustainable business models with a focus on technological innovation are market devices that overcome internal and external barriers of marketing clean technologies; of significance is the business model's ability to create a fit between technology characteristics and (new) commercialisation approaches that both can succeed on given and new markets."

Under this unique theme were identified the following subthemes:

1) The ground-breaking technological innovation of companies' products/services with high added value was identified in eight cases (C1, C3, C5, C6, C8, C12, C16, C19). To illustrate the results, professionals reported two exceptional companies cases, both with *resource-efficient and recycling* CBMs:

a) "*It seems that innovation is already an integral part of C5. A clean-tech C5 has a ground-breaking innovative product that solves landfill contamination by recycling alkaline batteries. The product is the only foliar fertiliser globally, made from used alkaline batteries appropriate to be used in organic farming. Farmers benefit from an environmentally responsible fertilisers alternative."*

b) "*C6 offers unique, patented technology for recycling mixed plastic waste and other hard-to-recycle waste streams. The company's unique patented technology allows multiple waste materials to be recycled and converted into new ecological composite products."*

2) Innovative CBMs reinforced with advanced technical innovation were recognised in six cases (C3, C8, C12, C15, C16, C19) where professionals noted companies' position as technologically leading innovators enabling companies to develop unique CBMs and service offerings, which have higher sustainability performance and user-friendly towards the customer C2B or B2B. To demonstrate,

a) "*C19 offers compressed air-as-a-service provided by environmentally-friendly air compressors. C19 invoice their customers based on usage, provide remote monitoring, and as the contract ends, machines*

are shipped back to the company to be maintained and re-used. C19 is the frontrunner in the industry, innovation, and infrastructure."

b) "*C16, with value-added service innovation, provides a complete solar panel service for customers who wish to cover their energy consumption with a solar panel on their roof. C16 remains the equipment owner and handles maintenance and production, while the customer pays for the photovoltaic power produced on its roof over a contract period. Later, the customer may purchase the power plant and continue to make solar power without any separate charges."*

c) "*C3, with resource-efficient and recycling, offers concrete-as-a-service. C3 uses geopolymer concrete from other industries, such as mining, energy, pulp and paper. C3 minimises the materials going into landfills and the materials used in conventional concrete. C3 products are created as a fit-for-purpose recipe for each customer. With a tailored product to the client's specific need, the C3 can maximise the product's secondary waste materials value and life cycle. The company's circular strategy reduces the demand for finite resources in concrete production. C3 licensing business model considers the planetary boundaries concept with maximising concrete manufacturing's resource efficiency and material innovation by prolonging the life cycle of their concrete products and offering aids from an environmental, economic, and social perspective.*"

3) Lack of product and SD when developing new products/services was explicitly seen in start-ups cases C5 and C6, both with *resource-efficient and recycling* CBM. Observing the company website, professionals state that C5 is not yet utilising SD thinking to its most potential. The lack of SD might result in non-transparent service/product value offerings in four cases (C3, C6, C8, C12). Professionals reported a positive C3 case where a service value proposition based on a CBM aimed to reuse waste streams and emissions in concrete production.

2. Customer experiences

Westin et al. (2022) state that recent quantitative and conceptual models have acknowledged relations between stakeholder perceptions of sustainable development, a company's brand image and customer satisfaction. Furthermore, Signori et al. 2019 recognise the need for a sustainable customer experience due to customers' requests for products and services concerned with economic, social and environmental sustainability. Furthermore, Jiang et al. (2020) findings indicate that sustainable practices improve customer evaluations of the service experience. Unfortunately, this was not the case in this pilot. Author identified:

1) Limited customer-oriented services and poor user experience were identified in two cases (C4, C7) *with sharing platforms and life extension* CBMs. Furthermore, companies were unfamiliar with their customers' needs in five instances (C3, C5, C6, C12, C13). Nevertheless, user-friendly experiences were identified in only three cases (C1, C4, C14) out of 16 analysed all three cases of *product life extension* CBMs.

To illustrate user-friendly experiences, a professional who tested C1's *product life extension* services reported a holistic online service experience: "*My overall service experience was outstanding, and I would highly rate C1's services as fast, with lower product prices and sustainable service process! What surprised me was how fast I could browse, search, decide, and purchase the phone. The whole process of buying a refurbished mobile phone took me less than 10 minutes. I received an ordered phone in less than 36h. The service was super convenient."* Nevertheless, on the C1 company website and social media, the sustainability aspect of C1's services in a broader context is barely acknowledged.

Lee et al. 2021 state that customer alignment relates to market positioning. The ability to address the customer's challenges and meet their needs can directly impact process improvement, customer loyalty, and corporate performance; however, this was not the case in this pilot.

2) Unfamiliarity with customers and their needs were identified in nine instances (C3, C4, C5, C6, C7, C9, C12, C13, C16). To illustrate, professionals reported

"The key to C9 benefit is to reach the end-user view to developing products that are more desirable and match products with the customer's needs. Empathy helps to understand the different stakeholders, and it also makes it easier to find the hidden customer needs."

C16 really aren't even interested in having more customers. For me, this looks like they don't care about customers; they seem to want to operate in B2B, and B2C might be something less interesting for them.

3) Limited marketing and communication companies' sustainability know-how was reported in three instances (C1, C4, C6). C6 has limited marketing skills, unclear service offerings, and no clear selling channels. Consequently, products are not targeted to environmentally aware markets. Moreover, C4 operates in the manufacturing industry, and its target groups are IT professionals and business leaders; therefore, C4 should emphasise innovative business ideas emphasising professionalism, accountability, and trustworthiness.

4) Limited sustainable value communication was identified in four instances (C4, C5, C8, C12). According to Viciunaite & Alfnes (2020), if sustainable companies incorporate sustainability information about their BM into their value proposition, like resources, activities, and partners, it can be for particular consumer segments to add value to the products and services offered by the company. Nevertheless, professionals exposed the C12 case:

"C12's business model is currently linear, and the company does not share their values. The business model could be switched to a service (Robotics-as-a-service) rather than a product. C12's website became evident that its communication is IT and product-driven. We started thinking about what alternatives they would have to change their communication towards sustainability and provide some new opportunities through storytelling."

5) Limited communication transparency with customers was reported with B2C customers in two cases (C4, C13), with B2B companies in five points (C3, C4, C8, C12, C13) and with B2S stakeholders in one (C12). To demonstrate, professionals wrote:

"How C12 might bring sustainability message across to the audience? For a company related to waste management, it is crucial to be transparent and publicly have the essential information on sustainability, especially for its customers."

3. Transparency of service life cycle, the value and supply chain, and waste management

In their research, Crenna, Gauch, Widmer, Wäger & Hischier (2021) suggest flexible and transparent life cycle processes concerning sustainability assessment within the current framework. They developed a life cycle for lithium-ion batteries, which has higher transparency in terms of better traceability of the data sources at different levels of detail. Nevertheless, when professionals assessed selected CBMs, they identified:

1) The haziness of the service life cycle process in six cases (C3, C4, C5, C8, C12, C13). To demonstrate the issue, professionals reported:

a) **"***C13 should hire a team assisting the company in following sustainable principles. Furthermore, C13 needs to document and share the manufacturing process, give relevant information to consumers at the right time, and have the resources to reply to customer queries."*

b) "*C5 product production and waste management strategy remain unclear. C5 describes and visualises the product development process on its website; holistic product manufacturing remains unclear for the farmer customer.*

According to Montecchi, Plangger & West (2021, p. 238), "*supply chain transparency is the practice of disclosing detailed and accurate information about operations and products, such as their origin and sourcing, manufacturing processes, costs, and logistics."* Furthermore, Montecchi et al. (2021) state that supply chain transparency is operational competence crucial for implanting sustainable principles in supply chain management. However, in the pilot, professionals reported:

2) The haziness of the supply chain in four cases (C3, C4, C8, C16). To exemplify, professionals pointed out that although the C8 is transparent on its energy consumption reduction and processes through their ISO certifications, C8 can significantly improve the transparency of the production supply chain with new lighting solutions, manufacturing process the lights, and the materials, chemicals, and suppliers used in the production process. Furthermore, to assess the C16 case, professionals adopted the sustainable design strategies tool focusing on reusability, recycling and equity (Acaroglu, 2017). They reported for the C16 case the following:

"Reusability: The production of solar panels is energy consuming and heavy on the environment, so we tried to find out whether C16 panels or solar panels, in general, are designed and produced to be reused. Are they long-lasting and efficient? Can they either be reused as panels or be disassembled into parts or smaller panels after their initial use? Do solar power plants contain other parts that could be reused? What happens to the panels after the contract period if they remain in use by the customer. Do they become waste, or are they recycled? How can the customer make the most out of the panels also in the future?

Recycling: Solar panels contain a large amount of non-renewable minerals such as aluminium, silver, lithium, tin, copper, silicon and nickel, just to mention a few. The worldwide production of solar panels is increasing rapidly […]. High volumes of new panels create greater demand for recycling technologies and end-of-life production development.

Equity: Solar panels are often produced in developing countries and require raw materials that are not always safely and fairly produced. Where are the raw materials produced and panels manufactured? How ethical and fair is the process from raw material to end product? Is solar power available to all in society? C16 *does not offer that much information on their production process online."*

Viciunaite & Alfnes (2020) emphasise that as the sustainability of some BM elements is often not seen by customers, the importance of incorporating the value BMs' segments into a value proposition; therefore, the product/service value chain must become more transparent and make pro-social and pro-environmental elements visible to consumers. Additionaly, Wrålsen, Prieto-Sandoval, Mejia-Villa, O'Born, R., Hellström & Faessler (2021) illustrate in several cases the importance of evaluating the product (batteries) value chains from a sustainability and transparency perspective to strive for circularity and

encouraging the design of CBM for product second use, improved recycling practices, and ways to eliminate waste, emissions, and pollution in the value chain. Yet, the professionals identified:

3) The haziness of the value chain in five cases (C3, C4, C6, C8, C13). Two of identified instances are illustrated below:

a) *"C3 value proposition is based on a circular business model aiming to reuse waste streams and reduce emissions in concrete production. However, C3 would need to increase the transparency of the value chain for the stakeholders and customers by displaying on the website customer references with facts and figures."*

b) "*C6 produces products from waste through its patented technology. Still, we lacked references and further information on how the technology works or how the three-year payback time has been determined.*"

4) Haziness of waste management during production and after use was identified in six cases (C3, C4, C5, C8, C12, C13). Only one company out of 16 has a closed loop of product manufacturing, use and recycling (C14). Professionals reported, among others, the following instances:

a) "*C5 describes and visualises the product development process on its website; however, holistic product manufacturing remains vague to the customer. For example, C5 touchpoints, like batteries collection, product delivery to end-users, and fertiliser use in the landfill, remain unknown to potential customers. Waste material is mentioned on the C5's website without explaining the recycling batteries process or waste material management strategy. C5's primary material is 90% recyclable, and contamination of landfills can be avoided; however, C5 does not reveal what happens with the 10% remaining material from extracting the zinc and manganese used for primary products. Therefore, C5 must create a closed-loop system to re-circulate materials after use."*

b) "*C12 reveal little about waste management and end-of-life management of their machinery despite operating in the recycling industry."*

c) *"C8 provide limited information about the replaced lightning fixtures and how these are recycled. Therefore, those parts of the service business model cannot be evaluated towards the concept of the planetary boundaries."*

4. Discussion

The paper contributes to the conference theme and session by utilising SD as an alternative sustainability assessment approach to investigate how sustainable are pertinent CBMs in innovation, sustainability of customer experiences and transparency of service life cycle, value chain, supply chain, and waste management in CBMs. Utilising SD as a sustainability approach in these areas can offer a complete picture of elements connecting to the actual sustainability performance of CBMs through:

1. Innovation is crucial for sustainable organisational development and, therefore, higher sustainability of CBMs.

2. Sustainable customer and employees experiences on a human level are linked to the advanced organisational sustainability and

3. Transparent companies' internal and external processes indicate high organisational sustainability.

If SBMs literature provides extensive benefits of high sustainable performance for the organisation, unfortunately, a pilot does not confirm this apart from high groundbreaking technological innovation (n=8). The result partly differs from Hofmann's (2019) and Kennedy & Bocken's (2020) claim CBMs' technological innovativeness and the opportunity for fundamental change. The pilot also identified (n=6) companies' technologically advanced innovations supported with unique CBMs and sustainable service offerings with higher sustainability performance. These companies combine technological innovation with BM innovation to achieve high sustainability performance.

Evaluating customer experiences, which are crucial drives for sustainable development (Westin et al., 2022), reviled three holistic, user-friendly experiences *product life extension* CBMs out of 16 analysed cases. Moreover, Jiang et al. (2022) indicate that sustainable practices improve customer evaluations of the service experience. Yet, the pilot stated limited customer-oriented services, reduced user experiences (n=5), and unfamiliarity with the customer and their needs (n=9). These findings also confirm Nußholz 2017; Gaziulusoy & Brezet 2015; Bradey et al. (2020) CBMs' user practices limitations; that way, CBMs have limited transitions toward sustainability. Last, companies do not fully communicate sustainable values of product/services production (n=4) with customers (n=2), companies (n=5) and stakeholders (n=1).

When assessing the CBM's transparency of service life cycle, value and supply chain, and waste management, a pilot demonstrates the haziness of the service life cycle in a product/service production process (n=6), supply chain (n=4), value chain (n=5), and waste management (n=6). Results confirm Hofmann's (2019); Kennedy & Bocken's (2020) claim of current CBMs' placement in the business logic of the Anthropocene, leaving significant production and consumption operations challenges unsolved (Boons & Lüdeke-Freund 2013). Furthermore, the pilot confirmed CBMs' ecological and social impact and behaviour change to be indefinite (Hofmann, 2019; Bocken et al., 2014; Boons & Lüdeke-Freund, 2013), as only one case (C14) out of 16 professionals reported a positive impact on the environment and society. Equally, due to the limited sample, the pilot study could not demonstrate the lower environmental impact of CBMs (Tukker, 2004). Last but not least, professionals exposed CBMs companies' dependency on linear industry waste (n=5), also recognised by Tamminen et al. (2020).

The research gap concerned the CBMs' sustainability assessment in CBMs innovation increasing sustainability, sustainable customer experiences and CBM's transparency of service life cycle, supply and value chain, and waste management reviled the appropriateness of SD as a sustainable assessment approach, particularly in listed areas. Concerning adopting SD as a sustainability assessment tool, according to Prendeville & Bocken's (2017) definition, SD is the planning process for organising people, technology, and materials to enhance the quality of interaction between a customer and provider. It can be established that SD is a relevant sustainability assessment tool, particularly in assessing sustainability performance concerning CBMs innovation, sustainable service experiences and transparency of internal organisational processes of the service lifecycle, the supply and value chain and waste management. However, an author would recommend using SD alongside established assessment tools (Bocken, Miller & Evans, 2016; Lüdeke-Freund et al., 2017; Hoffmann, de Simone Morais, & Teodoro, 2020).

5. Conclusion

This paper contributes to the conference theme and session by addressing the research gap concerning the CBMs' sustainability assessment, utilising the SD approach in innovation being crucial for sustainable business development enabling greater sustainability of CBMs; in sustainable customer experiences level, allowing progressive organisational sustainability, and transparency in companies' internal and external processes indicate high sustainability processes area. These themes were selected because of SBMs' academic literature critics concerning CBMs' limited sustainability performance and because they provide a holistic structure for sustainability assessment in the CBMs' innovation; customers, employees and stakeholders' sustainable experiences, and organisational internal and external processes transparency aspects of companies' CBMs' when utilising SD as a sustainability assessment approach.

To answer the RQ, *how sustainable are CBMs across different industries when adopting SD as a sustainability assessment approach,* the short answer would be partly. When assessing sustainability with the SD approach, this revealed high technological innovation, which reinforced the development of the innovative CBMs. The other two areas, sustainable customer experiences and transparency of service life cycle, the value and supply chain and waste management, demonstrate clear limitations of CBMs sustainability development and, therefore, lower sustainability performance (see Figure 4).

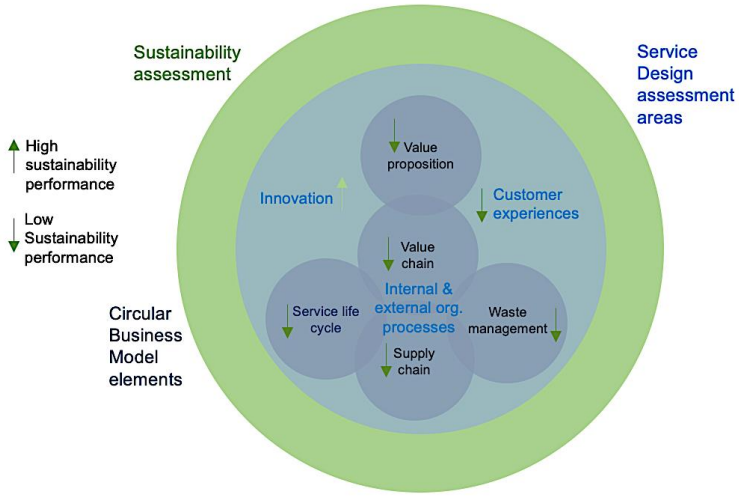

Figure 4: Diagram visualises results from the pilot study assessing sustainability in pertinent CBMs when adopting the SD approach.

This paper is unique, and it brings value to the SBMs field by utilising SD and proving proof of its appropriateness as a sustainability assessment tool in CBMs, which has not been done before, by assessing CBMs innovation, sustainable customer experiences, and internal and external organisational life cycle processes. Then, with theoretical contributions of conforming or opposing the constructive critique of the CBMs' sustainability, supported by relevant qualitative research results from the pilot study.

It seems that CBMs could minimise material input and outflow from the economic system and play a crucial role in utilising the resources and capabilities of the private sector towards the transition to more sustainable economic development. Nevertheless, the growing prominence of the CBM concept in research and practice demonstrates considerable uncertainty on how to implement pertinent CBMs in the current global economy (Galvão, Homrich, Geissdoerfer, Evans, Scoleze Ferrer & Carvalho, 2020).

The pilot study has three limitations: first, despite professionals utilising websites, companies' sustainable development reports, social media in accessing the companies' cases, they did not have direct access to companies; second, professionals who performed the analysis were not researchers but were experts in their field; and third, the cases sample was too small to make sustainability comparisons between different types of CBMs.

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