

# Circular Economy in SMEs: The Role of Commitment to Sustainability and Digitalization

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**Abstract:** Small and medium-sized enterprises (SMEs) are a decisive part of the efforts against climate change. However, they are late in terms of sustainability and circular economy (CE). Little is known about the factors that facilitate the implementation of CE practices in SMEs. Due to CE leading to cost savings, new business models or reputation gains, companies can achieve a competitive advantage. To realize this competitive advantage the strategic orientation of a firm is pointed out. Various theoretical papers have shown how CE can be enabled and how it can be inhibited. However, empirical studies that support the existing literature are lacking. The goal of this paper is to investigate the influence of two mechanisms, namely commitment to sustainability (CtS) and digitalization as strategic orientations on CE implementation. Therefore, we conduct a study with a self-developed sample of 754 German SMEs. Using multiple linear regression analyses, the results show that digitalization and CtS positively influence CE implementation in SMEs. Interestingly, the complementary effect of pursuing a dual strategy toward digitalization and sustainability is not significant for CE implementation. Our study contributes to the CE literature by giving a nuanced understanding of various antecedents of CE implementation. This study provides several approaches for managers of SMEs to improve their CE practices. First, digitalization is indeed an effective tool for implementing CE practices. Therefore, practitioners should strengthen their digitalization efforts when considering increased CE implementation. Second, a general focus on sustainability increases the implementation of CE practices. Therefore, practitioners should raise awareness of sustainability throughout the organization. Third, the combined focus on CtS and digitalization needs to be carefully considered. To implement CE, digitalization should be embedded in the sustainability strategy. Due to the liability of smallness, SMEs should seek their resources for digitalization and sustainability commitment not only within but also outside the company boundaries.

**Keywords:** Circular Economy, Strategic Orientation, Digitalization, Commitment to Sustainability, Small and Medium-Sized Enterprises

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## 1. Introduction

Circular Economy (CE) plays an important role in reducing resource consumption and providing significant economic potential (Bressanelli et al., 2018). However, great efforts are needed from various parties especially small and medium-sized enterprises (SMEs). SMEs play an important role in the world's economy. Not only their economic but also their environmental and social impact is significant (Revell, Stokes, & Chen, 2010). However, research points out that SMEs lack behind in terms of sustainability in general (Revell et al., 2010). Most SMEs struggle to include CE practices in their operations (Ormazabal et al., 2018). Therefore, it should be of interest to investigate what factors influence the adoption of CE practices in SMEs.

To realize CE the strategic orientation of a firm is pointed out (Ferasso et al., 2020). Even though the particularity of SMEs regarding the strategic orientation has been shown (Ardito et al., 2021; Eller et al., 2020), the strategic orientation applied by SMEs have received less attention than those by large enterprises (Aragón-Correa et al., 2008). While Schmidt et al. (2021) have shown that strategic orientation positively relate to CE practices, Ardito et al. (2021) have found that digital and environmental orientations positively relates to innovation performance in SMEs. To complement the existing research, this study focuses on two mechanisms, namely commitment to sustainability (CtS) and digitalization as strategic orientations.

Even though the strategic orientations CtS and digitalization are pointed out to be interconnected, research studies them independently of each other (Isensee et al., 2020). A better understanding of digitalization and CtS in relation to CE implementation is needed (Chauhan, Parida, & Dhir, 2022; Kristoffersen et al., 2020).

This paper contributes to the literature by answering the following research questions: *Can CtS and digitalization facilitate CE implementation in SMEs? Does the dual strategic commitment to digitalization and sustainability affect the CE implementation of SMEs?*

## 2. Theoretical background and hypotheses

The concept of CE is being used in a wide range of contexts and many definitions address and conceptualize different aspects of CE (Kirchherr, Reike, & Hekkert, 2017). CE promotes better resource use thereby avoiding waste and supporting the regeneration of the natural system (Kirchherr et al., 2017). Studies point to slowing (extended useful life of products), narrowing (fewer resources), and closing the loop (reused resources) as important strategies of CE (Bocken et al., 2016).

Especially SMEs offer adequate conditions to establish CE activities. SMEs are characterized by a strong and dominant, and far-reaching top management (Willard, Krueger, & Feeser, 1992) supported by flat hierarchies and closer communication between different parts of the organization (Aragón-Correa et al., 2008). It is thus easier for a smaller company to implement a certain strategy. Furthermore, SMEs often have a simple capital structure that increases their flexibility (Aragón-Correa et al., 2008). However, the lack of resources and the environment of SMEs are identified as reasons for falling behind (Jansson et al., 2017). Hence, it is important to identify success factors for the establishment of CE in SMEs. Investigating the strategic orientation, particularly CtS, as well as digitalization, can advance CE implementation.

### 2.1 Digitalization and CE

Many companies have begun to use digital technologies to manage their innovation processes (Urbinati et al., 2020) and are using digital technologies in a variety of processes in their organizations (Hanelt et al., 2021). Digitalization is pointed out as a key enabler of the CE (Chauhan et al., 2022; Kristoffersen et al., 2020). However, there is a gap between the potential shown in theory (Bressanelli et al., 2018) and practical implementation (Ingemarsdotter, Jamsin, & Balkenende, 2020). Digitalization can address several prerequisites of the CE, such as cooperation of different companies (Holzer et al., 2021), bringing transparency to supply chains and products (Agrawal et al., 2022), enabling new business models that decouple economic growth from resource consumption (Lüdeke-Freund, Gold, & Bocken, 2019), and improving production (Chauhan et al., 2022).

The mentioned aspects point towards a positive relationship between digitalization and CE implementation in SMEs. Hence, we argue the following:

*Hypothesis 1. Digitalization positively relates to CE implementation of SMEs.*

### 2.2 CtS and CE

CtS is pointed out to be a potential source of sustained competitive advantage (Banerjee, 2002; Roxas, Ashill, & Chadee, 2017). CtS builds upon the premise of integrating an environmental focus into the strategic orientation of the firm (Linnenluecke & Griffiths, 2010). CtS “reflects the deliberate strategy of the firm to reconfigure its organizational system, structure, processes, and activities to mitigate the negative impact of its practices on the natural environment” (Roxas et al., 2017, p. 164). Hence, CtS requires a company to recognize that its activities can harm the environment and to strive to limit this impact (Banerjee, 2002). However, there is a lack of research on CtS in SMEs.

The companies’ policies and strategies are a key aspect in the implementation of CE (Ferasso et al., 2020). Management values are important in SMEs for implementing sustainability practices (Jansson et al., 2017) because the business leader often owns the business and has a strong influence on proactive environmental management. SMEs that have a CtS, in the sense that the management focuses on sustainability in its decisions and strategic planning, should tend to have more CE practices established. Hence, we conclude the following:

*Hypothesis 2. CtS positively relates to CE implementation of SMEs.*

### 2.3 The complementary effect of digitalization and CtS

Existing research calls for a closer look at the interaction between sustainability and digitalization (Isensee et al., 2020). We argue that digital and sustainable orientations lead SMEs to develop a mindset that commits the company to adopt digital technologies that protect the natural environment. This results in SMEs acquiring new knowledge and capabilities, building relationships with other organizations, and in turn linking the digital world or the natural environment to new products and processes, leading to improved innovation performance in products and processes (Ardito et al., 2021) and thus to the implementation of CE activities.

Digitalization is a key enabler for CE implementation (Chauhan et al., 2022) and CE is a major component of sustainability (Bocken et al., 2016). Therefore, companies that are committed to sustainability and are digitally positioned can more easily implement CE activities. Hence, we hypothesize the following:

*Hypothesis 3. The interaction between digitalization and CtS has a positive effect on CE implementation of SMEs.*

Figure 1 shows the research model.

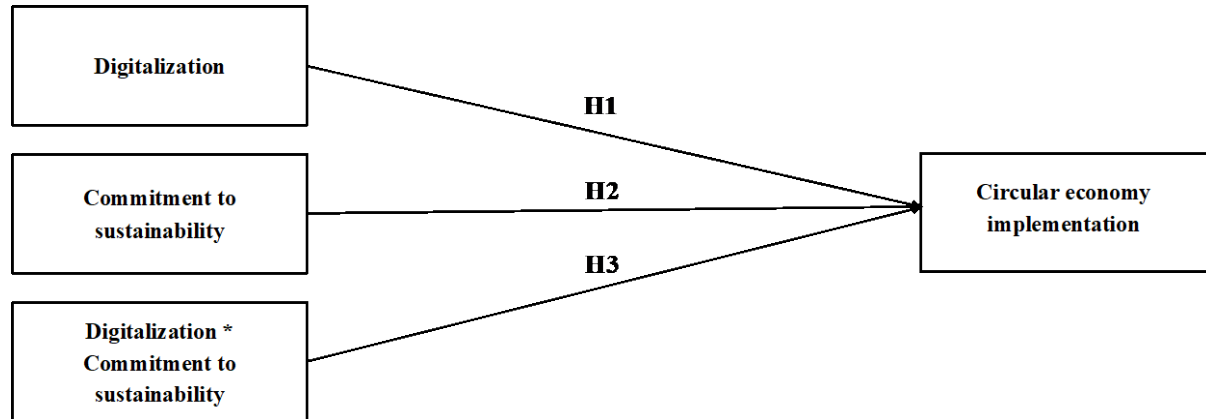


Figure 1: Research model

### 3. Methodology

#### 3.1 Sample and data collection

We focus on German SMEs since they are well suited for the investigation of CE as pointed out by Schmidt et al. (2021). Consumers and other stakeholders in Germany have high expectations towards companies in terms of sustainable business practices due to a long tradition of sustainability-oriented legislation (Patel et al., 2000).

Overall, we contacted 15,034 SMEs via email including a self-administered online survey. The data collection including a reminder took place over eight weeks from August to September 2022. Overall, 1,058 emails were undeliverable and 34 companies were permanently closed. A total of 754 questionnaires were filled out completely and correctly, i.e. the questionnaire was completed and there are no missing answers in the construct items. This results in a response rate of 5,4 % and represents a comparable response rate for this research field (Ardito et al., 2021; Eller et al., 2020; Khan, Daddi, & Iraldo, 2021). Table 1 contains descriptive statistics of the sample.

Table 1: Descriptive statistics

Firm size	Frequency	%	Firm age	Frequency	%
1	126	16.71	<= 5 years	108	14.32
2-4	208	27.59	6-20	280	37.14
5-9	216	28.65	21-35	324	42.97
10-19	110	14.59	>= 36	41	5.44
20-49	53	7.03	n/a	1	0.13
50-250	14	1.86			
n/a	27	3.58			

#### 3.2 Measurement

The research model builds upon established indicators, which were all applied in the context of SMEs. The measures were translated into German and adapted to the specific circumstances of the sample with the feedback of academics and industry experts. In the following, the variables are introduced. Table 2 presents the study's measures and factor loading.

**Table 2: Factor loadings after varimax rotation**

Variable	Item	Factor loadings
CE	Do you design and develop products that can be easily repaired? (Spare parts and repair possibilities available, economic efficiency of repair given).	0.91
	Do you design and develop products that are easy to maintain (e.g., easy monitoring and control of functionality)?	0.91
	Do you design and develop products that are recyclable (e.g. easily separable)?	0.81
	Do you use products (not packaging) made from recycled material?	
	Do you design and develop products that are biodegradable (e.g. no hazardous substances, fast decomposition)?	0.73
	Do you use products (not packaging) that are biodegradable?	0.83
	Do you use packaging that is biodegradable and/or reusable?	0.61
	Are there closed loops in production (e.g. return/recycling of product residues into production, waste as raw material)?	0.64
	Do you increase the material and energy efficiency of your business by achieving the same result with less material and energy input?	0.55
	Do you reduce your waste by passing on by-products (e.g. products resulting from a manufacturing process whose main purpose is to produce another product; production residues)?	0.65
	Do you procure by-products from other companies/organizations?	0.61
	Do you provide repair services for customers?	0.78
	Do you provide maintenance services for customers? (e.g. monitoring and control of product functionality)	0.74
	Do you use materials that have been used before (e.g. old products)?	
	Do you rent and share tools, machines, or facilities/rooms?	0.55
Digitalization	How do you rate digitalization in your business compared to other businesses in your industry?	0.69
	How do you rate the use of information and communication technologies in your company?	0.84
	How do you rate your own use of information and communication technologies?	0.82
	How pronounced is the use of sensor technology (e.g. RFID or QR codes) for measurement and control in your operation?	0.59
	How pronounced is the collection and analysis of data in your operation?	0.54
	How pronounced is the digitalization and automation of service/operating processes in your company (e.g. ordering processes)?	0.62
	How pronounced is the digitalization and automation of production processes in your company (e.g. computer-aided manufacturing processes)?	0.84
	How pronounced is the use of (innovative) digital tools in product design and manufacturing (e.g. 3D printing, robotics, AI) in your company?	0.79
	How pronounced is the use of "smart" devices in your operation (e.g. smartphones, tablets, etc.)?	0.75
	How pronounced is the use of social media and technologies that support collaboration in your business?	0.63
	How pronounced is the use of e-commerce (e.g. an online store) for buying and selling goods on the Internet?	0.84
	How pronounced is the use of digital trading platforms for the marketing of (quality-assured) secondary materials (e.g. recyclates, already used materials) in your company?	0.78

Variable	Item	Factor loadings
CtS	In strategic decisions involving a product/service, the environmental friendliness of the product/service is an important factor.	0.83
	Environmental friendliness is an important aspect in planning the competitive focus for our key products, services and markets.	0.84
	Environmental friendliness and social compatibility are important in the purchase and manufacture of products and services.	0.82
	Sustainability is an important part of our company's values and philosophy.	0.84
	Sustainability is a prioritized area for the management in the firm.	0.84
	Sustainability considerations have an impact on the strategic planning in the firm.	0.84

Note. Blanks represent loadings < 0.5.

*Dependent variable – CE.* We assess the dependent variable CE with the scale established by Khan et al. (2021). The scale covers all different phases of CE implementation. To address the specific circumstances of the German SMEs we added 6 items to the existing items. Thus, a total of 15 items were included. The items are measured on a 5-point Likert scale (1= currently not planned, 5 = successfully implemented). We added the option “not possible in my company” as some CE practices are not feasible due to resource constraints or the nature of the respective business model in SMEs.

*Independent – Digitalization.* We assess digitalization with the scale by Eller et al. (2020). We complement this scale by items addressing specific technologies whose absence was identified by Rajput and Singh (2021) to hinder CE implementation. The complemented scale consists of 12 items. The items are measured on a 4-point Likert scale (1 = very low, 4 = very high) because feedback from practitioners indicated that too many points could reduce the response rate. As it was shown that Likert scales with 7, 5, or 4 points do not show different results with regards to mean, SD, correlations, or factor analysis the scale was reduced accordingly (Leung, 2011). For the items assessing the use of a certain technology, we added the option “not possible in my company”.

*Independent – CtS.* The independent variable CtS is assessed with the scale by Jansson et al. (2017) which is partly based on Kärnä, Hansen, and Juslin (2003). The scale consists of 6 items. The items are measured on a 4-point Likert scale (1 = completely disagree, 4 = completely agree).

*Control variables.* Following earlier research in the field of SMEs, we control for turnover, industry, firm age, segment, and the number of employees (Ardito et al., 2021; Eller et al., 2020; Schmidt et al., 2021). Larger firms might have more resources at their disposal and therefore implement more CE practices (Longoni, Luzzini, & Guerzi, 2018). Additionally, older firms have been shown to innovate less (Gopalakrishnan & Bierly, 2006). Depending on the industry and whether a firm produces products or provides services, different CE practices can be implemented.

## 4. Analysis and results

### 4.1 Construct validity and reliability

In line with other researchers (Schmidt et al., 2021), we confirmed measurement reliability and validity before estimating the hypotheses. To build the constructs, we calculated the mean of the items for every scale. We computed Cronbach's alpha (Cronbach, 1951), average variance extracted (AVE), and composite reliability (CR) to assess the inter-item reliability of the scales (see Table 3).

**Table 3: Validity and reliability indicators**

Variable	Number of Items	Cronbach's alpha	AVE	CR
1 CE	15	0.79	0.21	0.75
2 Digitalization	12	0.81	0.36	0.87
3 CtS	6	0.91	0.63	0.91

Note: AVE = Average variance extracted; CR = Composite reliability.

Cronbach’s alpha above 0.70 is commonly assumed to be acceptable (Taber, 2018). A threshold of 0.50 for AVE (Bagozzi & Yi, 1988) and a threshold of 0.60 for CR (Fornell & Larcker, 1981) is applied. All constructs fulfill the threshold for Cronbach’s alpha and CR. Since AVE is a more conservative measure and if the threshold for CR is fulfilled, internal reliability can still be assumed (Lam, 2012).

The discriminant validity is assessed by comparing the square root of AVE with the pairwise correlation of the constructs (Fornell & Larcker, 1981). As in each case the square root of AVE exceeds the correlation the discriminant validity can be confirmed (see Table 4).

**Table 4: Correlation table and discriminant validity**

Variable	M	SD	1	2	3	4	5	6	7
<b>1 CE</b>	3.2	1.0	<b>0.46</b>						
<b>2 Digitalization</b>	2.6	0.6	0.22**	<b>0.60</b>					
<b>3 CtS</b>	2.9	0.7	0.37**	0.20**	<b>0.79</b>				
<b>4 Firm age</b>	38.8	40.6	-0.03	-0.02	0.01	<b>-<sup>a</sup></b>			
<b>5 Employees</b>	9.0	19.8	-0.03	0.19**	0.05	0.23**	<b>-<sup>a</sup></b>		
<b>6 Segment</b>	2.1	0.7	-0.21**	0.01	0.07*	-0.05	-0.00	<b>-<sup>a</sup></b>	
<b>7 Sales</b>	4.7	1.7	-0.08*	0.28**	-0.06	0.25**	0.43**	-0.04	<b>-<sup>a</sup></b>

Note. \*p < .05 \*\*p < .01. In the diagonal in bold is the square root of AVE for CE, digitalization, and CtS. <sup>a</sup>Not applicable.

#### 4.2 Regression analysis

To test our research model, we use multiple linear regression analysis. We tested and confirmed the Gauss-Markov assumptions (Hallin, 2014). Furthermore, variance inflation factor (VIF) statistic was performed to rule out multicollinearity. None of the VIF score of each variable were above the threshold of 3.3 (Hair, Ringle, & Sarstedt, 2011). Hence, multicollinearity is not a problem in our study.

Model 1 includes control variables and CE and reveals that company age ( $\beta = -0.00$ ,  $p < 0.05$ ) and the number of employees ( $\beta = -0.00$ ,  $p > 0.10$ ) nearly have no effect on CE implementation. The segment shows statistically significant effects on CE implementation. On one hand, companies that offer only services have on average a lower level of CE practices ( $\beta = -0.64$ ,  $p < 0.01$ ). On other hand, being a company that offers both services and products increases the level of CE ( $\beta = 0.43$ ,  $p < 0.01$ ). The sales volume does not have an influence on CE implementation.

Model 2 includes control variables, digitalization, and CE (hypothesis 1). Digitalization has a positive statistically significant effect on CE implementation ( $\beta = 0.46$ ,  $p < 0.01$ ). Hence, hypothesis 1 is supported. Model 3 includes control variables, CtS, and CE implementation (hypothesis 2). CtS has a positive statistically significant effect on CE implementation ( $\beta = 0.46$ ,  $p < 0.01$ ). Thus, hypothesis 2 is supported.

Model 4 includes all summarized constructs as well as the interaction effect of digitalization and CtS. Digitalization ( $\beta = 0.52$ ,  $p < 0.05$ ) and CtS ( $\beta = 0.55$ ,  $p < 0.05$ ) have a positive statistically significant effect on CE. The interaction effect is slightly negative but not significant ( $\beta = -0.06$ ,  $p > 0.10$ ). Hence, hypothesis 3 is not supported. All models (1-4) are statistically significant. Table 5 reports the results.

**Table 5: Results of regression analysis**

CE (dependent variable)	Model 1	Model 2	Model 3	Model 4
<b>Controls</b>	$\beta$	$\beta$	$\beta$	$\beta$
<b>Firm age</b>	-0.00**	-0.00	-0.00**	-0.01
<b>Employees</b>	-0.00	-0.00**	-0.01**	-0.01***

Segment (production as base)				
Services	-0.64***	-0.64***	-0.60***	-0.61***
Both (services & production)	0.43***	0.43***	0.38***	0.38***
Sales (< 22 T. € as base)				
22 T. - < 50 T. €	-0.09	-0.16	-0.13	-0.18
50 T. - < 125 T. €	-0.07	-0.17	-0.10	-0.17
125 T. - < 250 T. €	-0.07	-0.25	-0.13	-0.25
250 T. - < 500 T. €	-0.19	-0.37	-0.15	-0.29
500 T. - < 2,5 Mio. €	-0.15	-0.38**	-0.11	-0.29
2,5 Mio. - < 5 Mio. €	-0.15	-0.43**	-0.09	-0.31
> 5. Mio. €	-0.06	-0.46	0.11	-0.21
Independent variables				
Digitalization		0.46***		0.52**
CtS			0.46***	0.55**
Digitalization * CtS				-0.06
R <sup>2</sup>	0.21	0.27	0.31	0.34
F	18.29***	25.54***	28.49***	27.69***

Note. \*p < 0.10 \*\*p < 0.05 \*\*\*p < 0.01; N = 740.

## 5. Discussion and conclusion

In this paper, we focus on the relationship between digitalization, CtS, and CE implementation in SMEs. Digitalization and CtS are positively related to CE implementation (hypotheses 1-2) while their interaction is not significantly related to CE implementation (hypothesis 3).

### 5.1 Theoretical implications

#### 5.1.1 Influence of digitalization on CE

Various theoretical papers have shown how digital technologies enable CE and how their absence hinders it (e.g. Chauhan et al., 2022). However, empirical studies that support the existing literature are lacking (Rosa et al., 2020). This paper empirically support the hypothesized relationship between digitalization and CE in SMEs.

The higher the level of digitalization, the more CE practices are implemented. Companies with a high degree of digitalization are enabled to implement CE practices in different phases of the product lifecycle. Innovative digital tools such as 3D printing can be used to increase the development of products that are easily repaired in the design and production stage (Ingemarsdotter et al., 2020). The digitalization and automation of production processes enable increased material and energy efficiency. Sensor technology allows for the collection of end-of-life products in the consumption and collection stage (Agrawal et al., 2022). Digital trading platforms facilitate the reusing of bi-products or recycled materials from other organizations in the recycling and resourcing stage (Kristoffersen et al., 2020). In this respect, this paper answers the call for empirical studies supporting the existing literature (Rosa et al., 2020).

#### 5.1.2 Influence of CtS on CE

The far-reaching influence of the management in SMEs points towards the link between a CtS of the management and the implementation of CE practices. The results of this paper support the hypothesized relationship between CtS and CE in SMEs. The higher the CtS, the more CE practices are implemented. CtS measures the extent to which companies prioritize sustainability. CE is a very effective way of increasing the sustainability of a company. If a company decides to increase the environmental friendliness of its products in its strategic product decisions, the actions that implement CE, such as the 10 R-strategies (refuse, rethink, reduce etc.), can contribute to achieve that goal (Lüdeke-Freund et al., 2019). When environmental friendliness plays a

role in purchasing decisions, used or recycled materials could be preferred, or their products could be remanufactured, which again increases the degree of CE. Therefore, CE is one of several potential manifestations of CtS. In line with prior research (e.g. Bocken et al., 2016), this paper empirically supports the connection between CtS and the implementation of CE practices.

### 5.1.3 Influence of digitalization and CtS on CE

When considering the full model, both CtS and digitalization simultaneously decrease CE implementation. However, this effect is insignificant and small. The results do not support the assumption that pursuing digital and sustainable orientations simultaneously does improve CE implementation. According to Ardito et al. (2021), the reasons for this slightly negative effect may be due to the complexity of managing the different types of resources underlying digital and sustainable orientation, as well as the commitment of these resources to unrelated goals. As a result of the liability of smallness that SMEs often face, SMEs are not able to meet resource-intensive strategic commitments. Managers and employees of SMEs are thus more likely to have attention allocation problems (Ocasio, 2010).

Our study contributes to a better understanding of the relationship between sustainability and CE implementation and shows that, in addition to economic considerations, environmental and strategic aspects are important contributors to a move from linear to CE. This study thus builds on previous work (e.g. Ardito et al., 2021; Neligan et al., 2022) and extends it to include the complementarity of digital and sustainable orientation in relation to CE implementation in an SME context, an area that remains under-researched.

## 5.2 Managerial and practical implications

Our results contribute to the understanding of the interrelationship of digitalization, CtS, and CE in the context of SMEs. First, digital technologies are effective tools to implement CE practices. Therefore, practitioners should increase their digitalization efforts when considering increasing or facilitating CE practices. Two digital technologies which might be particularly helpful in this context are the digitization and automation of production processes and the use of innovative digital tools for product design and manufacturing.

Second, a general focus on sustainability increases the implementation of CE practices. Therefore, practitioners should increase awareness throughout the company for sustainability. This could lead to employees also incorporating sustainability aspects into their daily activities and decision-making, thus increasing the circularity of the whole business.

Third, the combined focus on CtS and digitalization must be carefully considered. As the transition to CE can only be mastered if strategic orientations can be linked, SMEs need to be shown how to connect their digital and sustainable strategies without inhibiting CE implementation. Awareness must be created in SMEs that resources for digitalization and sustainability engagement are not only available within the company but also outside its boundaries (Ardito et al., 2021). Therefore, SMEs need to consider not only their own commitment to digitalization and sustainability but also that of their stakeholders, as they can be a source of relevant resources. The exchange of tangible and intangible resources will become increasingly important with regard to CE in order to close, narrow, and slow material loops with the help of digital and sustainable orientation. Therefore, practitioners should build an environment and network that focuses not only on digital but also on sustainable innovation (Isensee et al., 2020). SMEs should adopt green digitalization tools to improve their sustainable performance and integrate digitalization into their sustainability strategy.

## 6. Limitations and future research

Some limitations must be considered. First, this paper focuses on German SMEs. These companies are particularly suitable for CE implementation as they have a high intensity of processing and treatment of materials and have the potential for efficiency increases and material savings. Further research could apply the research model in larger companies and other regions outside Germany to assess whether the results are reproducible and generalizable to other contexts. Second, we used a cross-sectional design. However, the mutual influence of the different constructs often happens over time. In this respect, a longitudinal study could provide further insights. Third, future research could address the question of why digitalization is rather low in SMEs and specialize on the interdependencies between CtS and digitalization. Overall, the degree of digitalization in SMEs is low to very low. Therefore, digitalization seems to provide a high potential to increase CE implementation by

synergizing resources. Future research that applies case studies in SMEs might extend the understanding of our findings.

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