

Mind the gap: Towards a systematic circular economy encouragement of small and medium-sized companies



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ARTICLE INFO

Article history:

Received 15 April 2020

Received in revised form

18 January 2021

Accepted 9 March 2021

Available online 12 March 2021

Handling editor: Yutao Wang

Keywords:

Circular economy

Resource efficiency

SME

Survey

Transition

ABSTRACT

Despite a growing number of circular economy (CE) strategies, reports, methods and tools, researchers have provided little empirical evidence on the corporate practices in small and medium-sized enterprises (SMEs) that are crucial to affect the transition towards a CE. Although there is an increase of studies on barriers for and driver to CE, there is little knowledge about what represents CE for SMEs and which topical areas are of central interest especially for SMEs. Based on CE related literature, we identified sustainability, resource efficiency, differentiation, cooperation with stakeholders, independence from resource supply and life cycle knowledge as such topical areas. Drawing on empirical survey data gathered from a cross-sectional sample of $N = 183$ SMEs in Austria, we first applied an Importance-Performance Analysis (IPA) to identify gaps between the perceived performance and importance ratings, reported by SME representatives, in those topical areas. The identified gaps give a direction which topical areas offer opportunities for further improving a company's performance. The findings reveal that the efficient use of resources as well as the procurement of resources plays a major role for Austrian SMEs. Cooperation with stakeholders, however, seems to be an underestimated topical area in the present sample. Based on the results of this IPA, we carried out a cluster analysis to identify groups of SMEs that vary according their overall perceived performance in and importance of the topical areas of CE. The result reveals four strategic groups of SMEs, namely CE frontrunners, fast followers, a late majority and laggards, which provide a basis for policy makers, intermediaries or cluster representatives to effectively address diverse SMEs as specific target groups by addressing topical areas of CE in order to facilitate a shift towards CE.

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1. Introduction

Global material consumption has tripled over the last four decades and continues to accelerate for various reasons, including a product-based linear economy (de Wit et al., 2018). Circular Economy (CE) offers a way to create "an economic system that replaces the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes" (Kirchherr et al., 2017, p. 229). The Ellen (EMF) (2015a) has estimated that a transition to a CE could reduce global emissions by 48% by 2030 and by 83% by 2050, based on current levels; therefore, CE contributes to environmental quality and social equity (Kirchherr et al., 2017), supporting the shift towards more

sustainable social and economic systems in general. CE was originally based on various schools of thoughts (e.g., Industrial Ecology, Biomimicry, Cradle to Cradle), and its popularity is indicated by the growing number of CE tools, strategies and reports (e.g., EMF, 2015b; European Commission (EC), 2020a, 2020b; de Wit et al., 2018). The European Green deal (EC, 2019) recently outlined strategies for a climate-neutral, resource-efficient and competitive economy. This deal stems from the CE action plans (EC, 2015; 2020a), which identify new opportunities for business, innovation and job creation through CE, while reducing the use of energy and raw materials. However, it is unclear whether these benefits act as stimulating factors for companies that are transitioning to a CE, and especially SMEs. SMEs account for 99% of all enterprises in the EU. They are characterized by their highly diverse and heterogeneous structures in terms of their business models, ages, sizes and performance (OECD, 2019; EC, 2020b). This diversity consequently makes it difficult to promote CE equally for all SMEs. Previous CE studies have placed a main focus on larger companies (Stahel,

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2016) despite the importance of SMEs to the economy and their contribution to total pollution (70%) in the EU (Ormazabal et al., 2018). Furthermore, there is insufficient empirical evidence (Rizos et al., 2016) that would enable the identification of the most influential aspects in the transition process towards a CE, such as the branch of industry, the availability of resources, or the business culture (Masurel, 2007). SMEs face specific challenges and, because the sustainability transition to a CE is also at an early stage (Ghisellini and Ulgiati, 2019), a variety of renewable and more environment-friendly innovations and practices are required. Although an extensive body of knowledge about sustainability exists, and public awareness for sustainable production and consumption patterns has increased, many economic actors are resisting this transition because they have few incentives to address sustainability comprehensively. For this reason, political measures (e.g., environmental regulations, taxes, subsidies) will play a crucial role in this process as well (Köhler et al., 2019). To investigate this CE transition process, studies were conducted recently to investigate the barriers to and drivers for CE implementation in general (de Jesus and Mendonça, 2017; Kirchherr et al., 2018; Tura et al., 2019) and CE implementation in SMEs in particular (Rizos et al., 2016; D'Amato et al., 2018; Garcés-Ayerbe et al., 2019). Identifying the barriers to and drivers for a CE may provide insights into mechanisms that enable or hinder the transition to a CE, but they neither provide information about what constitutes a CE for SMEs nor provide any insights into progress in this transition. In the present study, therefore, we extracted studies from the literature on barriers to and drivers for a CE to identify relevant topical areas of a CE for Austrian SMEs. We then examined these topical areas to detect potential opportunities or motivational factors that could encourage SME representatives to adopt CE practices in their company.

In this study, we addressed the following research questions:

1. Which of the identified topical areas of CE are perceived as important by SME representatives in Austria?
2. What are potential gaps between the perceived importance and performance in these topical areas of a CE?
3. Do similarities in the perceived importance and performance, as well as the resulting gaps, enable us to categorize SMEs appropriately regarding their CE endeavors?

To answer these research questions, no actual performance data were collected; instead, we collected data on the SME representatives' perceptions. This enabled us to describe the attitudes of or the factors motivating SME representatives in the context of a CE.

Section 2 presents relevant background information and provides an overview of empirical SME studies on barriers to and drivers for a CE. In Section 3, the survey instrument and data collection process are described, as well as the data analysis steps. These included an Importance-Performance Analysis (IPA), an exploratory factor analysis, a principal component analysis and a cluster analysis (CA). In the results section, six topical areas of the CE are presented, followed by a discussion of the results obtained by applying the two main analytical methods (IPA and CA). In Section 5, we draw conclusions from the results, outline the limitations of this study and provide an outlook on further research.

2. Background: Barriers to and drivers for a circular economy from the perspective of small and medium-sized enterprises

SMEs differ from larger organizations in terms of their available resources and their research, development and technology (RDT) capacities (Rizos et al., 2016). Several studies have addressed the topic of barriers to and drivers for a CE regardless of company size,

presenting the results of scientific literature reviews (de Jesus and Mendonça, 2017; Govindan and Hasanagic, 2018), empirical case studies (e.g., Brown et al., 2019; Tura et al., 2019), or larger empirical surveys (Kirchherr et al., 2018; Testa et al., 2019). These barriers to and drivers for a CE in the specific context of SMEs are shown in Table 1.

These studies (Table 1) recognized considerable barriers related to insufficient financial resources. These barriers included the high investment costs for sustainable innovations (D'Amato et al., 2018) and difficulties to obtain financial support (Garcés-Ayerbe et al., 2019). The results of the Flash Eurobarometer441¹ (EC, 2016) on European SMEs in the CE indicate that these barriers are particularly relevant for companies that have not yet taken a step towards a CE (Garcés-Ayerbe et al., 2019). Mura et al. (2020) noted that a major concern is that sustainability is associated with costs rather than an investment. Access to financial support and incentives could make sustainability more appealing (Rizos et al., 2016). With regard to Spanish SMEs, Ormazabal et al. (2018) concurred that financial resources are crucial but suggested that the lack of consumer demand to address environmental issues represented the most inhibiting factor.

One of the largest studies on CE barriers identified a hesitant company culture and a lack of consumer interest as the main barriers. The authors determined that these barriers are also amplified by market barriers such as "high up-front investment costs" and "low virgin material prices" (Kirchherr et al., 2018). Rizos et al. (2016) observed that company culture (especially the employees' levels of commitment and attitudes) can act as a driving force for the implementation of CE in SMEs, while Mura et al. (2020) found that access to a sustainable market serves a prerequisite for CE.

Researchers frequently mention technical factors as another main barrier (e.g., de Jesus and Mendonça, 2018; Govindan and Hasanagic, 2018). This barrier is described as heterogeneous, as it affects both process optimization (Caldera et al., 2019) and explicit processes, such as design challenges (Govindan and Hasanagic, 2018), material flows (Tura et al., 2019) and reverse logistics (Brown et al., 2019). SMEs must overcome relevant obstacles to implement these activities (Caldera et al., 2019), as the immediate added value of the activity may not be recognized or the expertise for implementation is not available (Garcés-Ayerbe et al., 2019). However, some researchers have found CE drivers in the technical areas, namely, new job creation (D'Amato, 2018), increasing knowledge (Rizos et al., 2016) and the education and training of employees (Mura et al., 2020).

3. Methods

Since little empirical research on the perception of the topical areas of a CE – especially among SME representatives – has been conducted so far, the present study was carried out to address this gap. Austrian SME representatives were invited to complete an online survey, enabling us to collect their perceptions of the relevance of topical areas of a CE. The data collection process is outlined in Section 3.1, and the questionnaire is described in Section 3.2. The data analysis is specified in more detail in Section 3.3, allowing for a better understanding of the results (Section 4).

3.1. Data collection

To reach a high number of representatives at SMEs of all sizes and to enhance the results, an online survey (Appendix A) was chosen for data collection; this was sent out in the second half of

¹ European Commission, 2016 [12.01.2021].

Table 1
Recent studies on barriers to and drivers for a circular economy in small and medium-sized companies.

Authors	Methods and N	Identified Barriers	Identified Drivers
Rizos et al. (2016)	Case study, GreenEcoNet platform (EU), N = 30 SMEs;	lack of supply and demand network lack of capital lack of government support administrative burden lack of technical know-how and information company environment culture	company environmental culture networking and recognition support from demand network financially attractive personal knowledge government support
Ormazabal et al. (2018)	Survey, Spain: Navarra, Basque Country N = 95 SMEs,	lack of adequate technology/technical lack of support from public institutions lack of customer interest in the environment lack of qualified personnel in sustainability	prestige increase cost reduction environmental recovery guarantee the permanence of the company
Caldera et al. (2019)	Case study, Australia, N = 13 SMEs	lack of knowledge/skills/awareness lack of financial resources existing organizational culture current regulations and policies concept is weakly recognized	integrated strategy continuous improvement stakeholder engagement streamlining processes sustainable solutions are demanded by legislations or customers
D'Amato et al. (2018)	Case study, Finland, N = 8 SMEs	lack of capital and financial resources; reliance on public support and R&D cooperation along the value chain lack of human resources (demand)	job creation and quality of life reduced social and environmental impact no enabling factors were analyzed
Garcés-Ayerbe et al. (2019)	Case Study, Based on Flash Eurobarometer 441 N = 10618	lack of expertise to implement complex administrative or legal procedures difficulties in accessing finance	
Mura et al. (2020)	Mixed methods, Italy N = 254 SMEs	perception of sustainability as cost lack of guidelines to define sustainability difficulty in the renewable energy market administration on sustainability regulations in the field of sustainability	promotion of sustainability policies access to financial in area of sustainability green procurement/supplier dialogue/projects on the CE personnel training

2019. A database from the CMD Compass Group² was used to obtain contact information for SME representatives. The sample includes representatives working at SMEs located in the provinces of Styria, Carinthia and Burgenland in south-eastern Austria, as well as SME representatives working in the sectors of manufacturing, construction, trade and services. Consequently, the sample is a convenience sample rather than a random sample, which is not unusual for an IPA (Rial et al., 2008; Ka et al., 2015) and for an exploratory approach.

The online survey was distributed by e-mail to 2251 SME representatives, 183 of whom participated (response rate (RR) = 8.13%). The online survey was distributed by e-mail to 2251 SME representatives, 183 of whom participated (response rate = 8.13%). A study with a similar survey approach (Kiesner and Baumgartner, 2019), that also used the CMD database to extract a sample of companies, showed a comparable response rate (9.01%).

To ensure data confidentiality the survey was kept as short as possible, the anonymity of the participants was guaranteed, and the data were stored on university servers.

3.2. Development of the survey tool

At the beginning of the questionnaire (Appendix A), respondents were provided with a definition of the CE concept. Respondents were asked to consider how relevant CE was to their respective SME using a seven-point Likert scale. Subsequently, respondents were asked to evaluate the perceived importance and performance of six topical areas within a CE, using a seven-point Likert scale. To ensure comparability, the topical areas and a definition of the CE were uniformly explained in the questionnaire (Appendix A). The studies on barriers to and drivers for a CE (see Table 1) were enriched by collecting information from other literature (Table 2). The following topical areas were included in the

questionnaire, along with a brief explanation:

Sustainability is displayed by companies that decrease their environmental impacts in accordance with their corporate philosophy, rather than in response to legislative forces or for strategic reasons. As described in Rizos et al. (2016), this category was created to enable us to collect information about the company culture.

Resource efficiency increases profits by reducing material or energy consumption (Linder and Williander, 2017). This category is characterized by improved resource utilization and process optimization (Caldera et al., 2019), which reduce costs (Stahel, 2012) waste and emissions (Bocken et al., 2016).

Differentiation can be demonstrated by companies that have distinguished themselves from their competitors (Mura et al., 2020) by creating new value propositions, thereby increasing their competitive advantage (Lewandowski, 2016).

Collaboration with stakeholders is considered a key element of a CE (Rizos et al., 2016), as a product is linked to an entire supply or value chain; therefore, growth within a network of industrial partners and research institutions promotes CE activities (e.g., industrial symbiosis, off-site recycling) (Lewandowski, 2016).

Independence from resource supply implies the use of similar strategies as in the previous topical area, but a stronger focus is placed on the dependence on raw materials and green procurement (Mura et al., 2020), which may increase the resilience of companies (e.g., oil prices, lack of supply) (Ghisellini et al., 2016).

Life cycle knowledge refers to information that is obtained about product usage, for example, to minimize errors and to improve the company representatives' understanding of customer consumption patterns, as well as to improve the product itself by securing spare parts or remanufacturing parts (EMF, 2015a).

Further, participants were asked to list external factors (market, technology and legislation) that had the strongest perceived influence on the respective SME and to provide information about the economic sector, size and location of the company. Respondents were also asked to describe their position in the company.

² Compass Verlag GmbH [Accessed: 26-08-2019].

Table 2
Topical areas of the circular economy.

Topical areas	Examples of quotes used for categorization
Sustainability	<p>“Environmental culture refers to the philosophy, habits and attitudes of the company” (Rizos et al., 2016, p. 3, p. 3)</p> <p>“...placing profit in a secondary role of importance for the benefit of employers, the community and nature.” (Zamfir et al., 2017, p. 3)</p> <p>“...sustainability is part of their vision (...), working to improve that aspect.” (D’Amato et al., 2018, p. 4, p. 4)</p>
Resource efficiency	<p>“Higher resource efficiency also means reduced costs.” (Stahel, 2012, p. 4, p. 4)</p> <p>“Resource efficiency or narrowing resource flows, aimed at using fewer resources per product.” (Bocken et al., 2016 p. 309)</p> <p>“...increased capacity in utilization and the efficiency of the resources.” (Caldera et al., 2019, p. 576, p. 576)</p>
Differentiation	<p>“CE will give companies new profit possibilities, increase competitive advantage.” (Lewandowski, 2016, p. 15, p. 15)</p> <p>“...creating competitive advantages and new markets are among the main reasons for European SMEs.” (Rizos et al., 2016, p.2)</p> <p>“A differentiation strategy aims to distinguish a company’s (...) from competing ones.” (Mura et al., 2020, p. 5–6)</p>
Collaboration with stakeholders	<p>“...to provoke system change by communicating and collaborating for the Circular Economy” (Geissdoerfer et al., 2018, p. 719, p. 719)</p> <p>“Collaborative consumption models are recognized as one of the best available options on the consumer side to shift from the present business-as-usual model to CE.” (Ghisellini et al., 2016, p. 23, p. 23)</p> <p>“Dialogue between institutions...” (Mura et al., 2020, p. 4, p. 4)</p>
Independence from resource supply	<p>“It replaces the concept of waste with the one of restoration and aims to decouple economic growth from the use of virgin resources.” (EMF(b), 2015, p. 7)</p> <p>“CE-type arrangements of the physical flows of materials and energy would reduce virgin inputs into the system and waste and emissions outputs from the system.” ((Korhonen et al., 2018a, p. 40)</p> <p>“...idea of a CE is celebrated for its potential to decouple growth from resource use.” (Reike et al., 2018, p.249)</p>
Life cycle knowledge	<p>“...designing optimal product life-cycle scenarios for new products and processes (...) requires in-depth knowledge about ongoing enhancements and the optimization of part replacement.” (de Jesus and Mendonça, 2018, p. 81, p. 81)</p> <p>“Caterpillar engineers study returned components and continually improve the company’s ability to remanufacture them at lower cost and higher quality.” (EMF, 2012, p.72)</p>

3.3. Data analysis

The IPA was originally developed for marketing research (e.g., buyer/supplier perception gap (Weinfurter and Hansen, 1999)), then adapted for use in healthcare (Abalo et al., 2007), and later used to examine the perception of electric vehicles (Riedner et al., 2019). The original method (Martilla and James, 1977) presents the results of performance and importance ratings with five- or seven-point Likert scales (usually the mean values) in a four-quadrant scatter plot. (Fig. 1a).

The main emphasis is placed on the “Concentrate here” quadrant, which represents a gap between importance and performance ratings and, therefore, indicates opportunities for improvement (Martilla and James, 1977; Abalo et al., 2006, Ka et al., 2015). To clarify the graphical representation of the analysis, a diagonal line was drawn (Fig. 1b) to highlight topics of higher importance than performance. All topics located above the diagonal line have a higher priority than those located below the line; the data-centered approach (based on the aggregated mean values of the importance

and performance ratings) (Fig. 1b) was used to adjust the quadrants to the distribution of the IPA results (Abalo et al., 2007; Rial et al., 2008). To determine a significant difference (p -value < 0.05) between the mean values of importance and the performance ratings of the topical areas, either a two-sample t -test (when two mean values are compared) or an analysis of variance (ANOVA) (when two or more mean values are compared) was performed (Ka et al., 2015).

Furthermore, an exploratory factor analysis (EFA) was conducted to examine whether the importance and performance of the assessed topical areas of the CE share a similar structure. A principal component analysis (PCA) was performed to identify new factors that contain information about the overall importance and performance of the topical areas (Ka et al., 2015). A hierarchical cluster analysis, which is considered as appropriate for smaller data sets (~150 observations), was then used to group the respondents based on the new factors. To determine the optimal number of clusters, the elbow method was used, enabling the minimization of the total variation within the clusters. In addition, the Ward method was

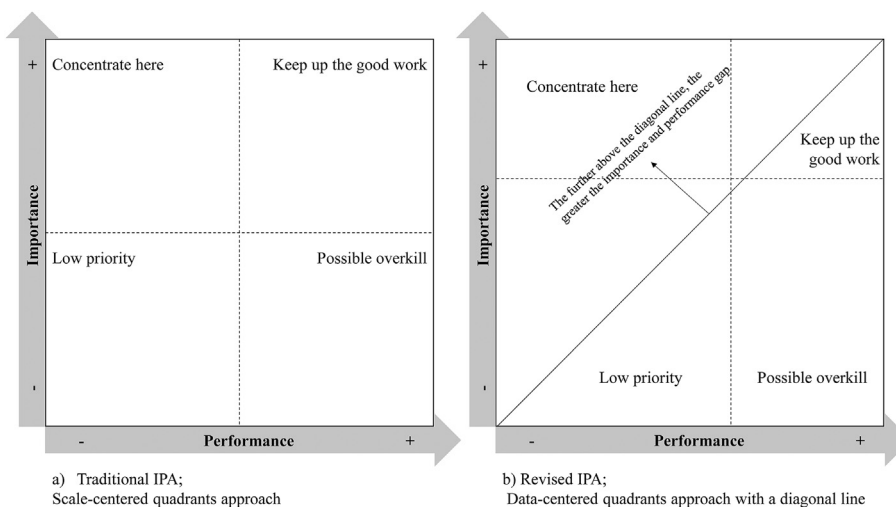


Fig. 1. a and b: Different importance-performance visualization types. Source: constructed by the authors, adapted from Martilla and James (1977), Abalo et al. (2006); Ka et al. (2015)

Table 3
Sample characteristics (N = 183).

Company size	Micro (0–9) 50.8%	Small (10–49) 35.5%	Medium (50–250) 13.7%	
Location	Styria 56.8%	Carinthia 23.5%	Burgenland 14.2%	NA 5.5%
Branch of the company	Manufacture 47%	Construction 8.7%	Wholesale 7.7%	
	Service Activity 12%	Waste management 8.7%	Others ^a 15.8%	
Main external influence	Market 56.8%	Legislation 18.6%	Technology 18.6%	Mixed ^b 6%
Position in company	CEO/Owner 82.5%	Head of Department 9.3%	Assistant 8.2%	
Relevance of CE for the company	High relevance 37.2%	Moderate relevance 42.1%	Low relevance 16.4%	NA 4.3%

^a Others: Agriculture, Forestry, Fishing (4.4%), Electricity, Gas, Steam (4.4%), Professional, Scientific, Technical (7.1%).

^b Mixed: Same importance in all categories.

used to allocate the clusters by computing the distances of all objects based on the squared Euclidean distances and then grouping the objects that increase the sum of squares the least (Kabacoff, 2015).

4. Results and discussion

4.1. Sample characteristics

Since the questionnaire results reflect the company representatives' perceptions in the CE topical areas, and 82.5% of the respondents indicated that they were the CEO or the owner of the respective SME, the fact that most of the respondents in the company held a higher position strengthens the significance of the results.

Moreover, the company characteristics for the sample correspond to the distribution of companies in Austria, as the majority of SMEs are micro-sized companies (50.6%) and were founded in Styria (56.8%). With regard to the branch of industry, SMEs in the manufacturing sector (47%) account for the largest share, followed by SMEs in the service sector (12.2%), the construction sector (8.7%) and wholesale trade sector (7.7%) (Table 3). According to national statistics³ 345200 SMEs are based in Austria (99.6% of all enterprises), 87% of which are micro- (0–9 employees), 11%, small- (10–49 employees) and 2%, medium-sized (50–250 employees) companies. Most SMEs are in the trade (23%), services (20%), construction (11%) and manufacturing (7%) sectors.⁴

In general, respondents stated that CE was of interest for their companies (CE had moderate relevance: 42.1%, CE had high relevance: 37.2%). The market itself (56.8%) was most often perceived as the strongest external influence on the company, followed by legislation and technology (18.6%).

4.2. Importance-performance analysis

Table 4 presents the results of a two-sample *t*-test comparing the mean values of the performance and importance ratings of the six topical areas for CE. A significant difference between them was observed, except for "Collaboration with stakeholders," where almost no difference was seen (0.04).

The biggest gaps detected for all respondents were ranked in the following order: "Resource efficiency" (−0.79), "Independence from resource supply" (−0.65), followed by "Sustainability"

(−0.48), "Differentiation" (−0.33) and, finally, "Life cycle knowledge" (−0.32). Thus, the largest gaps perceived appear to be in the efficient processing and procurement of resources. Fig. 2 illustrates the IPA plot, where the red dotted lines represent the aggregated mean value of the importance (5.7) and performance (5.3) ratings of the CE topical areas, creating data-centered quadrants. Since all topical areas (except "Cooperation with stakeholders") display higher importance than performance ratings and, therefore, are arranged above the horizontal line (Fig. 2), each of these are areas in which opportunities for improvement exist. In this study, performance was assessed as perception rather than as actual behavior; therefore, the results illustrate the attitudes of SME representatives rather than their actual behavior. However, the results also indicate that the company representatives in the sample firstly consider the topical areas to be important because of the overall high ratings and secondly identify opportunities for improvement in their companies, as performance was rated inferior to importance.

The three topical areas "Resource efficiency," "Sustainability" and "Differentiation" are perceived as more important than the others, which is not consistent within the gap sizes, since "Independence from resource supply" shows the second lowest importance, but the worst performance rating, representing the second highest gap after "Resource efficiency."

Moreover, we analyzed whether the perceived importance and performance ratings of topical areas of the CE differed between groups of SMEs, depending on how relevant CE was perceived to be for the respective SME. The importance of all topical areas correlates with the relevance of the CE (Pearson correlations between $r = -0.179$ and -0.391 with $p < .05$ for all topical areas; see Table B.1 in Appendix B). The more relevant the CE is perceived to be by a company representative, the more important all topical areas were perceived to be. In the case of "Differentiation" and "Life cycle knowledge," the correlations appear to be comparatively lower, while "Sustainability" correlated the most strongly.

If CE was considered as relevant for the respective SMEs, the importance and performance ratings tended to be higher on average. The perceived performance in the case of "Independence from resource supply" was identified, but this seemed to be an exception, as can be seen in Table 5. The analysis of variance (Table 5) results verify the results of the gaps for SMEs in terms of whether the relevance of CE was perceived differently (i.e., high, medium and low relevance). Significant differences were found in the gaps with regard to the topical areas "Sustainability," "Cooperation with stakeholders" and "Independence from resource supply."

In case of "Sustainability," the biggest gap was perceived by company representatives who rated CE as moderately relevant

³ KMU Forschung Austria [12-01-2021].

⁴ KMU im Fokus, 2019 [12.01.2021].

Table 4
Paired two-sample *t*-tests for mean differences between performance and importance (*N* = 183).

Topical areas	Mean Performance	Mean Importance	Gap (P-I)	<i>t</i>	<i>p</i> -value
Sustainability	5.79	6.27	-.48	4.667	***
Resource efficiency	5.52	6.31	-.79	7.983	***
Differentiation	5.37	5.70	-.33	3.440	***
Collaboration with stakeholders	5.11	5.07	.04	-0.398	.69
Independence from resource supply	4.68	5.33	-.65	4.587	***
Life cycle knowledge	5.20	5.52	-.32	-2.867	***

Responses for all items range from 1 (not important/low performance) to 7 (high importance/high performance) Significance codes: ****p* < .001, ***p* < .05, **p* < .1.

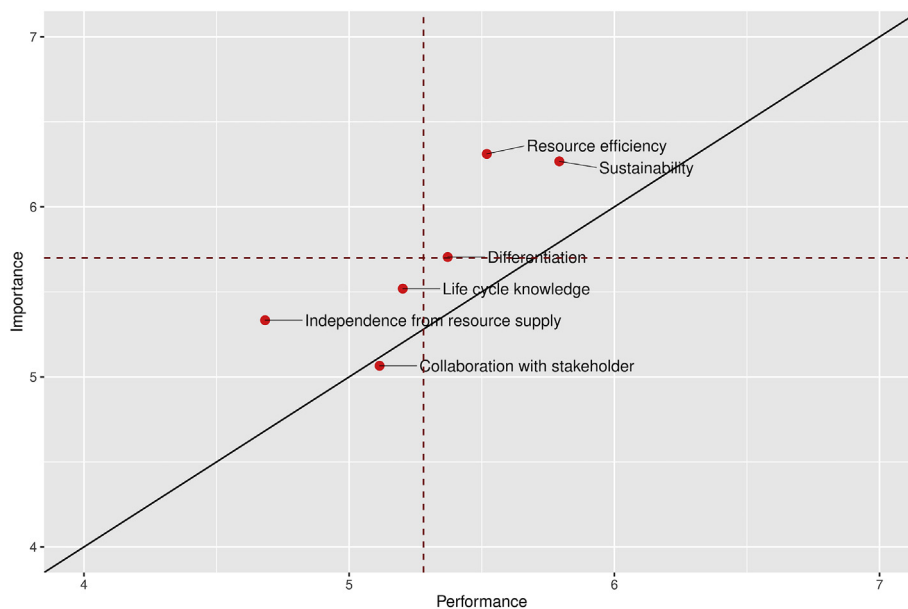


Fig. 2. Importance-performance analysis of the entire sample (*N* = 183).

Table 5
Analysis of the variances (ANOVA) of gaps (P-I) for different perceptions of the relevance of CE for the respective SME (*N* = 183).

Relevance CE	Importance				Performance				GAP (P-I)			
	high	mod.	low	<i>p</i>	high	mod.	low	<i>p</i>	high	mod.	low	<i>p</i>
Sustainability	6.66	6.29	5.27	***	6.31	5.55	5.20	***	-.36	-.74	-.067	**
Resource Efficiency	6.65	6.30	5.53	***	5.97	5.38	4.87	***	-.68	-.92	-.67	.48
Differentiation	6.03	5.47	5.43	**	5.69	5.21	5.00	**	-.34	-.26	-.43	.82
Collaboration stakeholder	5.5	5.08	4.17	***	5.46	4.88	5.03	**	-.044	-.20	.87	***
Independence resource supply	5.78	5.27	4.63	***	4.90	4.47	4.70	.2	-.88	-.81	.067	*
Life cycle knowledge	5.90	5.51	4.97	**	5.49	5.13	4.77	*	-.412	-.377	-.2	.85

Responses for all items range from 1 (not important/low performance) to 7 (high importance/high performance). The relevance for CE was measured on a 1–7 Likert scale and transformed into a new variable (ranging from 1 to 2 as “high”, 3–4 as “moderate,” and 5–7 as “low” relevance). Significance codes: ****p* < .001, ***p* < .05, **p* < .1.

(-.74), followed by those who rated CE as highly relevant (-0.36). Almost no gap was detected in the case of a low perceived relevance of CE (-0.067). It appears as though company representatives who consider CE to be relevant take a more critical attitude towards sustainability than those company representatives who do not consider CE to be relevant for their business. In the case of “Collaboration with stakeholders,” low gap values were observed for respondents who assigned high (-0.044) and moderate (-0.20) relevance to CE, while a comparatively high overperformance was perceived by the respondents in the case of low relevance (0.87). The largest gaps were found in the topical area “Independence from resource supply” (high: -0.88, moderate: -0.81). In contrast, low CE relevance (0.067) corresponds with a small gap (0.067).

The biggest gap among all topical areas was found in the case of “Resource efficiency” for respondents who assigned a moderate relevance to CE (-0.92), but no significant differences to the other levels of relevance were detected, since all groups showed rather large gaps.

The results of the IPA (Fig. 2) illustrate that the transition to CE in SMEs can be fostered by establishing a sustainable corporate philosophy and using and procuring resources efficiently. However, if we examine these findings with respect to how the respondents perceived the relevance of the CE, it becomes apparent that the topical area “Resource efficiency” is perceived as important regardless of the CE, since even SMEs whose representatives showed little interest in CE show a large gap in this area. In contrast,

respondents considered “Independence from resource supply” as more important if they considered CE as relevant to their company. Therefore, these study results contribute to the current literature and support the current policy recommendations. For example, the EC (2020) or EMF (2015) policies set resource efficiency as a key principle for a CE rather than procurement or decoupling from resource dependency. In a similar manner, the literature has primarily referred to resource efficiency as an explicit or implicit goal of CE activities (e.g., Rizos et al., 2016; Ghisellini et al., 2016). However, the focus on resources must not be pervasive, as “Cooperation with stakeholders” was consistently ranked as the least important, although it is considered as a key component of the CE for integrating new business models (parts, leasing), collaborative production, or solving complex problems (Lewandowski, 2016; Köhler et al., 2019). Perhaps the opportunities in this topical area have not yet been recognized by SMEs.

The present sample indicated that the assessed company characteristics are weak predictors (Table B.2 in Appendix B). Significant differences were found in the gaps of company size. Therefore, larger companies in the sample displayed larger gaps in “Differentiation” (−0.68), “Cooperation with stakeholders” (−0.68) and “Independence of resource supply” (−1.44).

4.3. Establishing strategic groups of small and medium-sized enterprises to implement circular economy

An EFA was used to analyze the structure of all responses of the importance and the performance ratings of the topical areas of the CE. The Kaiser-Meyer-Olkin (Kaiser, 1974) measure of sampling adequacy (KMO = 0.687) indicated that the structure was suitable for further analysis. Thus, a PCA using a Varimax rotation was carried out, indicating the presence of two factors that accounted for 44.95% of the total variance. Results of the subsequent reliability analysis of the two factors revealed high Cronbach’s alpha values (Table 6) for both factors (factor 1 ($\alpha = 0.739$); factor 2 ($\alpha = 0.741$)). Accordingly, individual items were aggregated to compute the following scales: (1) the overall performance in topical areas of the CE and (2) the overall importance of the topical areas of the CE.

Consequently, a hierarchical cluster analysis was carried out based on the two new factors. The elbow method (Fig. B1 Appendix B) was used to determine the number of clusters. The curve decreases further after four clusters, indicating that a four-cluster solution is supported by the data. Furthermore, the hierarchical classification (Ward method) of the clusters is graphically displayed in a dendrogram (Fig. 3).

To illustrate the classification of all 183 companies, the four cluster groups were presented in an IPA grid (Fig. 4). Each point in

Fig. 4 represents an SME included in the sample, based on its overall performance and importance of the topical areas of the CE. Subsequently, an IPA was applied to the four clusters (Fig. B2 in Appendix B). Although large differences were identified in the perceived importance and performance of the topical areas of the CE (Table B.3 in Appendix B), their ranking remained almost identical in all four clusters. A detailed analysis of the four clusters, their ranking and their sample characteristics (Table B.4 in Annex B) is presented below.

Cluster 1 (28% of the sample) contains SMEs with representatives who perceived high importance and performance in the topical areas of the CE (Fig. 4), as these are located close to the diagonal line, indicating small gaps. The three largest gaps were identified in the topical areas “Resource efficiency” (−0.35), “Life cycle knowledge” (−0.22) and “Independence from resource supply” (−0.14). This cluster comprises those company representatives for whom CE was perceived as highly relevant (60%) as well as the largest share of companies in waste management (18.6%). Cluster 1 could be considered as “CE forerunner,” as companies from the waste management sector are typically perceived (Garcés-Ayerbe et al., 2019) or as perceived forerunners while overestimating their actual performance. In this case, policymakers and economic development agencies may have difficulties to reach these companies, because they see no benefit in receiving support. While companies in this cluster do not seem to need as much external support, these results could be used to identify and study best-practice examples.

Cluster 2 (30% of the sample) contains SMEs whose representatives indicated that the topical areas were important but perceived their performance as lower than seen in cluster 1; these SMEs are located further above the diagonal line (Fig. 4), indicating that there are greater gaps within this cluster. The three largest gaps were identified in the topical areas “Independence from resource supply” (−1.27), “Resource efficiency” (−0.97) and “Sustainability” (−0.75). This cluster represents the highest percentage of market- (60%) and legislation-driven companies (29%), but the fewest technology-driven companies (5%). Cluster 2 could be considered to be comprised of “fast followers.” There is no need to explain benefits of a CE to companies assigned to this cluster, but they may require support to realize their goals. These results were not surprising, since this cluster contains the largest proportion of market- and legislation-driven companies and, hence, consists of companies whose representatives perceived external pressures that drove them relatively strongly towards a CE. External pressures may not only explain the high perceived importance but also the relatively lower perceived performance. The largest gaps in this cluster seem to correlate with resource-related topical areas.

Table 6

Principal component analysis and Cronbach’s alpha for the importance and performance items in the topical areas of the CE.

Factors:	Items	Factor loading	
		Factor 1	Factor 2
The overall performance in the topical areas of the CE	Performance - Resource efficiency	.780	
	Performance - Independence from resource supply	.718	
	Performance - Differentiation	.715	
	Performance - Sustainability	.673	
	Performance - Life cycle knowledge	.553	
	Performance - Collaboration with stakeholders	.447	
The overall importance of the topical areas of the CE	Importance - Differentiation		.687
	Importance - Sustainability		.682
	Importance - Independence from resource supply		.644
	Importance - Life cycle knowledge		.637
	Importance - Collaboration with stakeholders		.622
	Importance - Resource efficiency		.606
Cronbach’s alpha (α)		.739	.741

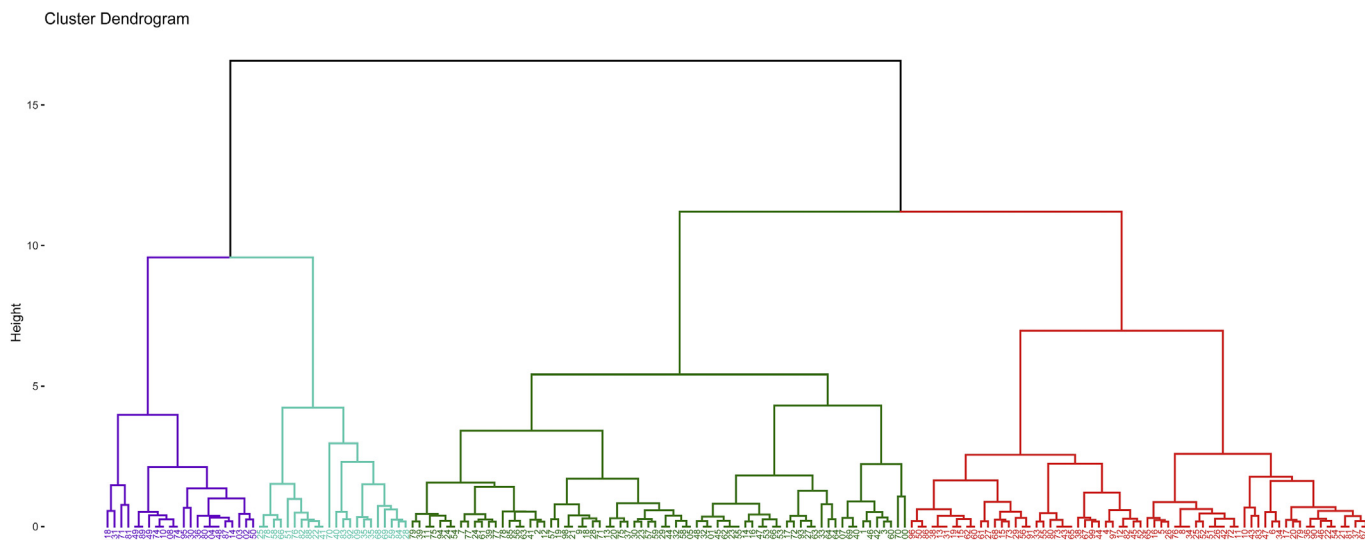


Fig. 3. Dendrogram of clusters (N = 183).

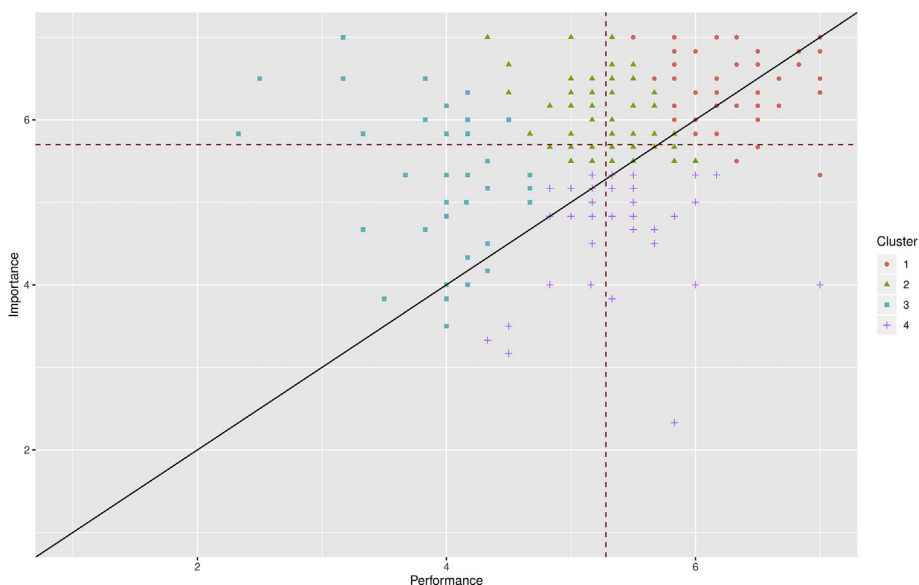


Fig. 4. Results of a cluster analysis based on overall importance and performance factors of all SMEs in the IPA grid (N = 183).

Policymakers and economic development agencies may identify this cluster as a main target group for CE-supporting activities.

Cluster 3 (23% of the sample) contains companies with the lowest average performance in the respective topical area, which indicates the existence of rather large gaps. The three largest gaps were identified in “Independence from resource supply” (−1.8), “Resource efficiency” (−1.74) and “Sustainability” and “Differentiation” (−1.35). This cluster contains the largest share of technology-driven companies (27.9%) and companies in the construction sector (15.2%). Even if the sample distribution in this study cannot be generalized to other populations, we assume that cluster 3 represents a “late majority.” Hence, policymakers and development agency representatives would first need to communicate with the companies in this cluster, convince them of potential advantages of the CE and motivate them to act.

In Cluster 4 (19% of the sample), only “Resource efficiency” (−0.03) appears above the diagonal line; all other topical areas

indicate higher performance than importance values. This cluster includes most companies whose representatives considered CE to have low relevance (34%) for their company, as well as most micro-sized companies (57%). Consequently, the performance values often exceed the perceived importance of the topical areas, leading to a potential overperformance. This cluster represents what could be called “laggards,” which will not adapt to a CE unless they are forced by legislative measures to do so (Ghisellini et al., 2016). Unlike Cluster 3, it may be assumed that resistance arises from structural conditions (e.g., consumer demand, lack of knowledge), while Cluster 4 seems to operate differently (Köhler et al., 2019) by displaying considerably less interest in the topical areas for a CE.

As noted by Tassinari et al. (2020), two shortcomings described in the prevailing CE literature are the CE monitoring process and the evaluation of CE implementation in companies. This statement is supported by Korhonen et al. (2018b), who classified CE research on the basis of sustainability. The focus has been placed primarily

on practical aspects and, in particular, (natural science) issues, instruments and metrics, such as energy and material flows, resource consumption, waste, or emissions. However, less attention has been devoted to (social science) issues, such as the organizational culture, attitudes, perceptions, and visions that contribute to a CE. To achieve a transformation towards a CE, sustainable innovations and technological solutions are required, but also a change in everyday practices and public perception (Köhler et al., 2019).

5. Conclusions

The aim of this study was to identify relevant topical areas of the CE and to identify opportunities for SMEs, providing initial guidelines to facilitate a transition towards a CE (e.g., de Jesus and Mendonça, 2018; Bocken et al., 2017). No previous studies have addressed the perception of importance and performance regarding topical areas in the CE in an SME context. Consequently, we identified attitudes or motivations of SMEs representatives that foster a transition towards the CE. This approach may provide policymakers, intermediaries, or cluster representatives with valuable information that enables them to address SMEs effectively. These contributions support the implementation of CE practices, as well as innovations and competitive advantages in SMEs, but also require SMEs to institute changes that range from strategies enacted by individual actors to systemic corporate changes (de Jesus and Mendonça, 2017).

First, by addressing the first research question, our findings enabled us to derive six topical areas of the CE from the existing literature (e.g., Bocken et al., 2016; Ghisellini et al., 2016; Lewandowski, 2016; Rizos et al., 2016; Linder and Willander, 2017; Geissdoerfer et al., 2018) and assess how appropriate these topical areas were for Austrian SMEs by examining the correlation between perceived importance and perceived relevance of the topical areas. The three topical areas “Resource efficiency,” “Sustainability” and “Differentiation” were perceived as most important in the context of a CE for Austrian SMEs.

The second research question was addressed using the methodological approach of an IPA. The IPA results illustrated which topical areas are more likely to contain opportunities (gaps) for Austrian SMEs. Austrian SME representatives considered the efficient use of resources is a key opportunity, an aspect that is also emphasized in the literature and policy reports; however, if CE is seen as relevant for the respective company, the procurement of resources becomes predominant. Cooperation with stakeholders seems to be an underestimated topical area in the present sample, since it is considered as a key component of the CE transition in the literature.

Third, the results of a CA illustrate the heterogeneity of the SMEs. This aspect has also been addressed by policymakers, intermediaries and cluster representatives (e.g., OECD, 2019; EC, 2020b), as this fact hinders consistent communication about CE implementation. Our data suggest that at least four different company clusters can be distinguished based on the perceived importance of and the perceived performance in topical areas of CE. These clusters, which can be described as “frontrunners,” “fast followers,” “late majority” and “laggards,” have distinct characteristics and may require different approaches to be taken regarding communication and support.

However, this study was constrained by certain limitations. First, it was exploratory in nature, and the findings are limited to this Austrian cross-industry sample. Further empirical validation of these findings in other economic settings or geographical areas is needed. Second, the sample used is not strictly representative. For example, manufacturing companies are overrepresented in terms of the Austrian sectoral distribution. This is not surprising, since

manufacturing companies are more heavily engaged with CE practices such as recycling (Garcés-Ayerbe et al., 2019). We also assumed that, due to a non-response bias, the sample generally overrepresented companies that considered a CE as relevant. Hence, the relative sizes of clusters 1 and 2 might have been overestimated. Therefore, future research could be carried out to place a focus on sectors that are less active in a CE. Since the perceived performance in our sample was usually lower than the perceived importance, CE implementation can be interpreted as an ongoing process that is still at an early stage (Ghisellini and Ulgiati, 2019). While the overall ranking of the topical areas in terms of their perceived importance and performance was rather uniform across the total sample (e.g., “Resource efficiency” first, “Collaboration with stakeholders” last), the responding SME representatives differed widely in how they perceived the importance and performance levels (e.g., small gaps, large gaps, high importance, low importance). These observations lead us to conclude that a few topical areas (e.g., “Resource efficiency”) dominate CE implementation in SMEs, while a larger number of topical areas could be involved.

Future research should be carried out to more carefully differentiate between rather general areas (“Resource efficiency,” “Differentiation”) and more CE-specific areas (e.g., “Independence from resource supply”). A broader consideration of different topical areas may help motivate formerly passive companies (e.g., clusters 3 and 4). While “forerunners” seem to be an obvious target for development agencies, the impact is probably limited. Therefore, those companies should be considered as best-practice examples. In comparison, development agencies and policymakers should support “fast followers,” not to convince them of a CE, but rather to offer them direct support (e.g., RDT collaboration). However, to facilitate a true transition towards a CE, the “late majority” group also requires consideration. This group is not yet convinced that a CE could provide them with business opportunities. In addition to improving communication about the CE, it may be necessary to find new ways to frame the CE (e.g., from a technology-push perspective) for this group.

Funding information

The authors gratefully acknowledge funding of the project Start Circles (Project Nr: 199), co-financed by the Cooperation Programme Interreg V-A Slovenia Austria from the European Regional Development Fund.

CRedit authorship contribution statement

Daniel Holzer: Conceptualization, Methodology, Formal analysis, Investigation, Writing – original draft, Writing – review & editing, Visualization. **Romana Rauter:** Conceptualization, Writing – original draft, Writing – review & editing. **Eva Fleiß:** Writing – original draft, Writing – review & editing, Formal analysis. **Tobias Stern:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

We warmly thank all companies that participated in this survey and for expressing interest in further cooperation. Cooperation

between business and science is particularly relevant in this area. Furthermore, we sincerely thank our colleagues at the Institute of Systems Sciences, Innovation and Sustainability Research for their excellent feedback.

APPENDIX A

Questionnaire in English

Pregiven Definition on CE: “The circular economy is a model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible. In this way, the life cycle of products is extended. In practice, it implies reducing waste to a minimum. When a product reaches the end of its life, its materials are kept within the economy wherever possible. These can be productively used again and again, thereby creating further value. This is a departure from the traditional, linear economic model, which is based on a take-make-consume-throw away pattern.”

(European Parliament, 2015. <https://www.europarl.europa.eu/news/en/headlines/economy/20151201STO05603/circular-economy-definition-importance-and-benefits> [26-08-2020].

- 1) How relevant is CE for your company? (on a Likert scale from 1 (very relevant) to 7 (not relevant))
- 2) How important are the individual topical areas for your company (on a Likert scale from 1 (not relevant) to 7 (important)).
- 3) How satisfied are you with the performance of your company in these topical areas of the CE (on a Likert scale from 1 (dissatisfied) to 7 (satisfied)).

Uniform explanation of the topical areas in the questionnaire:

- Companies that decrease their environmental impact because of their corporate philosophy and not because of legislative forces or strategic reasons display **sustainability**.
- Companies that maximize the effective use of resources, which not only reduces material and energy consumption but also reduces waste disposal, wastewater treatment and emissions display **resource efficiency**.
- Companies that have the capacity to distinguish themselves from competitors by finding new business opportunities and

transforming the business in a way that enhances market attractiveness (e.g., marketing) display **differentiation**.

- Companies that work together with stakeholders (e.g., suppliers, customers) and integrate them into internal processes or procedures display **collaboration with stakeholder(s)**.
 - Companies that reduce the degree to which they rely on the availability of external inputs from a limited number of companies or sources display **independence from resource supply**.
 - Companies that possess information about product utilization by, e.g., studying returned products after use can better understand customer behavior and product durability, which can be used to improve products and increases customer loyalty. These companies display **life cycle knowledge**.
- 4) Which of the following aspects is more important for your company?
(1 Left important – 3 Neither important nor unimportant – 5 Right important)
Market or Legislation; Market or Technology; Legislation or Technology
 - 5) In which branch of industry is your company located?
 - 6) What is the size of your company?
 - Micro sized enterprise//1–9 employees/Turnover ≤ € 2 million/Balance sheet total ≤ € 2 million
 - Small sized enterprise//10–49 employees/Turnover ≤ € 10 million/Balance sheet total ≤ € 10 million
 - Medium sized enterprise//50–249 employees/Turnover ≤ € 50 million/Balance sheet total ≤ € 43 million
 - Large sized enterprise//more than 250 employees/Turnover > € 50 million/Balance sheet total > € 43 million
 - 7) In which year was your company established?
 - 8) Where is your company located? (Country/Province)
 - 9) What does your company provide? (Products, Services or both)
 - 10) What is your position in the company?
 - 11) What is your gender?

APPENDIX B

Table B.1
Correlations regarding the importance and performance of the motives and the relevance of CE variable

	Importance							
	Relevance CE	Sustainability	Resource efficiency	Differentiation	Collaboration stakeholder	Independence f. r. supply	Life cycle knowledge	
Performance	1							
Relevance CE		-.391***	-.341***	-.179**	-.309***	-.295***	-.205***	
Sustainability			.358***					
Resource efficiency				.425***				
Differentiation					.453***			
Collaboration stakeholder						.368***		
Independence f. r. supply							.0781	
Life cycle knowledge								.334***

Significance codes: 0 '***' 0.05 '**' 0.1 '*'.

Table B.2
Analysis of variances (ANOVA): Illustration of the significant values of the variables: “company size,” business orientation” and “company age”

	Importance				Performance				GAP (P-I)			
	Micro	Small	Med.	p	Micro	Small	Med.	p	Micro	Small	Med.	p
Differentiation	5.68	5.69	5.64	.9	5.32	5.58	4.96	*	-.364	-.113	-.68	*
Collaboration stakeholder	4.88	5.15	5.68	*	5.27	4.98	5	.38	.398	-.161	-.68	***
Independence f. r. supply	5.32	5.24	5.8	.2	4.81	4.61	4.36	.36	-.511	-.629	-1.44	*

Significance codes: 0 '***' 0.05 '**' 0.1 '*'.

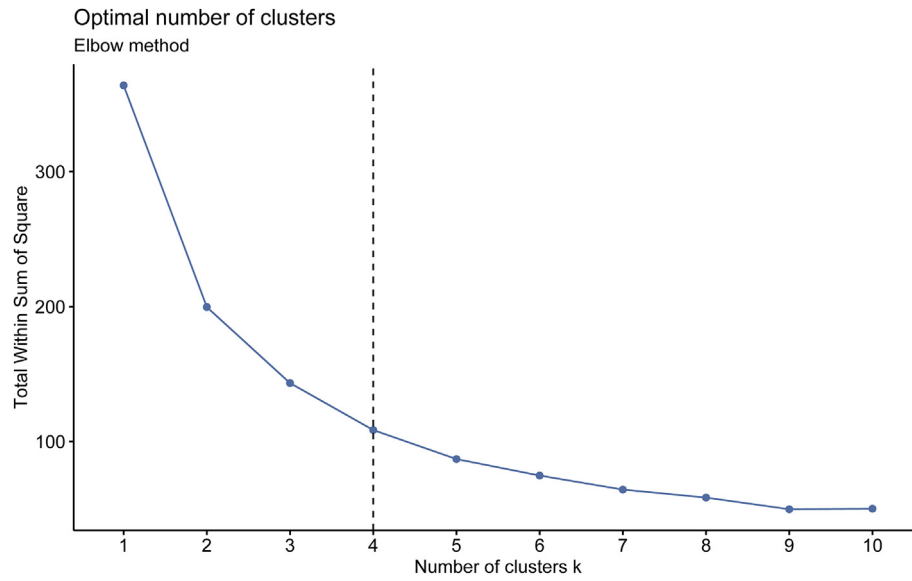


Fig. B1. Elbow method.

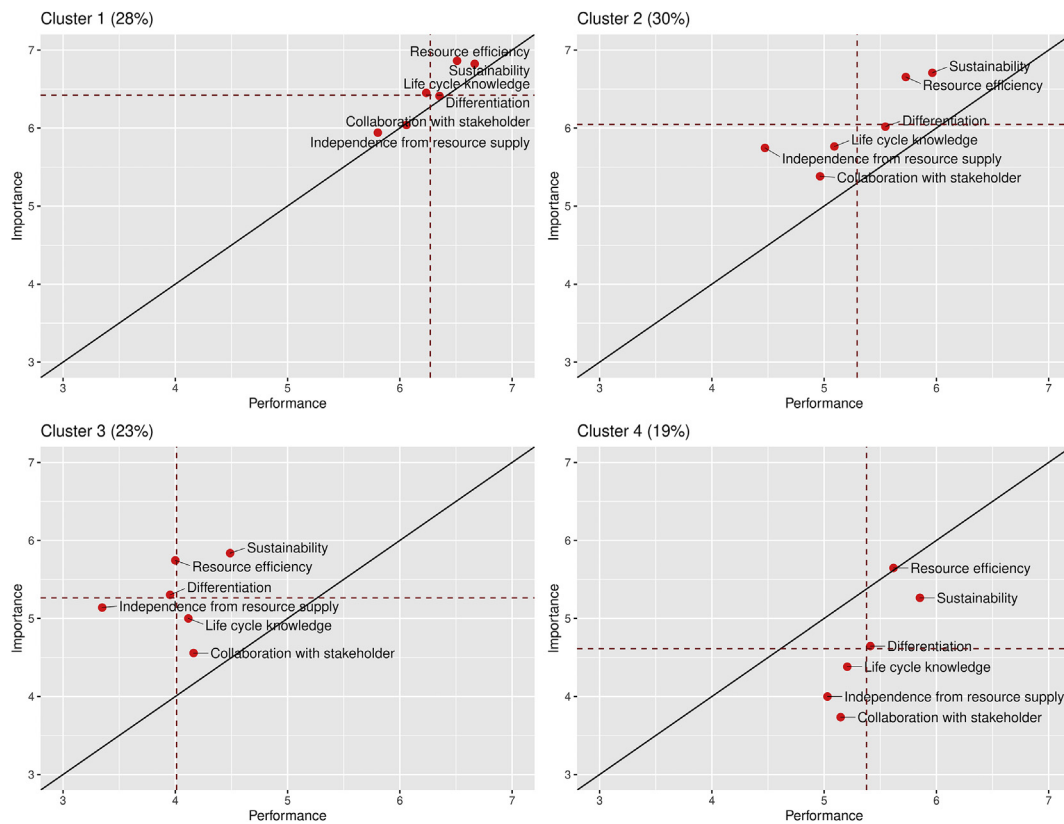


Fig. B2. IPA of all four cluster (N = 183).

Table B.3
Analysis of variances (ANOVA): illustration of the significant values of the four clusters

Cluster	Importance					Performance					GAP (P-I)				
	1	2	3	4	p	1	2	3	4	p	1	2	3	4	p
Sustainability	6.82	6.71	5.84	5.26	***	6.67	5.96	4.49	5.85	***	-.16	-.75	-1.35	.59	.36
Resource efficiency<	6.86	6.65	5.74	5.65	***	6.51	5.73	4	5.62	***	-.35	-.93	-1.74	-.03	.56
Differentiation	6.41	6.02	5.30	4.65	***	6.35	5.55	3.95	5.41	***	-.06	-.42	-1.35	.77	.37
Collaboration stakeholder	6.04	5.38	4.56	3.74	***	6.06	4.96	4.16	5.15	***	.02	-.42	-.4	1.41	***
Independence f. r. supply	5.94	5.75	5.14	4	***	5.8	4.47	3.35	5.03	***	-.14	-1.27	-1.79	1.03	*
Life cycle knowledge	6.45	5.76	5	4.38	***	6.24	5.09	4.12	5.21	***	-.22	-.67	-.88	.82	**

Significance codes: 0 '***' 0.05 '**' 0.1 '*'.

Table B.4
Description of the characteristics of the individual clusters

	Company size	Micro 51.1%	Small 29%	Medium 19.9%		
Cluster 1	Branch company	Manufacture	Construction	Wholesale	Service Activity	Waste management
	External influence	Market	Legislation	Technology	Mixed*	18.6%
	Relevance CE	High	Moderate	Low	2%	
Cluster 2	Company size	Micro	Small	Medium		
	Branch company	Manufacture	Construction	Wholesale	Service Activity	Waste Management
	External influence	Market	Legislation	Technology	Mixed*	10%
Cluster 3	Company size	Micro	Small	Medium		
	Branch company	Manufacture	Construction	Wholesale	Service Activity	Waste Management
	External influence	Market	Legislation	Technology	Mixed*	6.1%
Cluster 4	Company size	Micro	Small	Medium		
	Branch company	Manufacture	Construction	Wholesale	Service Activity	Waste Management
	External influence	Market	Legislation	Technology	Mixed*	3%

*Mixed: Same importance in all categories.

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