Self-assessment tool - English version

KFU-SIS

(WP T.1.1.1)

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CONTENT

1. WP T 1: SUPPORT TOOLS FOR CIRCULAR ECONOMY ORIENTED INNOVATIONS

The aim of this activity was to create a method to identify suitable SMEs and R&D partners and to foster exchange between them according to the aims of this project. The method also aims to raise awareness and knowledge on sustainability and resource efficiency, especially with regard to the implementation of the new waste management directives that will affect enterprises. The aim of the project partner KFU-SIS in work package T 1.1 is the conception and implementation of a self-check tool for the circular economy orientation in small and medium-sized enterprises.

1.1 REQUIREMENTS FOR WP T1.1: " SELF-ASSESSMENT TOOL FOR SMALL AND MEDIUM SIZED COMPANIES IN A CIRCULAR ECONOMY

According to the sample criteria specified in the project proposal, the sampling of the companies using this self-check tool was as follows:

- Location: The project programme area INTERREG Austria-Slovenia was taken into account, therefore Austrian companies from the provinces of Styria, Carinthia and Burgenland as well as Slovenian companies were considered.
- Company size: The sample comprises only small and medium-sized enterprises (SMEs). The definition of SMEs is based on the recommended EU definition[1].
- Industrial sector: Due to the focus of the project partners only SMEs from the wood and polymer industry were selected.

Objective of WP T1.1: To test the self-assessment tool of circular economy orientation in SMEs, with representatives of at least 40 SMEs (20 Austrian and 20 Slovenian SMEs).

1.2 QUESTIONNAIRE DESIGN

The questionnaire (which is the basis of this self-assessment tool) was developed using the Importance-Performance Analysis (IPA) method (Figure 1). An iterative, semi-structured literature search identified six potential motives (Table 1) for the introduction of the circular economy (CE) in companies, which formed the basis of an online survey.

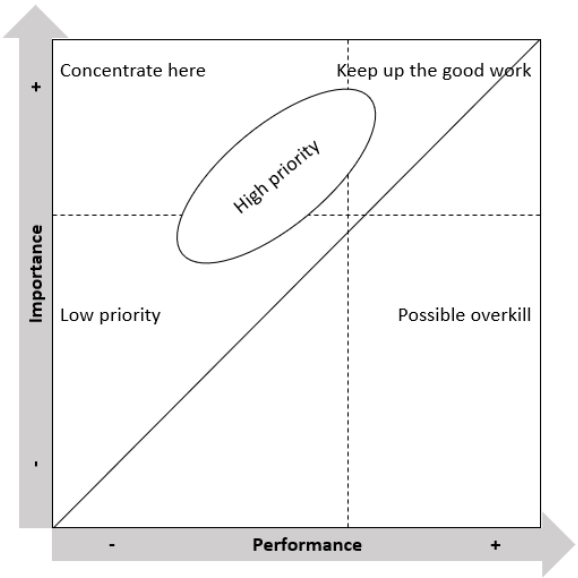

Figure 1: Visualization of the IPA (personal drawing, adapted from Lai & Hitchcock (2015) "Data-centered quadrant approach and diagonal line model

[1] KMU Definition, Europäische Kommission

Table 1: Potential motives for implementing CE (Source: Own compilation based on literature)

CE Motives	Uniform description in the questionnaire	Additional information
Sustainability	Companies that reduce their environmental impact based on their corporate philosophy rather than legislative forces or strategic reasons demonstrate **sustainability**.	Sustainability is shown by companies that reduce their environmental impact based on their corporate philosophy and not on legal obligations or strategic reasons. As in Rizos et al. (2016), this category was introduced to cover internal motives within the company.
Resource efficiency	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, demonstrate **resource efficiency**.	Resource efficiency increases profits by reducing the consumption of materials or energy (Linder & Williander, 2017). This category is characterized by optimal resource use, which can reduce costs (Stahel 2012) and reduce waste and emissions (Bocken et al. 2016).
Differentiation	Companies that differentiate themselves from the competition by finding new business opportunities and redesigning the company in such a way that the market attractiveness is increased (e.g. through a marketing activity) demonstrate **differentiation**.	Differentiation is shown by companies that differentiate themselves from other companies by creating new services and thereby increase their competitive advantage (e.g. Lewandowski 2016; Ness & Xing (2017); Rauter et al. 2018). Companies that find sustainable concepts or solutions (e.g. Fairphone , Recover Brands) can increase market attractiveness and achieve competitive advantages on the market.
Collaboration with stakeholder	Companies that work with stakeholders (interest groups) and integrate them into internal processes or procedures demonstrate **collaboration with stakeholder**.	Collaboration with stakeholders is seen as a key element of CE, as a product is linked to an entire supply or value chain; therefore, the growth that takes place within a network of industrial partners and research institutions also promotes CE activities (e.g. industrial symbiosis, off-site recycling), (Lewandowski 2016).
Independence from resource supply	Companies that reduce their degree of dependence on the availability of external inputs from companies or other sources show **independence from resource supply**.	Independence from resource supply can increase the resilience of companies (e.g. oil prices, lack of supply). In order to overcome dependency, the Ellen MacArthur Foundation (2015a) emphasizes the 3Rs principles (Reuse, Recycle, Remanufacture), which have already been extended up to 10 Rs (with the addition of Refuse, Reduce, Repair, Refurbish, Repurpose, Recover, Remine) to minimize the use of materials (Reike et al., 2018).
Life cycle knowledge	Companies that have information about product usage (e.g. returned products) can better understand customer behavior and product consistency, which can be used to improve products and increase customer loyalty. These companies demonstrate **life cycle knowledge** about their product.	Life cycle knowledge refers to information gained about product use to minimize errors and improve the understanding of company representatives of customer consumption patterns, as well as to optimize the product itself by securing spare parts or reconditioning parts (Ellen MacArthur Foundation 2015b).

The respondents were asked to rate both the perceived importance (Likert scale: 1 - unimportant, 7 - important) and the perceived performance (Likert scale: 1 - dissatisfied, 7 - satisfied) of the six CE motives in their own company. The aim of the IPA is to reveal differences between the individual motives in terms of their perceived importance and performance level. These differences become more relevant for the individual company when a motive is considered important, but the performance level is lower.

In addition, it was asked whether the market, technology or legislation has the strongest influence on the companies in the sample. Other aspects that were surveyed are the branch of industry, company size, company location, as well as the gender, age and position of the respondents in the company. The participating representatives of the companies were identified by the Compass Group database (data export: 24 April 2019) and by a snowball procedure of contacts by the project partners. The online survey was sent by e-mail to 723 SMEs (513 companies in the wood sector, 210 companies in the polymer sector) between June 2019 and November 2019. In the end 71 SMEs participated in the survey, which corresponds to a response rate of 9.8%.

1.3 SAMPLE COMPOSITION

In terms of demographic characteristics (Table 2), most respondents (N = 71) stated that they are CEO or owner of the respective SME (52.1%), the second largest group being heads of department (25.4%). As the results of the questionnaire reflect the perception of the employees of SMEs, a higher position in the company confirms the validity of the results.

38.5% of the enterprises are located in Slovenia, 61.5% in Austria. Regarding enterprise size, the sample is evenly distributed across the three subdivisions and most enterprises are in the manufacturing sector (53.5%). Furthermore, the market is perceived as the strongest external influence (63%) and the largest share of enterprises offers both products and services (49.3%).

Table 2: Sample composition (*n*=71)

Respondents 'characteristics				
Position in company	CEO/Owner	Head of Dept.	Ass. M.	Auth. Sig.
	52.1%	25.4%	14%	7%
Age	18-38	39-54	55-67	
	26.1%	52.2%	21.7%	
Gender	Female	Male		
	34%	66%		
Company characteristics				
Company size	Micro (1-10)	Small (11-50)	Medium (51-250)	
	38%	32.5%	29.5%	
Branch of the company	Manfacture	Construction	Wholesale	Service
	53.5%	18.3%	15.5%	12.7%
Main external influence	Market	Legislation	Technology	Mixed*
	63%	11.3%	18.3%	7.4%
Business orientation	Products	Service	Both	
	38%	12.7%	49.3%	
Company age	1-15	16-40	41+	
	25.5%	40%	34.5%	
Location	Slovenia	Austria**		
	38.5%	61.5%		

*Mixed: Same importance in all categories
** Austria: Styria (30%), Carinthia (19%), Burgenland (12.5%)

2. RESULTS

2.1 RESULTS OF THE IMPORTANCE-PERFORMANCE ANALYSIS

Table 3 shows the results of a two-sample t-test, in which average values of performance and average values of importance of the six CE motives are compared.

Table 3: Two-sample *t*-test of performance and importance of the six CE motives

CE Motive	Importance	Performance	Gap (L–W)	*t*	*p*
Sustainability	5.41	6.16	-.753	5.096	***
Resource efficiency	5.26	6.46	-1.2	9.271	***
Differentiation	4.86	6.01	-1.15	6.940	***
Collaboration with stakeholder	4.96	5.73	-.765	5.514	***
Independence from resource supply	4.56	5.64	-1.07	6.988	***
Life cycle knowledge	4.99	5.59	-.6	2.944	***

Likert Scale 1-7 (1 not important/low performance; 7 high important/high performance)

Level of significance: ***p <.001, **p < .05, *p < .1

The mean values of importance are higher than the mean values of performance in all CE motives. This fact allows the performance of an "Importance-Performance-Gap Analysis", which indicates that there

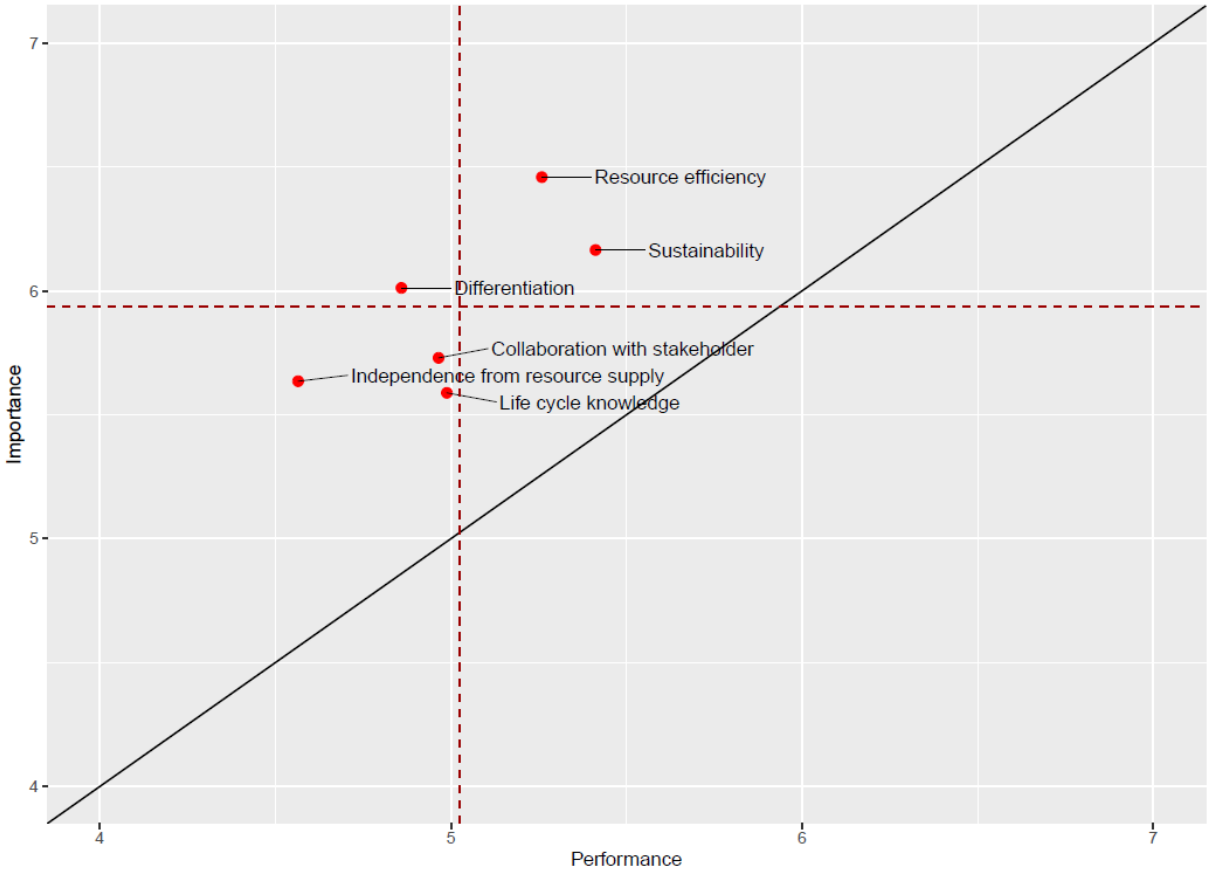

Figure 2: Importance-performance analysis of the entire sample (*n*=71)

is a demand for improvement or motivators regarding CE in the sample. To provide an easy and intuitive representation of the IPA (Figure 2), the scale values were adjusted to the added mean values of the CE motives. The red dotted lines have been adjusted to the mean scores of combined importance (5.88) and combined performance (5.02) of all motives. According to the quadrant model of the original IPA (Martilla & James 1977), the motive "Differentiation" lies in the quadrant "Concentrate here", the two motives "Resource efficiency" and "Sustainability" in the quadrant "Keep up the good work" and the remaining three motives in the quadrant "Low priority". Since a gap value is generated for each motive and therefore all motives can provide opportunities for improvement, a ranking of the gap values appears to be reasonable. The highest gap values can be found in the motives 1) "Resource efficiency" (-1.2), 2) "Differentiation" (-1.15), 3) "Independence of resource supply" (-1.07), 4) "Cooperation with stakeholders" (-.765), 5) "Sustainability" (-.753), and 6) Knowledge about the product life cycle (-.6). In order to illustrate these improvement opportunities in the six motives for each company, two solutions are presented in succession.

2.2 IMPROVEMENT OPPORTUNITIES FOR THE COMPANIES

In addition to an overview of the mean values of the individual motives, an IPA provides a more specific insight into the individual assessment of the motives for the respective company. This is of particular interest when cooperation or consultation with individual companies is considered.

Figure 3 presents an IPA for each CE motive with the corresponding distribution of SMEs within. The individual companies are presented according to their responses regarding the importance and performance in the CE motives. This allows a specific insight into which motive an SME has a need for action (if the importance is higher than the performance).

This presentation allows us to identify the improvement opportunities for individual companies in the respective CE motives in order to make thematic distinctions and to formulate specific recommendations regarding the CE implementation process.

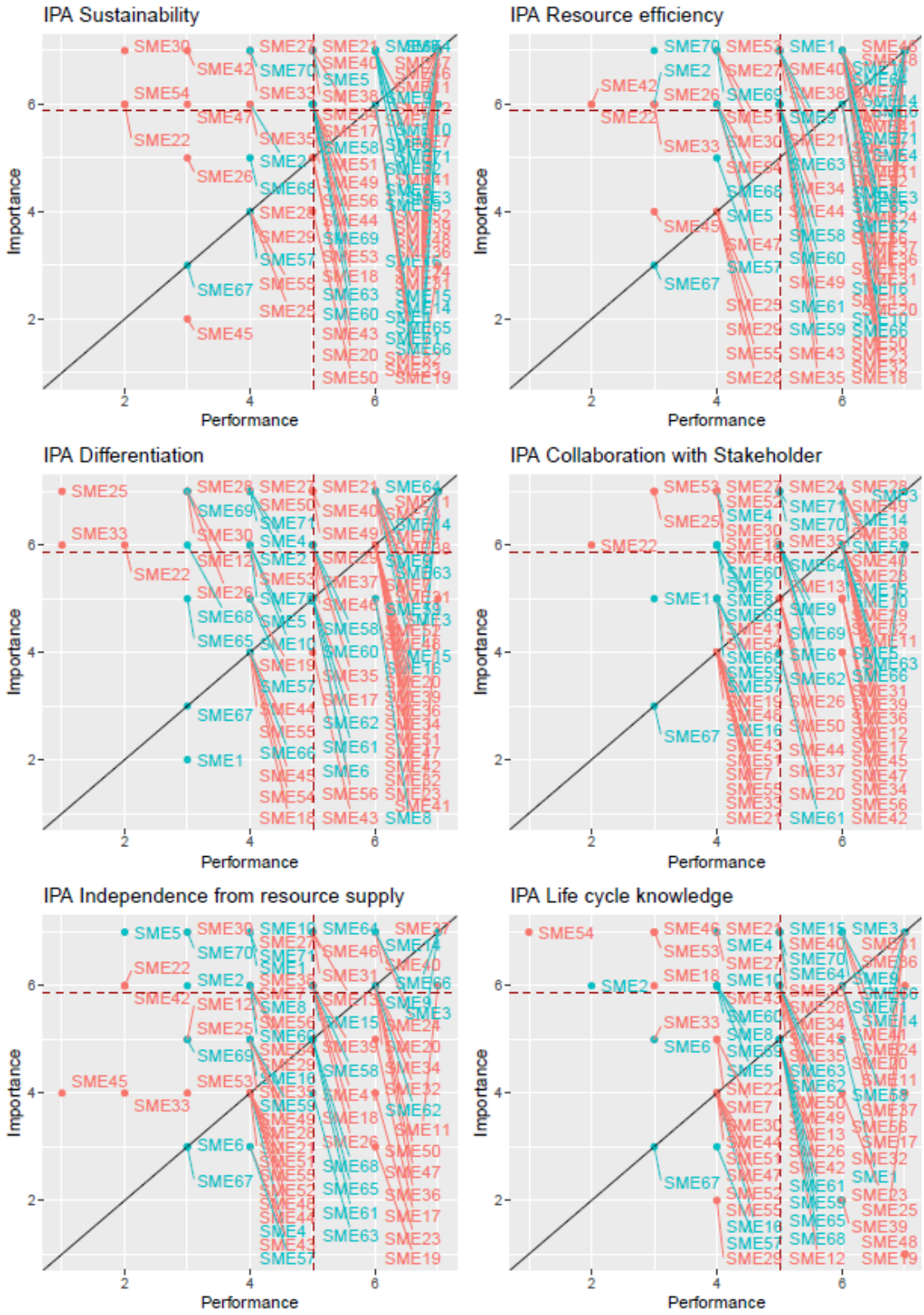

Figure 3: IPA of the individual CE motives (red: Slovenian enterprises; blue: Austrian enterprises)

2.3 STRATEGIC GROUPS OF SMES IN A CIRCULAR ECONOMY

To identify strategic groups of SMEs, a cluster analysis based on an exploratory factor analysis (EFA) was carried out. For this purpose, the six questions of importance and performance of the CE motives were selected for a factor analysis. Both the Bartlett test (Chi-square (66) = 468,685, p < .000) and the Kaiser-Meyer-Olkin (Kaiser 1974) measure of sample adequacy (KMO = .787) show that the variables are suitable for a factor analysis. A two-factor solution was chosen, since considerable cross-charges were found in other factor solutions (Table 4), which explain 54.5% of the variance.

Tabelle 4: EFA und Reliabilitätsanalyse der Variablen der Wichtigkeit und der Leistung in den CE Motiven

Factors	**Variables**	**Factor loading**	
		Factor 1	Factor 2
Performance in CE Motives	Performance - Resource efficiency	.851	
	Performance - Independence from resource supply	.801	
	Performance - Differentiation	.710	
	Performance - Sustainability	.839	
	Performance – Life cycle knowledge	.698	
	Performance – Collaboration with Stakeholder	.503	
Importance in CE Motives	Importance - Differentiation		.568
	Importance - Sustainability		.719
	Importance - Independence from resource supply		.700
	Importance – Life cycle knowledge		.718
	Importance – Collaboration with Stakeholder		.667
	Importance - Resource efficiency		.524
Cronbachs Alpha (α)		.861	.767

A subsequent reliability analysis of the two factors resulted in high Cronbach alpha values for each factor (Factor 1 (α =.861); Factor 2 (α =.767)), which led to the identification of two new variables; (1) the general performance in the CE motives and (2) the general importance of the CE motives, using a sum scale method. Based on the two new variables, a hierarchical cluster analysis was performed. To determine a number of clusters, the Silhouette method (Figure 4) was used, which allows an assessment of the relative quality of the clusters and an overview of the data configuration. The average width of the silhouettes allows an assessment of the validity of cluster formation and can be used to select an appropriate number of clusters.

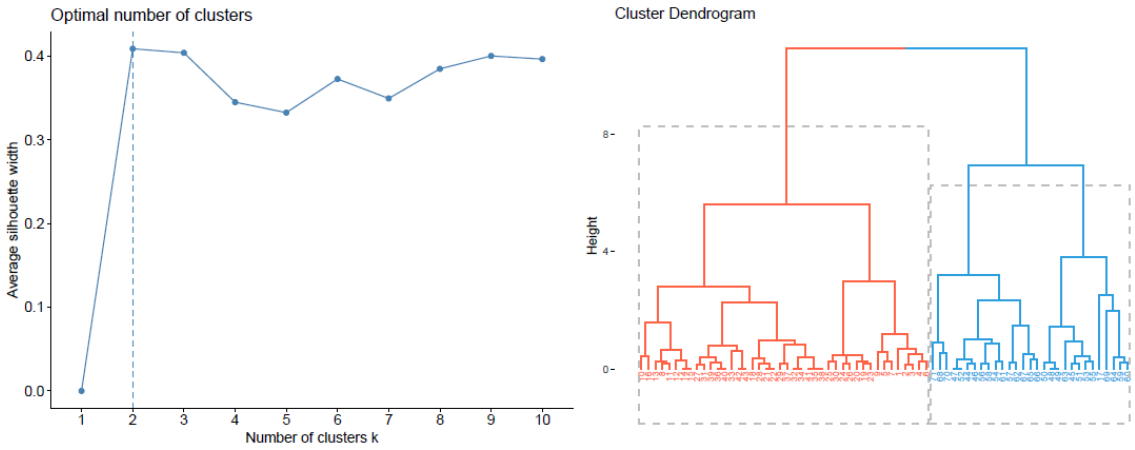

Figure 4: Silhouette method und dendrogram of the cluster distribution

A two-cluster solution is recommended for the present data material. To perform the cluster analysis, the Ward method based on the proximal dimensions of Euclidean square distances was used, since this method is less sensitive to the inclusion of outliers than other hierarchical cluster methods (Kabacoff, 2015).

Another two-sample t-test (Table 5) is required to distinguish the average power and importance of the six CE motives of the two clusters.

Table 5: Two-sample t-test of performance and importance of the six CE motives of the two clusters.

Cluster 1 (*n*= 37)	**Performance**	**Importance**	**Gap (L–W)**	***t***	***p***
Sustainability	6.24	6.65	-.41	3.402	***
Resource efficiency	6.14	6.81	-.68	5.795	***
Differentiation	5.65	6.35	-.7	3.499	***
Collaboration with Stakeholder	5.41	5.95	-.54	3.002	***
Independence from resource supply	5.19	5.97	-.78	4.117	***
Life cycle knowledge	5.57	6.03	-.46	1.590	*
Cluster 2 (*n*= 34)	**Performance**	**Importance**	**Gap (L–W)**	***t***	***p***
Sustainability	4.35	5.59	-1.24	4.055	***
Resource efficiency	4.24	5.94	-1.71	7.701	***
Differentiation	3.97	5.56	-1.59	5.067	***
Collaboration with Stakeholder	4.38	5.38	-1	3.842	***
Independence from resource supply	3.71	5.06	-1.35	4.449	***
Life cycle knowledge	4.21	5.03	-.82	2.216	**

Likert Scale 1-7 (1 not important/low performance; 7 high important/high performance)

Level of significance: ***p <.001, **p < .05, *p < .1

The values of importance of the CE motives are higher in both clusters than the values of performance in the CE motives. Cluster 1 has higher values than Cluster 2 in both the performance and the importance of the CE motives, but the differences in the mean values are smaller in Cluster 1 compared to Cluster 2. For clarification, Figure 5 shows the cluster analysis. Each item represents one SME from the sample, based on the new variables, the overall importance and performance of the CE motives.

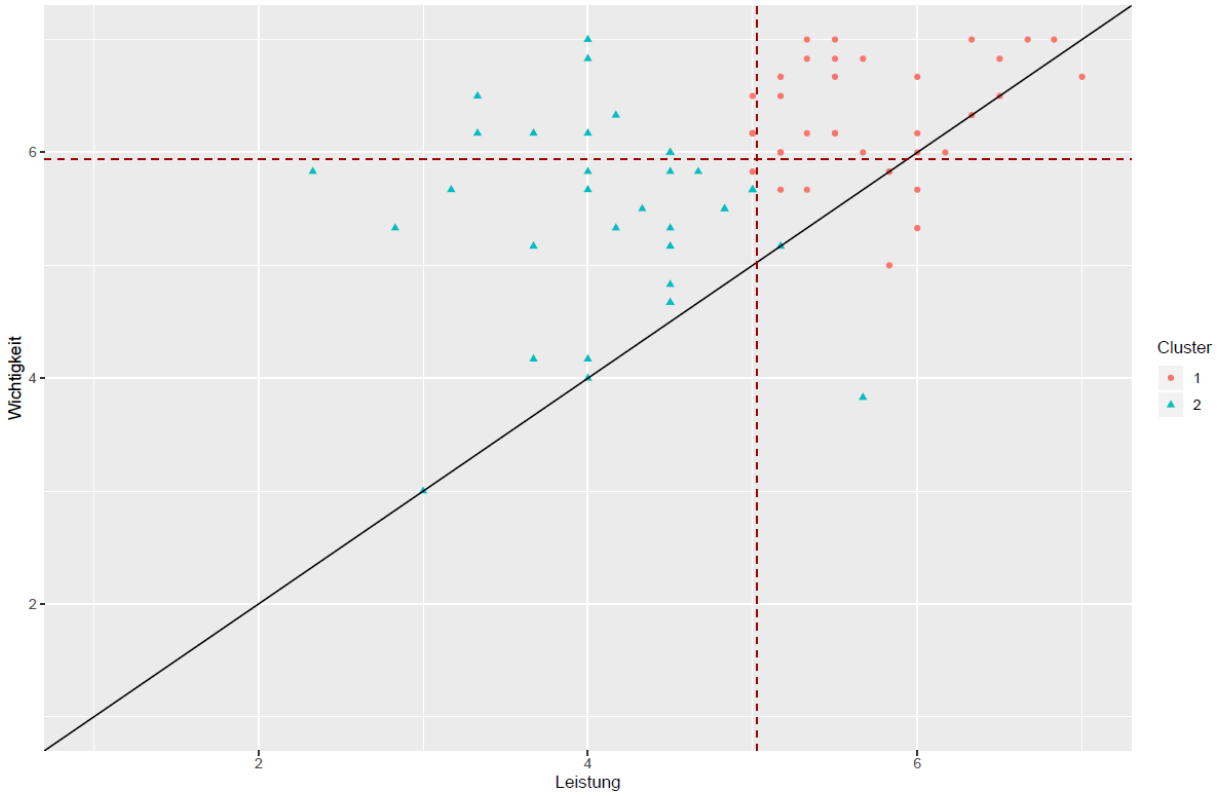

Figure 5: Results of the cluster analysis based on the overall importance and performance of the CE motives of all SMEs, presented in an IPA Grid (*n*=71)

Cluster 1 (52.1% of the sample) contains SMEs whose representatives show both high importance and high performance in CE motives (Figure 5). The gaps between the mean values of importance and performance of the CE motives are lower than in cluster 2, which is illustrated by smaller gap values. The three largest I-P gaps are in the motives “Independence from resource supply” (-.78), “Differentiation” (-.7), and “Resource efficiency” (-.68).

The SMEs in Cluster 2 (47.9% of the sample) are mainly characterized by lower values in the performance of the CE motives, resulting in significantly higher gap values. Although the three largest I-P gaps are in a different order, they are also found in the motives “Resource efficiency” (-1.71), “Differentiation” (-1.59) and “Independence of resource supply” (-1.35).

3. CONCLUSION & RECOMMENDATIONS

The cluster analysis (based on summarized importance and performance of all CE motives) offers policy makers, intermediaries or cluster representatives the opportunity to identify heterogeneous SMEs (OECD 2019) as specific target groups, to address them in a consistent way and to support them during the implementation of CE.

Relevant for policy makers, intermediaries and cluster representatives is the fact that the largest I-P-Gaps in both clusters are linked to resource-related motives and to market positioning and differentiation from competitors.

Companies assigned to cluster 1 (high importance and high performance) are likely to be less dependent on external support but could be used to identify and study possible best-practice examples. The benefits of CE within the company appear to be well known, but in some cases, support may be needed to achieve their objectives, as again the values of performance are consistently lower than those of importance.

Cluster 2 represents companies whose representatives still consider the CE motives to be important (but less than in Cluster 1), but whose performance in the CE motives is assessed to be significantly lower. For Cluster 2, it is necessary to clearly communicate the advantages of CE on the one hand, and to provide concrete recommendations for action and support on the other.

The external influences of the company (industry, business activity, location, etc.) show no clear differences between the two clusters. Therefore, the results suggest that external factors are not the decisive determinants for a CE, instead the motivators for a CE are located internally or in the company's corporate culture.

For a more in-depth cooperation between Start Circles and the SMEs in the sample, it is particularly useful to consider the individual improvement opportunities of the SMEs (Figure 3) in order to focus on the underlying CE motives. This method offers a possibility to locate each SME in each motive in order to find the motive that offers the greatest potential for improvement for the respective SME towards CE.

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