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RESEARCH ARTICLE

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Key elements in assessing circular economy implementation in small and medium-sized enterprises

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Abstract

The circular economy has become an important issue in recent years because it makes sustainable development feasible by creating value in the economy and by closing the energy and materials loops. However, since most companies continue to operate under a linear model, it is particularly important to start providing companies with tools that facilitate their shift to the circular paradigm. The main objective of this research is to establish the key elements that are necessary for assessing the level of circular economy implementation. To that end, the Delphi method is used to validate and define the key elements of three categories: circular economy fields of action, industrial symbiosis, and environmental certifications. As a result, this study identifies the key elements that assess the degree of circular economy implementation and that allows small and medium-sized enterprises to understand where they are and what they need to do to improve their performance.

KEYWORDS

certifications, circular economy, Delphi method, environmental management, fields of action, industrial symbiosis

1 | INTRODUCTION

In these challenging times, when environmental crisis is threatening social and economic sustainability, it is crucial that academics, policy-makers and practitioners share their knowledge and interact with each other to design eco-innovative solutions that move industry towards real sustainable development. One globally accepted solution is the circular economy (CE), a paradigm that aims to generate economic prosperity, protect the environment and prevent pollution (Prieto-Sandoval, Jaca García, & Ormazabal Goenaga, 2016). Within this paradigm, resources are taken from nature, transformed into products, distributed in the marketplace, consumed and then recovered through biological and technical cycles (McDonough & Braungart, 2002). In so doing, the flows of materials are closed, waste in industrial ecosystems is minimized, and symbiosis is fostered (Stahel, 2016).

This economic model does not reject economic growth, but sets limits on the exploitation of resources; if human societies pursue growth, they should be limited to the closed-loop of resources and energy, with a minimum amount of emissions (Prieto-Sandoval, Jaca García, & Ormazabal Goenaga, 2016). Consequently, this solution has been bolstered legally and financially over the last decade in countries and regions such as South Korea, the UK, China, the USA, the Nordic countries and the European Union (EU) (Murray, Skene, & Haynes, 2017; Patala, Hämäläinen, Jalkala, & Pesonen, 2014).

From the perspective of the supply side or individual business efforts, a large and growing body of literature has investigated the sustainable business models that have emerged from this

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paradigm, including recycling activities, remanufacturing (Lieder & Rashid, 2016), and product system services (PSS) which focus on selling performance instead of goods (Stahel, 1998; Tukker, 2015). Nonetheless, traditional and linear business models constitute most of the manufacturing industries (Linder & Williander, 2017), so businesses require guidance in their transition to a circular system in order to understand the circular economy step by step.

Academics, consultants and institutions have made several attempts to guide the global society toward CE implementation. In the field of research, numerous studies have proposed indicators for assessing and evaluating CE implementation (Geng, Fu, Sarkis, & Xue, 2012; Su, Heshmati, Geng, & Yu, 2013; Zhijun & Nailing, 2007). A recent study on CE implementation was undertaken by Lieder and Rashid (2016), who analysed the motivations that exist among CE stakeholders and proposed a strategy for aligning them through national public institutions and industry efforts. Additionally, consultancy firms like EMG (Elffers, 2014) have advanced general suggestions for transforming businesses and industries, and others have proposed ways to improve materials management. For example, McDonough Braungart Design Chemistry LLC developed the Cradle to Cradle design framework (McDonough & Braungart, 2002), and the Ellen MacArthur Foundation and Grata Design developed the Material Circularity Index (Ellen MacArthur Foundation & Grata Design, 2015). Such proposals tend to be focused on the macro or meso levels, meaning countries, regions, industrial parks and large-scale approaches in general (Geng, Mitchell, & Zhu, 2009; Prieto-Sandoval, Jaca, & Ormazabal, 2018).

Governments and institutions play a crucial role in CE implementation. Their strategies mainly include developing new legislation, standards and eco-labels to recognize companies and products that are CE-compliant in some way; examples are the EU Ecolabel and EMAS awards, which reward organizations that are "contributing to making the European economy more circular" (EU Commission, 2017a), the Cradle to Cradle eco-label (MBDC, 2012), the British Standards Institution under the BSI 8001:2017 standard (BSI Group, 2017), and the Towards Zero Waste certificate, which falls under the RC-2015 standard and was launched by the Spanish Association for Standardization and Certification in 2015 (AENOR, 2015). Although the standards offer key points about how companies can progress towards CE, they still do not give companies information about how to start.

To the best of our knowledge, there is no specific guidance for assessing CE implementation level at the micro-scale, meaning the CE efforts made by individual companies. It is important to point out that some companies are implementing CE actions, even though they do not know what the linear or circular economy is (Ormazabal, Prieto-Sandoval, Puga-Leal, & Jaca, 2018). Bearing this in mind, the main objective of this study is to provide companies with a set of key elements that they can use to assess their level of circular economy implementation. This assessment process and the resulting score will help companies to understand both the path that leads to a circular economy approach and their starting position on that path.

Consequently, the research questions that arise from this research are:

RQ1:. What are the key elements of CE implementation?

RQ2:. Are all the key elements equally important?

In the next section, we present the theoretical framework for CE. This is followed by an explanation of the Delphi method applied in this research. The results of the Delphi study as well as the discussion are presented in section 4, and the main conclusions are presented in section 5.

2 | THEORETICAL FRAMEWORK

A considerable amount of literature has been published on the circular economy, especially since it began to grow in importance in terms of legislation in countries and regions like China, the UK, and the EU (Boons, Spekkink, & Mouzakitis, 2011; Prieto-Sandoval et al., 2018). This framework aims to highlight the definition of CE, its fields of action, the role of industrial symbiosis, and the related environmental certifications.

A variety of definitions of CE have been suggested during the last decade (Geng & Doberstein, 2008; Haas, Krausmann, Wiedenhofer, & Heinz, 2015; Kirchherr, Reike, & Hekkert, 2017; Lieder & Rashid, 2016). In this paper, the circular economy is understood as "an economic system that represents a change of paradigm in the way that human society is interrelated with nature and aims to prevent the depletion of resources, close energy and materials loops, and facilitate sustainable development through its implementation at the micro (enterprises and consumers), meso (economic agents integrated in symbiosis) and macro (city, regions and governments) levels. Attaining this circular model requires cyclical and regenerative environmental innovations in the way society legislates, produces and consumes" (Prieto-Sandoval et al., 2018, p. 610). From this definition, four components of the CE emerge: (i) the recirculation of resources and energy, the minimization of demand for resources, and the recovery of value from waste, (ii) a multi-level approach, (iii) its importance as a path to achieve sustainable development, and (iv) its close relationship with the way society innovates.

Regarding the fields of action, many scholars hold the view that the CE should be understood in stages like a process (Ellen MacArthur Foundation, 2013; Stahel, 2016), which has been explored by Ormazabal et al. (2018) as a way to measure the level of implementation of CE in firms. Nonetheless, to the best of our knowledge, the limits of the CE fields of action and their number have not been sharply defined in previous studies. This indicates a need to understand the various perceptions, and as a consequence, we propose that CE can be understood through five main fields of action: Take, make, distribute, use and recover (Prieto-Sandoval, Jaca, & Ormazabal, 2017).

- **Take**: this term refers to the way in which industries take resources and energy from the environment. In the CE paradigm, companies should try to be more efficient and responsible about their use of biological and technical resources. This means they should select the suppliers and the materials they use according to environmental criteria that reduce the impact on nature.

Moreover, this field is strongly related to companies' economic benefit (Lieder & Rashid, 2016).

- **Make**: as soon as resources are obtained, they become part of the process that produces goods and services. In this field of action, those processes can be carried out in a sustainable way with ecological innovations (eco-innovations) and the best technological practices (Carrillo-Hermosilla, Del Río, & Könnölä, 2010).
- **Distribution**: this phase is associated with the way in which a product or service is delivered to the customer. Companies must ensure the efficiency and traceability of the product's distribution in order to reduce environmental impact. For example, companies can optimize transport routes or packaging (Zhang, Li, Zhao, & Mu, 2010).
- **Use**: as soon as goods and services are purchased by consumers or other companies, the CE proposes reducing the environmental impact associated with the use of the product (Stahel, 2016). In this field of action, the environmental efficiency of products can be improved by repairing or reusing them as second-hand products. This means that organizations should innovate their business models in two particular ways. First, they may allow customers to return the product after use, in order to extend its lifecycle through after-sales services or maintenance (Carrillo-Hermosilla et al., 2010; Mont, 2002; Tukker, 2015). Second, they could promote the The Authors Business Strategy and Product Service System model, which means offering customers the use of tangible goods instead of owning them (Tukker, 2015). Under this model, ownership and management of the good are maintained by the producer or distributor of the service (Stahel, 1982; Witjes & Lozano, 2016).
- **Recover**: in the CE, eco-innovation processes are boosted to recover the waste, materials and energy that remain in used products at the end of their lifecycle (Park, Sarkis, & Wu, 2010; Stahel, 2016). Waste should be managed as a biological or technical resource which may be redirected and returned to the biosphere or to the industrial process, thus closing the loop (McDonough & Braungart, 2002). Reverse logistics strategies are also very important in this field of action (van der Wiel, Bossink, & Masurel, 2012). Additionally, supply chain management is an important pillar in recovery activities and closes the loops (Lieder & Rashid, 2016).

At the same time, the CE cannot be examined without talking about industrial symbiosis, which Chertow defines as "the activity that engages traditionally separate industries in a collective approach to competitive advantage involving physical exchange of materials, energy, water, and/or by-products" (Chertow, 2000, p. 313). In other words, a successful transition to a CE paradigm requires an industrial metabolism in order to close the loops through different value chains. Industrial symbiosis has been widely documented and applied in ecosystems with large companies in China and European countries. In the case of small and medium-sized enterprises (SMEs), industrial symbiosis is gaining importance because a collaborative atmosphere helps them build competitive advantage (Porter, 1998) and support environmental innovation (Biondi, Iraldo, & Meredith, 2002). Furthermore, scholars have already documented multiple cases in the paper industry and in tanneries where SME clusters have become more competitive and sustainable through the construction of industrial metabolisms (Daddi & Iraldo, 2015; Daddi, Nucci, & Iraldo, 2017). But little has been written to guide the creation of this type of industrial metabolism in SMEs and to describe the most important features that define it. Thus, industrial symbiosis could be considered a sixth and transversal field of study based on the fact that the exchange of materials, energy, water, and/or by-products can be developed through any of the above five fields.

Therefore, although extensive research has been conducted on environmental certifications, no single study explores whether there is a direct relationship between those certifications and CE implementation in firms. Nonetheless, multiple governments, institutions and researchers have pointed out the importance of environmental management standards and eco-labels as instruments in facilitating CE implementation (BSI, 2017; EU Commission, 2017a; Evans et al., 2015) and the development of effective eco-innovations in firms (EU Commission, 2017b; Prieto-Sandoval, Alfaro, Mejía-Villa, & Ormazabal, 2016). In fact, the EMAS certification and the EU Ecolabel are part of the EU policy framework for sustainable consumption and production, and their proper implementation can boost firms' innovation, financial performance and competitiveness by increasing their resource efficiency (EU Commission, 2017b). Consequently, we included them in this study in order to assess their importance in a CE implementation process.

The evidence presented in this section suggests that the CE framework can be divided into three categories: (i) the CE fields of action, (ii) industrial symbiosis and, (iii) environmental certifications. In order to clarify the research questions given above, this paper analyses, for each of the categories, the key elements and their importance for CE implementation.

3 | METHOD

With the aim of addressing our research questions, this study is based on the theoretical framework described above and the Delphi technique. The Delphi method is a systematic and iterative process for structuring a group communication process in order to obtain consensus about a complex problem (Dalkey, 1969; Linstone & Turoff, 1975; Okoli & Pawlowski, 2004). The Delphi technique was used in this research project because it has been successfully used in studies focused on concept or framework development (Okoli & Pawlowski, 2004). In this case, this method is appropriate for understanding and defining the degree of importance that each field of action has in implementing the circular economy in firms. Moreover, this technique was selected because it provides access to the opinions of multiple experts from different regions at a reasonable cost. It is also anonymous and iterative, and it provides controlled feedback and a statistical response from the group (Landeta, 1999). Controlled feedback refers to the communication of the group opinions at the beginning of each round. Moreover, a statistical response guarantees the presence of each opinion in the result and reduces the pressure toward conformity (Landeta, 1999). One benefit of the Delphi technique is that anonymous participation gives panelists the freedom to express their views, which reduces bias. A second benefit is that the iterations give the experts time to think over the proposed topic by reconsidering their preliminary opinion. In contrast to other methods, the flexible design of the Delphi method permits the collection of richer data, which leads to a deeper understanding of the questions (Okoli & Pawlowski, 2004).

3.1 | Delphi participant selection

According to Scheele there are three primary kinds of panelists: "stakeholders, [...] who are or will be directly affected; experts, [...] who have an applicable specialization or relevant experience; and facilitators, [...] who have skills in clarifying, organizing, synthesizing, stimulating..." (Scheele, 1975, p. 65). Based on the objective of this study, our panelist selection criteria were oriented towards recruiting experts that had more than three years of experience in the CE, industrial symbiosis, the green economy, eco-innovation and environmental management and related topics. Moreover, the selection of participants took into account demographic and individual aspects such as gender balance, cultural diversity, and whether there had been previous contact between the Delphi coordinators and the participants, which ensured engagement with the activity. This last factor was important because the success of the Delphi technique depends on the willingness of participants to respond in every round and review the group's opinions.

In this study, 25 experts from different universities and consultancy firms were invited to participate in the Online Delphi Panel. The rate of acceptance was 44%, meaning there was a set of 13 participants, which included men and women of four different nationalities (Spanish, English, French and Portuguese). However, of the initial 13 participants, only 11 finished the three rounds (Figure 1), as two participants did not complete the Delphi rounds due to time constraints. The literature recommends between 10 and 18 experts on a Delphi panel, as it "does not depend on statistical power, but rather on group dynamics for arriving at consensus among experts" (Okoli & Pawlowski, 2004, p. 19).

As soon as the experts confirmed their participation, they were informed about the objective, and they received instructions about responding to the Delphi rounds online. At the end of each round, they received a statistical report that prompted them to rethink their opinions and look for consensus. In this report, each expert's previous answers and the mean of the group's ranking were provided (Skulmoski, Hartman, & Krahn, 2007). At the end of the Delphi process, all participants received a report on the activity and a certificate for their participation. Throughout the process, they never knew the identity of the other participants.

FIGURE 1 Delphi demographic data [Colour figure can be viewed at wileyonlinelibrary.com]

3.2 | Delphi structure and performance

The Delphi was structured into three assessment categories (Table 1). For the first category, CE fields of action, the Delphi questions began with a brief survey of the CE concept to build a unified perspective among participants from the beginning of the process. Then each field of action's worth was assessed through 11 global elements which were defined according to the theoretical framework. The second category was focused on the importance of six general issues in achieving industrial symbiosis in SMEs. The focus on SMEs was due to the reasons mentioned above: little has been written to guide the creation of this type of industrial metabolism in SMEs, even though it is known that integration makes SMEs more competitive and sustainable (Daddi et al., 2017; Daddi & Iraldo, 2015). Finally, the third category had the aim of assessing the importance of environmental management certifications in the implementation of the CE (Table 1).

The importance of these elements was assessed on a Likert scale from 1 to 7, where 1 is "Not important" and 7 is "Extremely important". Panelists were contacted via email or telephone and asked for additional explanations about their answers, especially when their opinions were too distant from the group. A total of three online Delphi rounds were carried out using Google forms, and at the end of every round the experts received a report with the overall results and comments by the panelists (names withheld). The Delphi process was finished as soon as the experts stopped changing their opinions, although consensus was not possible in certain cases, as will be explained.

4 | RESULTS AND DISCUSSION

This section discusses the findings which emerged from the Delphi panel and their statistical analysis. These results will enable firms to know how they perform regarding the key elements of CE in order to implement managerial and sustainable design strategies according to their own situations.

4.1 | Circular economy fields of action

The Delphi process starts by asking participants to agree on and validate the definition of the CE. Regarding the theoretical framework, the definition proposed to the panelists was: "The circular economy is a social, environmental, and economic paradigm, whose purpose is to prevent the depletion of resources and seek environmental regeneration through eco-innovative solutions and products that can be reintroduced in biological and technical cycles." First, participants were asked to what extent they agreed with this concept, and they were invited to justify their answer. After the three rounds, the participants agreed on the concept, after adding the importance of geographical location in the definition: "The circular economy is a social, environmental, and economic paradigm, whose purpose is to prevent the depletion of resources, encourage the performance of companies in the local territory and seek environmental regeneration through

TABLE 1 Main features of CE implementation in firms

Category		Element	References
CE fields of action	Take	Selection of biodegradable or easily recirculated materials in different value chains.	(McDonough & Braungart, 2002; Stahel, 2016)
		Environmental efficiency of production processes to reduce resource use and emissions.	(Lieder & Rashid, 2016)
		Sustainable energy sources for production.	(Park et al., 2010)
	Make	Environmental innovation in the design of sustainable products and services, in order to extend their lifecycles and facilitate recovery in the future.	(Carrillo-Hermosilla et al., 2010; Del Río, Carrillo-hermosilla, Könnölä, & Bleda, 2016; McDonough & Braungart, 2002)
		The recovery of raw material and resources in the internal process of the company.	(Park et al., 2010)
	Distribute	The development of a sustainable logistics system.	(Lieder & Rashid, 2016; van der Wiel et al., 2012)
	Use	The development of business models where the final consumer is not the owner of the goods.	(Antikainen & Valkokari, 2016; Stahel, 1998; Tukker, 2015)
		The offer of services that extend the life of the products or services.	(Graedel, 2000; Kortmann & Piller, 2016)
		Design of products that work with sustainable energies.	(McDonough, Braungart, Anastas, & Zimmerman, 2003)
	Recover	Channels of communication with customers to retrieve products that they no longer use or that they want to renew.	(Lewandowski, 2016; Lieder & Rashid, 2016)
		Recovery and industrial recirculation of materials from products that consumers do not use any more.	(Antikainen & Valkokari, 2016; Park et al., 2010; Sihvonen & Ritola, 2015; Stahel, 2016)
Industrial symbiosis		Belonging to an industrial association, cluster or related organization.	(Daddi et al., 2017; Daddi & Iraldo, 2015; Deutz & Gibbs, 2008; Short, Bocken, Barlow, & Chertow, 2014)
		Sharing infrastructure or services with industrial neighbors.	(Chertow, 2007)
		Valuing the "waste" of some companies as resources for others.	(Chertow, 2007; Kortmann & Piller, 2016; Tibbs, 2006)
		Creating joint value between companies.	(Chertow, 2007; Cohen-Rosenthal, 2000; Park et al., 2010; Sihvonen & Ritola, 2015)
		Managing aspects such as trust and transparency among potential partners in the industry.	(Baas, 2011; Chertow, 2007)
		Government and public institution intervention.	(Gibbs & Deutz, 2007; Rizos et al., 2016; Yu, Davis, & Dijkema, 2014)
Certifications		Certifications of environmental management systems for a company.	(AENOR, 2016; BSI Group, 2017; EU Commission, 2017a)
		Certifications of the product or service.	(EU Commission, 2017b)

eco-innovative solutions and products that can be reintroduced in biological and technical cycles."

Panelists were given the five CE fields of action with several elements for each of them. They were asked about the relevance of each field of action with respect to the others and also to select the elements that they considered most representative in the CE. Finally they were asked if there were any missing elements.

Based on the participants' comments during the three rounds, a scheme was designed to express the worth of each field of action in the assessment of the CE implementation in a company, including the elements proposed by the panelists (Figure 2). Among the most important findings, experts reported recover as being the most important field, and a recurrent theme in the Delphi process was the high importance of sustainable design strategies such as eco-design, biomimicry and Cradle to Cradle in the CE implementation process. In addition, the experts suggested highlighting the difference between up-cycling (giving materials the same or higher value) and down-cycling (decreasing the value of materials), even though they recognized both terms as part of the recover field of action.

Nonetheless, one of the experts suggested taking into account that the transition from a linear system implies the flow of materials that cannot be recovered yet.

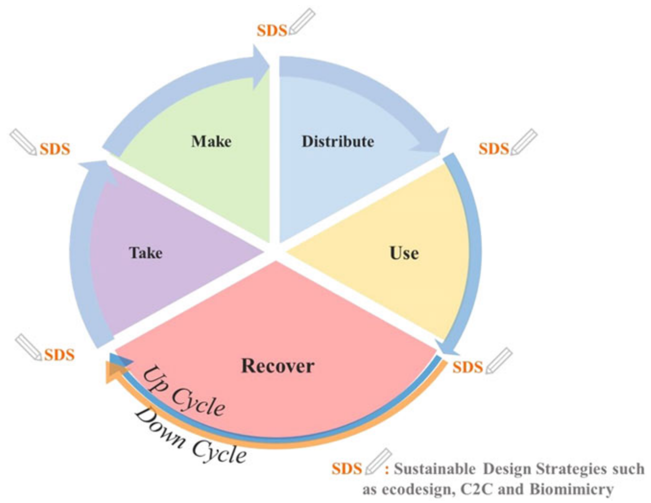

FIGURE 2 Proposed circular economy and fields of action scheme [Colour figure can be viewed at wileyonlinelibrary.com]

Moreover, during the three rounds, each CE field of action was globally analysed and experts were asked to rate from 1 to 7 the importance of the elements in CE implementation. Table 2 shows the final Delphi results.

Table 2 shows that at the end of the Delphi process, the mean score for each element in the CE fields of action was 5.9 and above,

TABLE 2 Main features of CE implementation in firms by fields of action. Likert scale from 1 to 7

Field	Element	Group average	Min. rate	Max. rate	Standard deviation
Take	Selection of biodegradable or easily recirculated materials in different value chains.	6.4	6	7	0.50
	Environmental efficiency of production processes to reduce resource use and emissions.	6.4	6	7	0.50
	Sustainable energy sources for production.	6.3	6	7	0.47
Make	Environmental innovation in the design of sustainable products and services, in order to extend their lifecycle and facilitate recovery in the future.	7.0	7	7	0.00
	The recovery of raw material and resources in the internal process of the company.	6.1	5	7	0.54
Distribute	The development of a sustainable logistics system.	6.2	5	7	0.75
Use	The development of business models where the final consumer is not the owner of the goods.	6.1	5	7	0.54
	The offer of services that extent the life of the products or services.	6.4	5	7	0.67
	Design of products that work with sustainable energies.	5.9	5	7	0.83
Recover	Channels of communication with customers to retrieve products that they no longer use or that they want to renew.	6.5	6	7	0.52
	Recovery and industrial recirculation of materials from products that consumers do not use any more.	6.8	6	7	0.40

out of a maximum of 7, and every participant gave a score of 5 or higher. This fact validated the high relevance of each element assessed in this section.

With regard to the "Take" field of action (Table 2), experts rated the three elements between 6 and 7. Those results indicate that every expert agreed on the relevance of using circular materials and being efficient with their use. They were close to reaching total consensus on the great importance of using sustainable energy sources for production.

The "Make" field of action contains the highest rated element, which had total agreement; the experts agreed on the great importance of "Environmental innovation in the design of sustainable products and services, so as to extend their lifecycle and facilitate recovery in the future." They stressed that sustainable design strategies have critical implications for all stages of the product life and the up-cycling or down-cycling after recovery (Figure 2).

With respect to "Distribute", the element associated with that field of action had the highest standard deviation, and it was initially given a low rating. However, when participants were asked if this aspect was the least important as a field of action, they all rejected that statement.

The "Use" elements had high standard deviations due to the distant opinions among experts, especially in the element related to "Design of products that work with sustainable energies." Moreover, experts commented on the importance of educating consumers about reusing products and extending the life of the product (before retrieval).

Finally, the "Recover" field was mainly oriented toward the channels of communication between firms and consumers so firms could recover products and recirculate materials. This field of action's elements were rated between 6 and 7, which reinforced the CE scheme's proposal regarding the importance of this category in the CE system. Moreover, the experts commented that innovation in the business model should also be properly aligned with the distribution and communication channels, generating value and closing the materials and energy loops.

4.2 | Industrial symbiosis for SMEs

When asked about this transversal category, the experts rated the importance of six general elements in achieving global industrial symbiosis in SMEs. Even though the scores were higher than 4 (Table 3), the elements with the highest level of agreement (minimum standard deviation) were "Government and public institution intervention" and "To value the 'waste' of some companies as resources for others". The importance of valuing waste refers to how companies get value from other processes or their neighbours' by-product waste. Examples have been developed in multiple sectors, such as the fishing industry (Kerton, Liu, Omari, & Hawboldt, 2013), where waste is used to get cellulose, biodiesel, biopolymers, fertilizers and pigments. Similarly, Gibbs and Deutz (2007) have stressed the role of policy-makers in boosting clusters and strategies towards creating eco-industrial parks.

The next group of elements, "Create joint value between companies" and "Management aspects such as trust and transparency among potential partners in the industry," had standard deviations of less than 0.65. In the Delphi process, "joint value" was focused on the

TABLE 3 Industrial symbiosis for SMEs elements

Element	Group average	Min. rate	Max. rate	Standard deviation
Government and public institution intervention.	6.00	5	7	0.45
Valuing the "waste" of some companies as resources for others.	6.45	6	7	0.52
Creating joint value between companies.	6.27	5	7	0.65
Managing aspects such as trust and transparency among potential partners in the industry.	6.36	5	7	0.67
Belonging to an industrial association, cluster or related organization.	5.36	4	7	0.81
Sharing infrastructure or services with industrial neighbours.	5.82	4	7	0.87

integration of material and energy flows to achieve processes with more added value and profitability for all the industries involved, as Short et al. (2014) have shown. Moreover, Kortmann and Piller (2016) highlight how competing companies have joined forces and created economic value by cooperating with communities and increasing recycling rates. In terms of the element “Managing aspects such as trust and transparency among potential partners in the industry,” the experts who gave the highest scores to these issues argued that they play a key role in working with potential partners. CE implementation and especially industrial symbiosis projects have to deal with information asymmetry among the different parties. This is coherent with Chertow's (2007) perception, which is based on the fact that successful symbiosis requires sharing resources and information. In addition, Deutz and Ioppolo (2015) have claimed that the human factors that are necessary to achieve industrial symbiosis should be explored in depth by scholars from social sciences.

Finally, and unexpectedly, the elements “Belonging to an industrial association, cluster or related organization” and “Infrastructure or services sharing with the industrial neighbours” had a broad spread of data. According to the industrial symbiosis cases documented by scholars like Daddi and Iraldo (2015), SME clusters have played a key role in building an industrial metabolism because the firms that participate have the collective power to take decisions, they can show their commitment to policy-makers, and they increase the sector's competitiveness in the market.

Moreover, successful eco-industrial parks usually share infrastructure or services, and sometimes even knowledge. However, these low scores uncover how challenging these issues are for companies and how difficult it is to assess the level of implementation of CE according to the actions described by those two elements of the Delphi study.

Finally, the experts suggested designing industrial parks, although they recognized that it is a challenging task for SMEs. Consequently, they proposed some key actions that could make it possible for SMEs to participate in industrial parks: Government intervening in the reconditioning of existing parks or building new ones; SMEs undertaking a search for appropriate firms to build eco-industrial parks; and industrial associations encouraging SMEs to be geographically close. However, the experts claimed that there is not one answer and a mix of measures might be better.

4.3 | Environmental certifications

Surprisingly, the experts in our study were unable to achieve consensus on the importance of environmental management certifications in the implementation of the circular economy (Table 4).

This discrepancy could be attributed to the extreme opinions of the panelists. There were two groups without middle ground: the supporters, who sympathized with the certifications and were clearly convinced of their benefits, and the severe opponents, who sharply criticized their use and effectiveness in the market. These data must be interpreted with caution because environmental certifications and eco-labels specifically oriented to CE are still young, and it is perhaps too early to demonstrate their worth.

However, the participants proposed some additional ways of communicating eco-innovation results and CE implementation in a company, such as providing industry awards, participating in the Ellen MacArthur Foundation's CE100 group, holding open houses, using customers as ambassadors, comparing conventionally manufactured products with their eco-innovative counterparts, providing passports for materials (listing the material's origin,e.g., extraction, reuse, recycling) and disseminating reports that show the lifecycle impact or materials' rate of wear and recirculation in the manufacturing process.

5 | CONCLUSIONS

This paper began by developing a theoretical framework that reviewed the literature on CE to support the Delphi structure and undertaking performance. Then our two research questions were addressed through the Delphi results and the discussion. The first question sought to determine the key elements of CE implementation, and thus this study is able to offer some important insights into the integrated analysis of three aspects which have not been assessed in combination before: (i) the CE fields of action scheme for implementing and assessing CE in firms, (ii) the role of industrial symbiosis, and (iii) environmental certifications. Accordingly, this research contributes to this growing area of research by providing a set of key elements that are needed in order to assess the level of circular economy implementation, which helps companies understand the path towards the circular economy and their position on that path.

With the aim of answering the second research question, the experts who participated in the Delphi process confirmed (Figure 2) that “recover” is the most important field of action (at least twice), and they highlighted that understanding CE required differentiating between up-cycling (giving materials the same or higher value) and down-cycling (decreasing the value of materials). Moreover, most of them emphasized that sustainable design strategies are essential in the CE implementation process. Interestingly, this study shows that all experts gave a high score (more than 5 out of 7 points) to every element in the main features of CE implementation in firms (Table 2), which were assessed in each CE field of action. This result validated the usefulness of these elements as features in assessing the CE fields of action.

Another interesting finding was that all participants gave the highest score to the following element: “Environmental innovation in

TABLE 4 Environmental certification elements

Element	Group average	Min. rate	Max. rate	Standard deviation
Certifications of environmental management systems for a company.	4.73	3	7	1.19
Certifications of the product or service.	4.82	3	7	1.25

the design of sustainable products and services, so as to extend their lifecycle and facilitate recovery in the future." This perfect consensus makes evident the importance of eco-innovation and the need to measure it as part of CE implementation.

Even although using cluster strategies and sharing infrastructure have been defined as important features of industrial symbiosis, this research showed that they are still challenging issues and should not be used to diagnose the level of implementation of CE in firms, especially in SMEs.

Finally, and contrary to expectations, this study did not find any consensus regarding the importance of environmental management certifications or eco-labels in measuring the circularity of a company or a product because the experts were clearly divided into two groups of supporters and severe opponents. This result indicates that there is abundant room for further progress in determining the role of environmental certifications through case studies and empirical analysis.

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