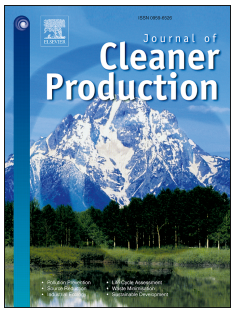
Journal Pre-proof



Circular economy in Italian SMEs: A multi-method study

Matteo Mura, Mariolina Longo, Sara Zanni

PII: S0959-6526(19)33691-1

DOI: https://doi.org/10.1016/j.jclepro.2019.118821

Reference: JCLP 118821

To appear in: *Journal of Cleaner Production*

Received Date: 14 January 2019

Revised Date: 8 October 2019

Accepted Date: 9 October 2019

Please cite this article as: Mura M, Longo M, Zanni S, Circular economy in Italian SMEs: A multi-method study, *Journal of Cleaner Production* (2019), doi: https://doi.org/10.1016/j.jclepro.2019.118821.

Circular economy in Italian SMEs: a multi-method study

Matteo Mura, Mariolina Longo, Sara Zanni*

Department of Management, University of Bologna

Via Capo di Lucca 34, 40131 Bologna, Italy

Corresponding author: sara.zanni7@unibo.it

Abstract

Climate change, population growth, and current rate of consumption at global scale have prompted academic and business communities to challenge the current models of production towards more circular approaches. This study aims at understanding what actions small and medium-sized enterprises (SMEs) are taking to meet the challenges and opportunities of the circular economy (CE), analysing actions, barriers, enablers and the connection between CE, business strategy and performance. This research involved 254 Italian SMEs through a multi-method approach, including interviews, surveys, and focus groups. Twenty different CE practices related to waste management, packaging, supply chain and product/process design have been explored. The results show that several CE practices are simultaneously implemented by SMEs, thus supporting the notion that CE implies a systemic approach to company's value creation. In particular, waste management was widely applied (e.g. separated waste collection was carried out by 84 % of the companies surveyed), while resource saving practices were implemented by only 14 % of the sample. Higher costs are the main barrier to CE for early adopters (5.13 on a 7-point Likert-type scale). However, companies implementing CE practices perceive them as a business opportunity rather than a cost, thus showing that CE may represent a source of value creation for companies, particularly SMEs.

Keywords: Circular economy, Business sustainability, SMEs, Survey, Focus groups, Interviews

1. Introduction

July, 29th was 2019's *Earth Overshoot Day*, i.e. the day in which our economic and social systems consumed an amount of natural resources that the Earth takes an entire year to generate. This means that, from August 2 to December 31, resources that will not be regenerated are actually depleted. To put it another way, in 2018 the equivalent of 1.7 planet Earths has been consumed, slightly more than the preceding year and 25% more than in the 1980s. If the trend won't be reversed, in 2050 it will take around three planet Earths to sustain our society (Global Footprint Network, 2018).

A solution to this global problem is to adopt a model of development in which economic and social growth are decoupled from natural resource usage (*resource decoupling*) and from environmental degradation (*impact decoupling*) (UNEP, 2011). A model no longer based on a linear "take, make, dispose" logic, but rather on circular cycles of "reduce, reuse and recycle" (3Rs) (Sihvonen and Ritola, 2015), able to self-regenerate and is rooted in the use of renewables and elimination of waste. As reflected in the recent agreement between *UN Environment* and *Ellen MacArthur Foundation*, signed in Davos on January 24th, 2018 during the World Economic Forum (WEF, 2018), the circular economy (CE) represents a true alternative for economic, environmental and social development, to which governments, firms and citizens are called upon to contribute, and from which they can benefit (Lieder and Rashid, 2016).

The CE has been defined 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*" (Prieto-Sandoval et al., 2018:613). A first key feature of the CE is to make the economy capable of regenerating itself, by developing eco-innovations (Hofstra and Huisingh, 2014) that help preserve natural capital. This can be accomplished by promoting the use of renewable resources, and augmenting the utilization and revaluing of materials through reuse and recycling. This is accomplished by distinguishing between a biological cycle, characterised by flows of non-toxic materials that can be directly reintegrated into the biosphere, and a technical cycle whose material flows need to be revalued in the production chain (Ellen MacArthur Foundation, 2014). In the CE, goods - and the materials used to make them - are designed so that they can be reused, upgraded and disassembled with minimal energy use, thereby transforming waste into a secondary raw material.

A second feature of the CE is to extend the product lifecycle, maximising the value-in-use of physical assets over time, by designing products in a way that makes them easy to repair and maintain, or by finding new uses for the product at the end of its life. Sustainable design strategies represent relevant CE principles (Ellen MacArthur Foundation, 2013), such as eco-design guided by the life cycle assessment (LCA) of a product (Rousseaux et al., 2017), nature-inspired design strategies (NIDS) such as biomimicry (Benyus, 2002), or cradle-to-cradle (C2C) design.

Finally, a third key feature of the CE is to facilitate and promote the transition to new purchasing habits and consumer culture. Rather than owning an object, it can be used as a service, thereby sharing the product's utility with other consumers. This product-as-a-service business model has gained increasing attention in the last decade (Annarelli et al., 2016) and it is currently adopted by a number of companies in different industries (e.g. *Bla-Bla Car* in the car industry, *Airbnb* in hospitality, Rolls Royce in the jet engine industry).

The three features described above can be applied singularly also to the linear economy. However, only an integrated and systematic adoption of all three leads to CE. Accordingly, companies need to re-think their value-creation process to devise new business models that incorporate all these elements.

The opportunities offered by the CE are many, and not just in terms of reduction of emissions and waste. From the business perspective, there is also less exposure to supply chain-related risks (Winn and Pogutz, 2013), such as price volatility of raw materials and procurement processes (Govindan and Hasanagic, 2018). However, its implementation calls for a concerted effort and awareness by all actors in the system (Wang and Hazen, 2016). Many businesses are unprepared to seize the opportunities and advantages of transition towards the CE, since they are allowed to offload all environmental costs onto society (e.g. using common resources, such as water, air, land). Most importantly, communication tools and incentives are needed to help disseminate the culture of sustainable development that underpins the CE, which remains much discussed but still little implemented (Milios, 2018), as "linear mind-set and structures in industry and society" still prevails (Lieder and Rashid, 2016:46)

SMEs can play a fundamental role in this debate. SMEs represent 95 % of the number of companies in the OECD member states (OECD, 2017), and over 99 % of the European enterprises (EU Commission, 2011). In the past five years, they have created around 85 % of new jobs and provided two-thirds of the total private sector employment in the EU (EU Commission, 2018). Also, the CE may represent a business opportunity for SMEs; indeed, as research shows, those SMEs that have implemented environmental-related practices experienced positive returns in terms of material cost savings (Rizos et al., 2016), opening up of new markets (Hillary and Burr, 2011), and increased turnover (Longo et al., 2005).

So far numerous studies have explored the key features of the CE (see Prieto-Sandoval et al., 2018 for a comprehensive review), detailing the business models related to the CE paradigm (Manninen et al., 2018) and proposing different implementation approaches (Lieder and Rashid, 2016). For example, Pieroni et al. (2018) explore the role of business innovation, while Lopes de Sousa Jabbour et al. (2019) focus on the role played by operations management process of decision-making for CE implementation .However, most studies have been mainly theoretical and based on literature reviews that link CE and sustainability (Geissdoerfer et al., 2017), create frameworks for CE assessment (Sassanelli et al., 2019) that include environmental resources and economic benefits (Lieder and Rashid, 2016), understand the basic features of the topic (Ghisellini et al., 2016), and explore the body of research to establish a common ground for future academic developments (Prieto-Sandoval et al., 2018). In some cases, systematic literature reviews became the basis for assessing CE strategies (Ünal and Shao, 2019), for developing a set of Key Performance Indicators (KPI) for the *ex-ante* evaluation of CE at the company level (Kravchenko et al., 2019), or at the product level, (Kristensen and Mosgaard, 2020).

The empirical studies available focus on a limited number of case studies, related to a segment, e.g. manufacturing industry (Lieder and Rashid, 2016), a single industrial sector (Fisher and Pascussi, 2017), a specific geographical area (Geerken et al., 2019) or a combination of the two aspects, as in the case of coal mining areas in China (Liu et al., 2019) or circular materials flow modelled at regional level for Southern Finland (Virtanen et al. 2019), or a small set of CE business model cases (Manninen et al., 2018).

Moreover, motivations, barriers and enablers for CE implementation for the implementation of CE into real companies have been explored only by focusing on a single segment of manufacturing firms (Gusmerotti et al. 2019) or have experienced only limited investigation (Agyemang et al., 2019). Studies that provide wider confirmatory evidence, for example by combining qualitative and quantitative data, are still lacking (Lieder et al., 2016). Additionally, very few studies so far have explored how SMEs are incorporating CE and authors have called for further research on this topic, in particular considering the effect of industrial sectors and geographical regions (Rizos et al., 2016), as well as business opportunities provided by CE (Ormazabal et al., 2018).

This paper aims at understanding what actions SMEs are taking to meet the challenges and opportunities of the CE, and it has the following objectives:

- Analyse the extent to which SMEs have developed CE practices in the Italian context, following the recommendation proposed by Ormazabal et al. (2018);
- Identify the principal enablers and barriers to the adoption of such practices, addressing the issue arisen by Agyemang et al. (2019);
- Explore the relationships between CE, business strategy, and company performance, filling an existing gap in the literature, as identified by Ormazabal et al. (2018).

A multi-method approach has been applied, by conducting interviews, a survey and focus groups and involving 254 Italian enterprises, SMEs in particular.

Considering the previous studies in the field, the major contributions of the present study lie (1) in the multi-method approach, that combines both quantitative and qualitative data, as suggested by Lieder (Lieder et al., 2016), (2) in the collection of a representative set of empirical data that encompass different sectors as proposed by (Rizos et al., 2016), and (3) in the focus posed on SMEs as a specific industrial segment.

The paper is organised as follows: section 2 describes the methodology of the study, comprising open and semi-structured interviews, survey, and focus groups; section 3 presents the results of the survey and summarises the evidence derived from the interviews and the focus groups; section 4 discusses the findings, draws the conclusions, and proposes avenues for future research.

2. Methodology

This research was launched during the *G7 Environment* meeting in 2017 in Italy and employed a multi-method approach based on interviews, surveys, and focus groups. Overall, 254 Italian SMEs were involved in the research - 209 companies answered the survey, while the remaining were directly interviewed by the authors or joined four sessions of focus groups.

This study combines qualitative and quantitative research methods; it was developed into three phases (Fig. 2), progressively elaborating over the core theme. In particular, the preparatory phase was conducted through interviews and focus groups (phase 1), and this led to the development of a survey, which was submitted to a sample of Italian SMEs (phase 2). Finally, results obtained from the survey were presented and discussed in two focus groups, where a sample of companies were asked to comment and validate the findings of the previous phases (phase 3). The three phases are described in details in the following sections.

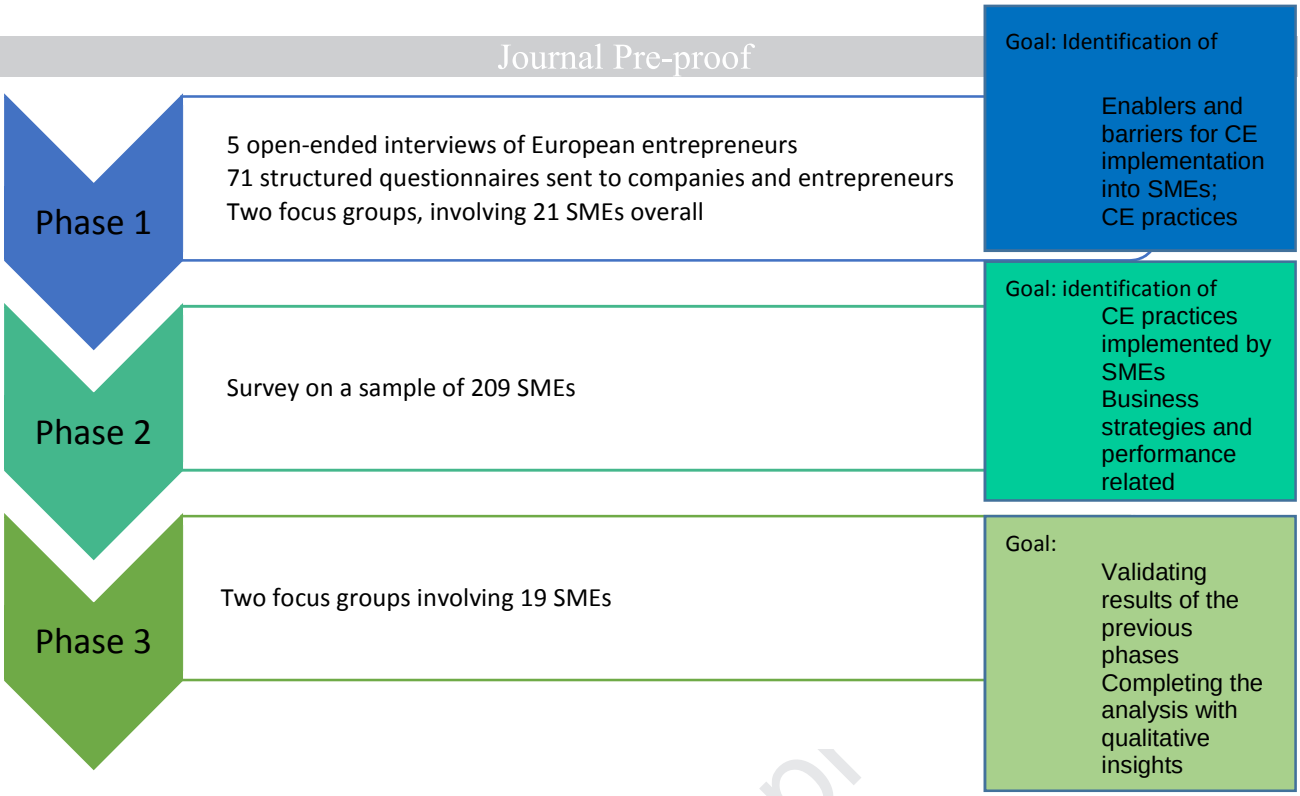


Fig. 2: Three-step research method.

2.1 Phase 1

In the first phase, an exploratory analysis was conducted during the *G7 Environment* meeting held in June 2017 in Italy. This consisted of:

1. five open-ended interviews of European entrepreneurs (Table A.1 in Appendix A reports the details of the interviewed entrepreneurs). These initial conversations were aimed to draft out the landscape of CE practices implementation by companies;
2. a preliminary, structured questionnaire was prepared, based on the interviews' results and on relevant academic literature. The questionnaire, in particular, focused on enablers and barriers to CE implementation and sustainable business practices. The questionnaire was submitted to companies and entrepreneurs attending conferences within the side-events of the G7 meeting. Finally, the71 questionnaires collected were analysed and presented directly to the audience to elicit real-time feedback on the results;
3. as final step of the first stage of the study, two focus groups were conducted, involving 21 SMEs (see Table A1 in the Appendix for details),. In order to tune information gathered through open-ended interviews and results of the preliminary questionnaire, a semi-structured interview protocol was developed, aimed at identifying relevant CE practices implemented by companies. This was used to facilitate the discussion among participants with the aim of identifying some common characteristics of CE practices in SMEs and, therefore perform a first control on the research construct, as suggested by Morioka et al. (2018).

2.2 Phase 2

Building on the evidence that emerged during the first phase of the project, i.e. a list of CE practices identified through open-ended interviews, a preliminary questionnaire and focus groups, and integrating previous studies in the field of sustainability measurement and management (see Mura et al. 2018 for a

comprehensive review), the final questionnaire has been developed. Based on that, a survey on a sample of Italian SMEs was carried out.

The final questionnaire aimed at investigating three main areas:

1. The CE practices that SMEs have implemented or are planning to implement in the next two years (twenty specific practices were selected and analysed, see Table 1). The set of practice was selected intersecting results obtained during phase 1 with international sustainability frameworks (e.g. GRI, Asset4, CDP);
2. The principal barriers (Table 2) and enablers (Table 3) to the implementation of CE practices;
3. The business strategies firms are adopting (Table 4), and their performance outcomes.

N.	CE practices
1	Environmental certifications (e.g. ISO14001/EMAS)
2	Separated waste collection system
3	Recovery / reuse of plastic and derivative packaging
4	Biodegradable materials (i.e. no plastic and derivatives) for packaging
5	Incentive policies for the return of old / worn products to the company
6	Reduction of the material content into packaging
7	Energy saving programmes
8	Energy supply from renewable sources (100 %)
9	Environmental selection criteria for suppliers
10	Environmental criteria for purchasing electricity, gas or other supplies
11	Bio/natural raw materials used into their products (e.g. biopolymers, biodegradable materials)
12	Secondary raw materials as inputs of the production
13	Substitution of chemicals (e.g. solvents, dyes) with safer and environmentally friendly alternatives
14	Resource-saving production processes
15	Environmental impacts monitored in air/earth/water
16	Closed loop for water reuse
17	Captation/reuse of wastewater and/or rainwater
18	Evaluation of the product life cycle (life cycle assessment)
19	The company develops products or services promoting energy savings
20	The company develops products or technologies in the renewable energy sector (e.g. wind, sun, biomass, geothermal)

Table 1: Circular economy practices implemented at company level.

N.	CE barriers
B1	Uncertainty about response times from public administrations in the area of sustainability
B2	Lack of coordination of regulations at EU, national, regional and local level in the field of sustainability
B3	Bureaucratic difficulty in applying the legislation on sustainability (e.g. waste, water) by companies
B4	Difficulty of orientation in the renewable energy market
B5	Lack of clear guidelines to define sustainability in small and medium-sized enterprises
B6	Perception of sustainability as a cost and not as an investment

Table 2: Barriers to CE practices implementation

N.	CE enablers
E1	Support for companies in the development of personnel training oriented to sustainability at multiple levels (e.g. actions aimed at individuals, firms, companies)
E2	Support for the participation of companies and entrepreneurs in European or transnational projects in the field of sustainability
E3	Dialogue between institutions, bodies and associations of the territory for the implementation of projects on the circular economy
E4	Support in the procurement of raw materials with low environmental impact / identification of suppliers with low environmental impact
E5	Facilitation of access to financial resources in the area of sustainability
E6	Promotion of policies dedicated to sustainability (e.g. tax benefits, loans, subsidies)

Table 3: Enablers to CE practices implementation

.	Business strategies
1	Cost leadership
2	Differentiation
3	Operational performance / Efficiency
4	Innovation performance
5	Overall performance

Table 4: Business strategies evaluated

The questionnaire also included control variables at company level (i.e. number of FTE, turnover, industry sector, type of ownership) and individual level (i.e., role and seniority in the company). Overall, the document consists of 57 questions, of which 49 are on a 7-point Likert-type scale (see Appendix B for details).

The final questionnaire was sent to 1,297 firms through a CATI (Computer-Assisted Telephone Interview) and web-based method, and 209 questionnaires were collected overall, with a redemption rate of 16 %.

Following the approach proposed by Micheli and Mura (2017), both the sample size and the redemption rate are considered consistent with the main literature (Hoque and James, 2000). The redemption rate, in particular, is considered acceptable in accordance with previous studies in the same field (Ormazabal et al., 2018).

The following Tables (Tables 5, 6, 7, 8) report the descriptive analyses of the sample. Most companies (almost 80 % of the sample) have less than 15 employees (mean=10; sd=18), as reported in Table 5, and about 78 % have an average turnover of 1.4 MEuro (sd= 4.36 MEuro) (Table 6). Table 7 reports the description of the sample in terms of industrial sector: as it results, the main industrial sectors are plant engineering (41 %), manufacturing (35 %), human services (13 %), tourism (7 %) and ICT (2 %). Based on descriptive results reported in Table 8, nearly all the companies surveyed (84 %) are either family owned or with the majority capital held by a family and almost none is listed.

N.of employees		
N. Employees	***Frequency (n.)***	***Percentage frequency***
5	70	53.44 %

10	34	25.95 %
15	14	10.69 %
20	4	3.05 %
25	3	2.29 %
30	2	1.53 %
35	3	2.29 %
40	0	0.00 %
More	1	0.76 %

Table 5: Sample description - Number of full-time employees (Full Time Equivalent - FTE).

Turnover		
Turnover classes (€)	***Frequency (n.)***	***Percentage frequency***
250,000	40	35.09 %
500,000	24	21.05 %
750,000	12	10.53 %
1,000,000	9	7.89 %
1,250,000	4	3.51 %
1,500,000	4	3.51 %
1,750,000	0	0.00 %
2,000,000	4	3.51 %
2,250,000	4	3.51 %
2,500,000	1	0.88 %
2,750,000	1	0.88 %
3,000,000	4	3.51 %
3,250,000	2	1.75 %
3,500,000	0	0.00 %
3,750,000	0	0.00 %
4,000,000	1	0.88 %
More	4	3.51 %

Table 6: Sample description - Turnover.

Industrial Sector		
Sector	***Frequency (n.)***	***Percentage frequency***
Mechanics/Manufacturing	47	35 %
Tourism	8	6 %
Human services	23	17 %
Plant engineering	55	40 %
ICT	3	2 %

Table 7: Sample description - Industrial sector.

Owneship		
Ownership	***Frequency (n.)***	***Percentage frequency***
Family owned	122	58 %
Majority capital held by family	55	26 %
Widespread shareholding	6	3 %
Listed	1	0 %
Not declared	25	12 %

Table 8: Sample description - Ownership.

2.3 Phase 3

After the survey, two focus groups involving 19 SMEs were conducted to present and discuss the results of the survey (phase 2). Companies were selected on the basis of theoretical sampling (Eisenhardt, 1989) to cover various industrial sectors and to further investigate circular business models. This last phase of the research was aimed at face validating data collected through the survey and receive feedback and deeper comments by experts of the entrepreneurial environment (Venkatraman and Grant, 1986). In addition to this, the focus groups offered additional insight on the results achieved, based on the experience of entrepreneurs that work in the field of CE, in particular on the definition of challenges and opportunities and practical implication of the study.

3. Results

This section presents the results of the survey together with the evidence emerging from the focus groups.

3.1 Survey

Firstly, survey results focus on descriptive analyses reflecting the adoption of CE practices by SMEs, the principal barriers and enablers to the adoption of such practices, the strategies that companies are developing, and the performance achieved. This first dataset offered valuable information and basis for following development of the study. Then, correlation analyses among CE practices, barriers and enablers, strategic business choices and company performance are presented.

3.1.1 Descriptive analyses

The most widely adopted CE practice is separated waste collection, implemented by 84 % of the companies surveyed, followed by recovery/reuse of packaging (38 %), programmes for energy conservation (32 %), monitoring of impacts on air/soil/water (32 %), and the development of products or services that facilitate energy conservation (31 %).

The remaining practices are implemented by less than 20 % of firms, with the least adopted ones being capture/reuse of waste and/or rainwater (10 %), and environmental certifications (e.g. ISO14001/EMAS)

(12 %). The practices that companies intend to implement over the next two years are related to energy saving (40 %), development of production processes with low resource usage (36 %) and environmental criteria for suppliers' selection (33 %). In general, circular economy practices appear weakly developed among the SMEs surveyed, with the exception of separated waste collection, which is likely to have been influenced by the stricter regulation in this field (see Figure 3). Within our sample, the most active sectors in the circular economy are mechanical/manufacturing, followed by plant, tourism, and finally ICT (Figure 4).

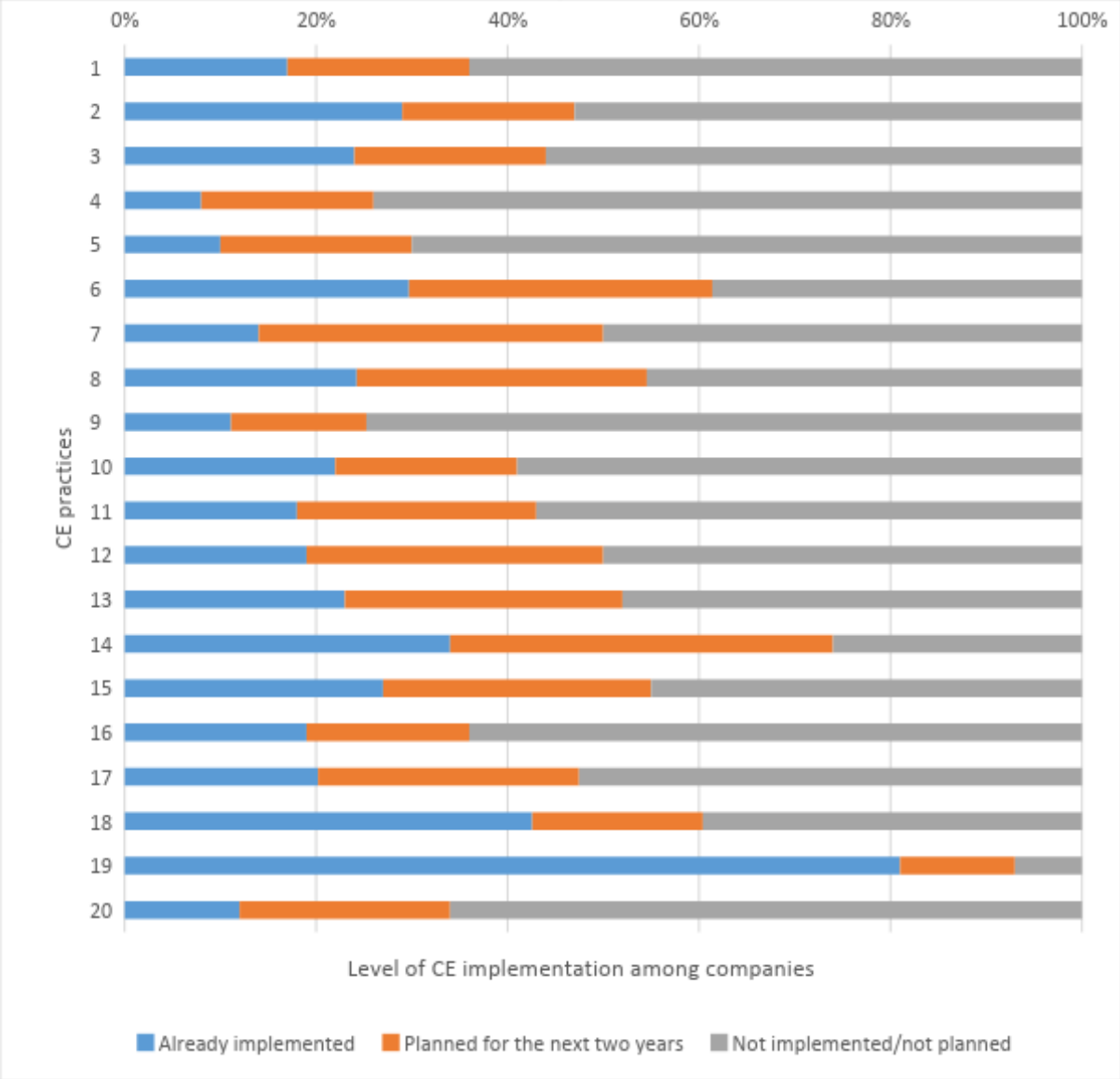


Figure 3. Circular economy practices implemented by SMEs. Note: Refer to table 1 for CE practices

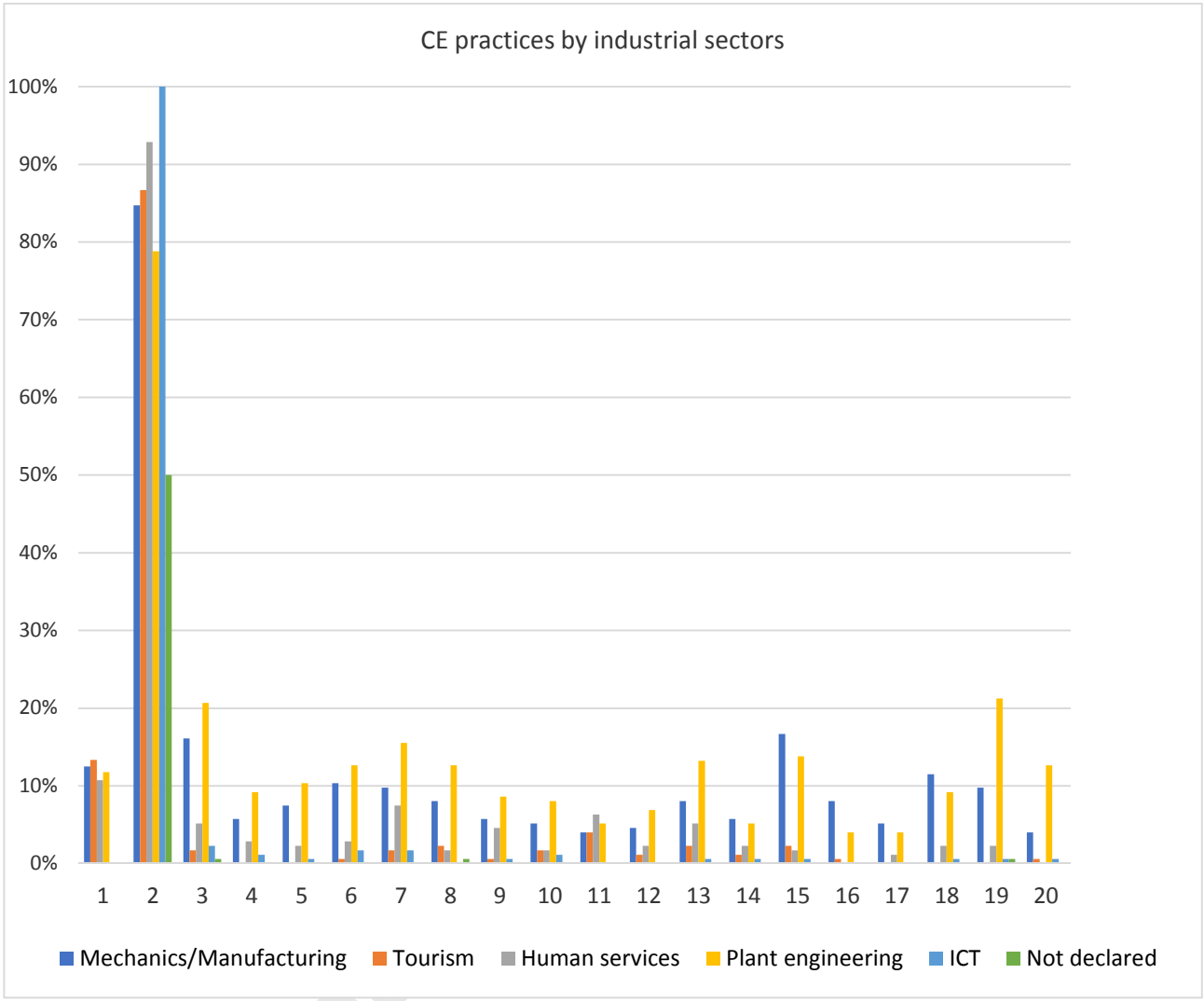


Figure 4. Application of CE practices in the different industrial sectors. Note: Table 1 must be taken as reference for CE practices

Considering the barriers (Tab. 9), the perception of sustainability as a cost rather than an investment is the principal obstacle to implementing circular economy practices, followed by the lack of clear guidelines that define sustainability for SMEs, and the bureaucratic difficulties encountered by firms in applying regulations on sustainability (e.g. water, waste). The factors least perceived as barriers are lack of regulatory coordination at the EU, national, regional and local levels, and uncertainty about response times of government agencies.

BARRIERS	Mean	St. Dev.	N
Uncertainty about response times from public administrations in the area of sustainability	4.17	2.26	132
Lack of coordination of regulations at EU, national, regional and local level in the field of sustainability	4.42	2.03	132

BARRIERS	Mean	St. Dev.	N
Bureaucratic difficulty in applying the legislation on sustainability (e.g. waste, water) by companies	4.58	1.83	135
Difficulty of orientation in the renewable energy market	4.69	2.02	131
Lack of clear guidelines to define sustainability in small and medium-sized enterprises	4.87	1.74	135
Perception of sustainability as a cost and not as an investment	5.13	1.71	134

Table 9. Barriers to adoption of circular economy practices

In relation to enablers (Tab. 10), the factors that most strongly support development of circular economy practices are policies to promote sustainability (e.g. tax credits, financing, subsidies), in particular with greater access to financial resources for implementing sustainability practices, and cooperation between local institutions, organisations and associations to implement circular economy projects. The factors least perceived as enablers are support for participation of firms and entrepreneurs in European or transnational projects on sustainability issues, and support for companies in developing training plans related to sustainability (e.g. actions aimed at individuals, firms, organisations).

ENABLERS	Mean	St. Dev.	N
Support for companies in the development of personnel training oriented to sustainability at multiple levels (e.g. actions aimed at individuals, firms, companies)	4.47	1.73	133
Support for the participation of companies and entrepreneurs in European or transnational projects in the field of sustainability	4.70	1.76	134
Dialogue between institutions, bodies and associations of the territory for the implementation of projects on the circular economy	4.84	1.76	134
Support in the procurement of raw materials with low environmental impact / identification of suppliers with low environmental impact	4.93	1.69	134
Facilitation of access to financial resources in the area of sustainability	5.04	1.90	133
Promotion of policies dedicated to sustainability (e.g. tax benefits, loans, subsidies)	5.24	1.68	133

Table 10. Enablers for adoption of circular economy practices

It can also be noted that there are no significant differences between industry sectors regarding barriers and enablers (X2 test $p > .05$). The results of the test suggest that belonging to a particular industrial sector does not necessarily influence the attitude toward sustainability, in terms of identification of barriers and enablers to its implementation. They appear to be rather linked to a particular ecosystem or national context.

Table 11 reports information on the strategic and business performance variables in the surveyed companies.

In particular, two competitive strategies of cost leadership and differentiation (Porter, 1985) were analysed. Cost leadership focuses chiefly on increasing the efficiency of operating processes (for example, in production or logistics) and on strict control of sales, as well as on costs. A differentiation strategy aims to distinguish a company's products or services from competing ones, and it is characterised by the development of novel products or the improvement of existing ones.

For the performance dimensions, three specific variables were selected, adapting them from existing scales. In particular: *overall performance*, adapted from Gibson and Birkinshaw (2004), includes customer satisfaction and achievement of full business potential; *innovation performance*, adapted from Villena et al. (2011), consists of the development of new generations of products and expanding the array of existing ones, opening up new markets and entering new technological areas; *operational performance*, adapted from Villena et al. (2011), includes making processes efficient and reducing costs.

These five variables related to company's strategy and business performance were statistically validated. Both convergent and discriminant validity were supported. Also Cronbach's alpha coefficients are above the recommended threshold of 0.6, suggesting good reliability of all the proposed variables.

	Number of observations	Minimum value	Maximum value	Mean	Std. deviation
Cost leadership	208	1.00	7.00	5.29	1.39
Differentiation	207	1.00	7.00	5.65	1.32
Operational performance / Efficiency	207	2.00	7.00	5.11	1.09
Innovation performance	207	2.00	7.00	4.88	1.23
Overall performance	207	1.67	7.00	5.34	0.95

Table 11. Mean values, standard deviation, and number of observations for the strategic and business performance variables

The values of the variables are fairly closely clustered, with fluctuations ranging from 4.88 for innovation performance to 5.65 for the differentiation strategy. Standard deviations are also limited, with values between 0.95 and 1.39.

The scatterplot below (Figure 5) compares the two strategic dimensions, as implemented by companies, in terms of cost leadership (Porter, 1985), and differentiation. These two competitive strategies have been chosen based on several papers available in the literature of performance sustainability and performance measurement (Micheli and Mura, 2017). The diagram reveals how companies position themselves in the top right quadrant of the matrix. About 85 % of the companies involved, in fact, reports values above the average 7-point Likert-type scale, both for cost leadership and differentiation, while about 4 % presents low values for both. 3 % of the sample reports low values for differentiation, but high on cost leadership and 7 % presents the opposite profile, with high differentiation and low values on cost leadership. As the wide majority of the sample is positioned on high levels of both, this suggests that SMEs perceive that they simultaneously conduct strategies aimed at stimulating both efficiency (cost leadership) and learning and innovation (differentiation).

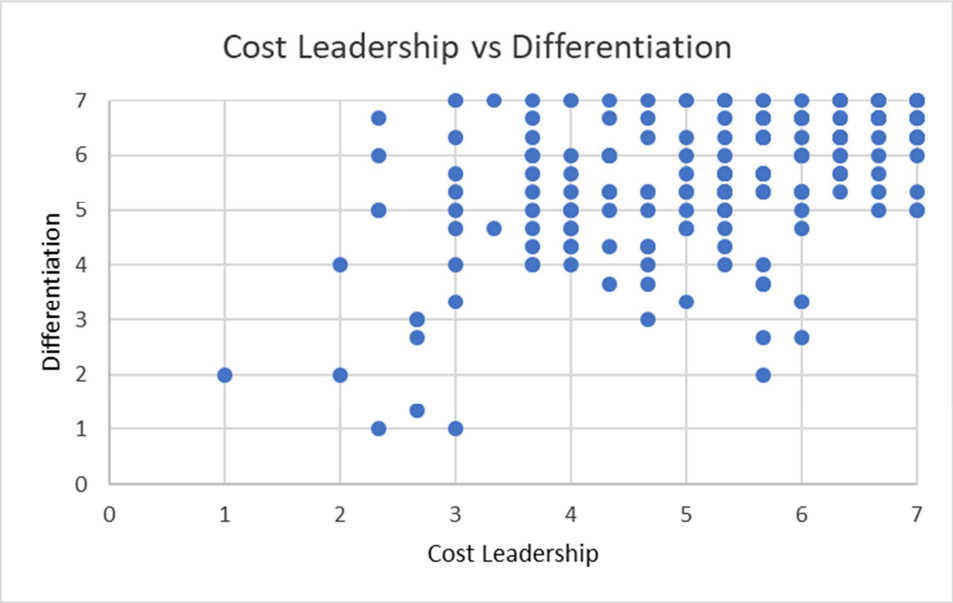


Figure 5. Scatterplot: cost leadership – differentiation

3.1.2 Correlation analyses

Correlation analyses were performed among the proposed variables, arranging them into three different sets. Firstly, the relationships between CE practices implemented by firms were explored. Next, correlations between CE practices and barriers and enablers were investigated. Finally, CE practices were related to the strategic choices of the firms and their performance.

Table 12 reports the correlation between different circular economy practices. Results show that life cycle assessment (LCA) is positively correlated with nearly all the other CE practices, and in particular with implementation of production processes with low resource usage, ISO14001/EMAS certifications, adoption of incentive policies for returning old/worn-out products to the company, reduction of the material used in packaging, policies for selecting suppliers based on sustainability criteria, replacement of chemical substances (e.g. solvents, dyes) with safer and more environmental-related alternatives. Also, the implementation of production processes with low resource usage is positively correlated with the creation of closed-loop systems for water reuse in the production process. Additionally, a positive correlation between recovery/reuse of packaging, the use of biodegradable packaging materials, and incentive policies for returning old/worn-out products to the company can be identified.

Therefore, the analysis identifies three major action areas for circular economy issues: (1) LCA appears particularly important for the implementation of CE practices; (2) Development of production processes with low resource usage, often connected to efficient use of water resources; (3) A set of actions focused on product packaging, in terms of reuse of raw materials (e.g. fossil-based plastics) and use of biodegradable or bio-based raw materials.

Table 13 analyses the correlation between circular economy practices, barriers to the adoption of such practices, and enabling factors. The coding for barriers and enablers is derived from Table 2 and 3, respectively.

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]	[19]	[20]
[1]																				
[2]	.132																			
[3]	.334	.304																		
[4]	.334	.162	.439																	
[5]	.276	.104	.235	.210																
[6]	.318	.098	.468	.437	.463															
[7]	.288	.231	.264	.319	.278	.326														
[8]	.312	.235	.270	.148	.173	.249	.404													
[9]	.419	.173	.277	.373	.305	.485	.321	.363												
[10]	.346	.183	.312	.225	.241	.368	.345	.420	.439											
[11]	.331	.087	.286	.417	.289	.412	.303	.364	.559	.219										
[12]	.461	.097	.142	.182	.414	.360	.237	.285	.467	.399	.499									
[13]	.099	.078	.320	.081	.375	.369	.167	.058	.216	.204	.380	.186								
[14]	.285	.082	.187	.115	.401	.414	.329	.261	.288	.302	.313	.397	.463							
[15]	.238	.229	.158	.377	.182	.258	.254	.107	.288	.361	.210	.358	.229	.464						
[16]	.352	-.015	.160	.255	.210	.228	.155	.167	.161	.238	.210	.270	.182	.506	.414					
[17]	.317	.003	.139	.256	.128	-.026	.158	.052	.135	.135	.091	.180	-.110	.115	.194	.531				
[18]	.407	.171	.397	.163	.474	.453	.284	.326	.429	.393	.321	.381	.405	.514	.317	.256	.165			
[19]	.370	.120	.321	.214	.327	.288	.321	.242	.128	.327	.036	.268	.138	.268	.219	.028	.073	.319		
[20]	.365	.180	.352	.245	.287	.272	.366	.276	.299	.395	.059	.173	.136	.209	.143	.155	.186	.244	.602	

Table 12. Correlation analysis between CE practices. Correlation coefficients > 0.20 are statistically significant with p-value < 0.01. Note: Refer to table 1 for CE practices, i.e. [1] Environmental certifications (e.g. ISO14001/EMAS); [2] Separated waste collection system; [3] Recovery / reuse of plastic and derivative packaging; [4] Biodegradable materials (i.e. no plastic and derivatives) for packaging; [5] Incentive policies for the return of old / worn products to the company; [6] Reduction of the material content into packaging; [7] Energy saving programmes; [8] Energy supply from renewable sources (100 %); [9] Environmental selection criteria for suppliers; [10] Environmental criteria for purchasing electricity, gas or other supplies; [11] Bio/natural raw materials used into their products (e.g. biopolymers, biodegradable materials); [12] Secondary raw materials as inputs of the production; [13] Substitution of chemicals (e.g. solvents, dyes) with safer and environmentally friendly alternatives; [14] Resource-saving production processes; [15] Environmental impacts monitored in air/earth/water; [16] Closed loop for water reuse; [17] Captation/reuse of wastewater and/or rainwater; [18] Evaluation of the product life cycle (life cycle assessment); [19] The company develops products or services promoting energy savings; [20] The company develops products or technologies in the renewable energy sector (e.g. wind, sun, biomass, geothermal).

	Barriers						Enablers					
	B1	B2	B3	B4	B5	B6	E1	E2	E3	E4	E5	E6
[1]	.160	.097	.113	-.025	-.057	-.063	.049	-.083	-.054	-.019	.003	-.002
[2]	.139	.183	.088	.029	-.138	.032	-.040	-.005	-.116	-.087	-.102	.008
[3]	.156	.178	.166	.194	.009	.087	.118	-.026	.023	-.076	.007	.192
[4]	.284	.117	.153	.185	-.084	.098	-.032	.060	-.021	-.036	.003	-.038
[5]	.113	.121	.004	.076	.066	-.018	-.029	.086	.116	.231	.131	.104
[6]	.280	.194	.116	.176	.053	.005	.087	.128	.081	.100	.123	.186
[7]	.212	.232	.045	.083	-.036	.000	.015	.082	.013	.042	.166	.004
[8]	.055	.181	.031	.109	-.147	-.025	.083	-.101	-.186	-.115	-.020	-.010
[9]	.278	.228	.178	.029	-.096	-.021	.079	.045	-.058	.053	.047	.076
[10]	.098	.025	.030	-.053	-.247	-.003	.083	.044	-.108	.029	.057	.010
[11]	.215	.052	.029	.012	-.086	.019	.094	.037	-.118	-.036	.059	.185
[12]	.100	-.007	.068	-.221	-.103	-.025	.031	.051	-.080	.020	.003	.039
[13]	.071	.129	-.022	.021	-.102	-.117	.060	.053	.030	.179	-.004	.215
[14]	.211	.133	.105	.025	-.098	-.002	.024	.027	.017	.102	.098	.093
[15]	.220	.104	.058	-.062	-.189	.053	-.026	.229	.023	.038	.114	-.028
[16]	.313	.088	.178	.066	-.158	.147	.062	.060	.144	.143	.082	.034
[17]	.141	-.056	.085	-.019	-.057	.128	.064	.009	.128	.091	.072	.047
[18]	.095	.169	-.026	-.008	-.018	-.088	.113	.082	-.053	-.003	.001	.087
[19]	.008	.147	-.073	-.128	-.031	-.164	-.037	.055	-.106	-.019	-.017	-.041
[20]	.156	.217	.040	.097	-.082	-.073	-.030	.090	.024	.124	.094	-.008

Table 13. *Correlation analysis between CE practices, barriers and enablers. Correlation coefficients > 0.15 are statistically significant with p-value < 0.05. Note: Refer to table 1 for CE practices, i.e. [1] Environmental certifications (e.g. ISO14001/EMAS); [2] Separated waste collection system; [3] Recovery / reuse of plastic and derivative packaging; [4] Biodegradable materials (i.e. no plastic and derivatives) for packaging; [5] Incentive policies for the return of old / worn products to the company; [6] Reduction of the material content into packaging; [7] Energy saving programmes; [8] Energy supply from renewable sources (100 %); [9] Environmental selection criteria for suppliers; [10] Environmental criteria for purchasing electricity, gas or other supplies; [11] Bio/natural raw materials used into their products (e.g. biopolymers, biodegradable materials); [12] Secondary raw materials as inputs of the production; [13] Substitution of chemicals (e.g. solvents, dyes) with safer and environmentally friendly alternatives; [14] Resource-saving production processes; [15] Environmental impacts monitored in air/earth/water; [16] Closed loop for water reuse; [17] Captation/reuse of wastewater and/or rainwater; [18] Evaluation of the product life cycle (life cycle assessment); [19] The company develops products or services promoting energy savings; [20] The company develops products or technologies in the renewable energy sector (e.g. wind, sun, biomass, geothermal). Refer to Table 2 for barriers, i.e. [B1] Uncertainty about response times from public administrations in the area of sustainability; [B2] Lack of coordination of regulations at EU, national, regional and local level in the field of sustainability; [B3] Bureaucratic difficulty in applying the legislation on sustainability (e.g. waste, water) by companies; [B4] Difficulty of orientation in the renewable energy market; [B5] Lack of clear guidelines to define sustainability in small and medium-sized enterprises; [B6] Perception of sustainability as a cost and not as an investment. Refer to Table 3 for enablers, i.e. [E1] Support for companies in the development of personnel training oriented to sustainability at multiple levels (e.g. actions aimed at individuals, firms, companies); [E2] Support for the participation of companies and entrepreneurs in European or transnational projects in the field of sustainability; [E3] Dialogue between institutions, bodies and associations of the territory for the implementation of projects on the circular economy; [E4] Support in the procurement of raw materials with low environmental impact / identification of suppliers with low environmental impact; [E5] Facilitation of access to financial resources in the area of sustainability; [E6] Promotion of policies dedicated to sustainability (e.g. tax benefits, loans, subsidies).*

Regarding the principal *barriers* to the adoption of circular economy practices, it is interesting to note that adoption of such practices is negatively correlated with the perception of sustainability as a cost. Although this barrier is regarded as the most salient one among SMEs overall (see Figure 3c), those that do develop CE practices perceive them not as a cost, but rather as an investment to support their business. Also, the adoption of CE practices is negatively correlated with lack of regulatory coordination at the EU, national, regional and local levels. This means that those companies that implement CE practices perceive this lack of regulatory coherence as an extremely salient barrier. The analysis also indicates that other critical factors for firms that implement CE practices comprise highly uncertain response times by government agencies, and bureaucratic issues in the application of sustainability regulations (e.g., waste or water regulations).

In relation to *enablers*, the implementation of CE practices is supported by the procurement of raw materials with low environmental impact, and by the identification of suppliers with low environmental impact. Another especially important enabler is support for the participation of firms and entrepreneurs in European or transnational projects relating to sustainability. This is positively correlated to various different circular economy practices such as: (i) incentives for returning old/worn-out products to the company, (ii) reduction of the material used in packaging, and (iii) implementation of energy conservation projects. Additionally, although training employees for sustainability and CE is perceived as a weak enabler for development of CE (Table 10), this aspect is actually regarded as particularly relevant by those firms that implement CE practices. Indeed, the analysis shows that training on sustainability issues is important for encouraging the return to the company of old and/or worn-out products, and for promoting the development of policies aimed at reducing the materials used in packaging. The results also indicate that better coordination is needed among local institutions, organisations and associations to implement CE projects, with particular emphasis on the monitoring of environmental impacts on air/soil/water and the reduction of the material used in packaging.

In summary, the enablers most strongly correlated with sustainability practices are support for firms in developing sustainability-oriented training for personnel at various levels (e.g., actions aimed at individuals, the firm, society), support for the participation of firms and entrepreneurs in European or transnational projects on sustainability matters, and assistance with procurement of raw materials with low environmental impact, together with support for identifying suppliers with low environmental impact. The training pertaining to circular economy programmes could begin by focusing precisely on these topics.

Table 14 shows the correlation between circular economy practices, business strategies, and the performance dimensions.

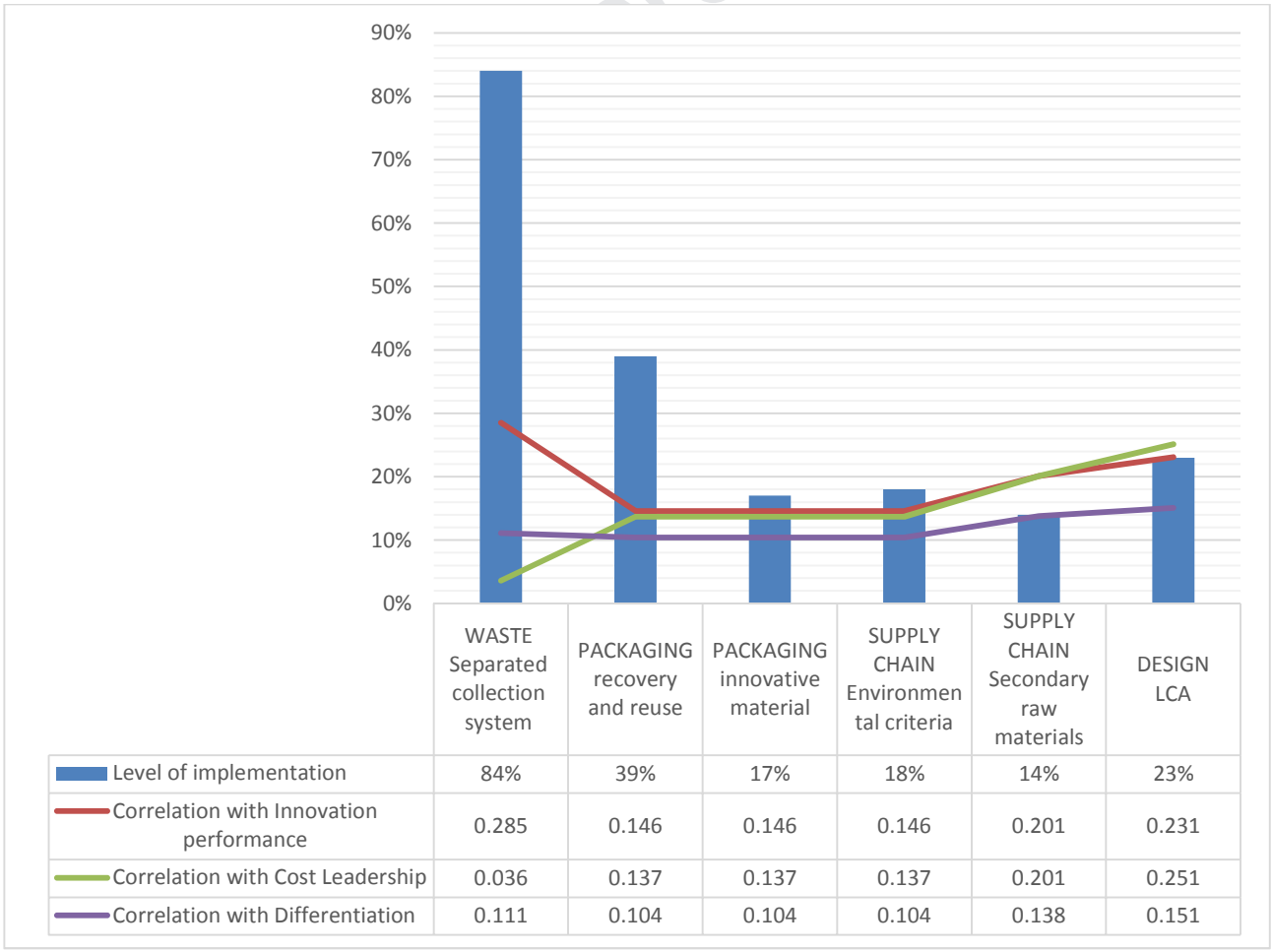
With specific reference to the two different strategies (Porter, 1985), cost leadership is positively correlated with half of the analysed CE practices. When considering differentiation strategy, instead, only some CE practices are correlated with this strategic approach, particularly: (i) return to the company of old/worn-out products, (ii) reduction of the material used in packaging, (iii) use of organically/naturally based raw materials for the company's products (biopolymers, biodegradable, natural).

Analysing the relationship between CE and the business performance dimensions, operational performance is correlated only to a few CE practices (i.e. reuse of old/worn-products, reduction of packaging, use of recycled raw materials to produce one's own products, development of production processes with low resource usage). Innovation performance is instead strongly positively correlated to many CE practices. Finally, overall business performance is positively correlated with 16 of the 20 circular economy practices analysed, in particular to implementation of energy-saving projects, use of secondary or bio-based raw materials, and implementation of environmental certifications (e.g. ISO14001/EMAS).

The survey findings suggest that the CE is perceived, by those who implement it, as a business opportunity and not merely as a "bolt on" tactic, whose sole purpose is to enhance the reputation of the firm towards its final customers. The introduction of process innovations - such as the use of recycled raw materials and the implementation of production processes with low resource usage allows the firm to effectively compete on cost. Moreover, CE supports the strategic differentiation of the company towards competitors, by characterising company's products as "green" or "sustainably manufactured". These market niches are gaining increasing attention by customers thus provide positive returns for the companies that get access to them.

Finally, it is worth noting that the correlation between the uptake of CE practices and organization size (in terms of both turnover and number of employees) is not statistically significant, indicating that company size need not be a driver for the adoption of CE and sustainability practices.

In the following Figure 6, the more significant results are summarised, in terms of level of implementation of six CE practices, namely separated collection system for waste, recovery and reuse of packaging material and the use of innovative material for packaging, application of environmental criterial for supplier selection, the use of secondary raw materials in the production and the application of LCA. In particular, their correlation with a selection of business strategies, i.e. innovation performance, cost leadership and differentiation, is highlighted. A detailed analysis is provided in the discussion section.



	WASTE Separated collection system	PACKAGING recovery and reuse	PACKAGING innovative material	SUPPLY CHAIN Environmental criteria	SUPPLY CHAIN Secondary raw materials	DESIGN LCA
Level of implementation	84%	39%	17%	18%	14%	23%
Correlation with Innovation performance	0.285	0.146	0.146	0.146	0.201	0.231
Correlation with Cost Leadership	0.036	0.137	0.137	0.137	0.201	0.251
Correlation with Differentiation	0.111	0.104	0.104	0.104	0.138	0.151

Figure 6. Summary of some significant results on six CE practices, in terms of level of implementation and thei correlation with business strategies.

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]	[19]	[20]
COST LEADERSHIP	.091	-.030	.092	.036	.226**	.147*	.185**	-.001	.196**	.206**	.080	.201**	.228**	.213**	.244**	.117	.007	.251**	.036	.137
DIFFERENTIATION	.120	-.054	.033	-.060	.199**	.181*	.162*	.058	.089	.135	.142*	.138	.131	.152*	-.052	-.029	-.111	.151*	.111	.104
EFFICIENCY	.115	-.011	.038	.155*	.141*	.166*	.243**	.024	.091	.075	.161*	.216**	.130	.190**	.143*	.133	.027	.031	.041	.022
INNOVATION PERFORMANCE	.238**	.026	.260**	.219**	.322**	.303**	.322**	.151*	.153*	.228**	.258**	.201**	.031	.234**	.067	.093	.186**	.231**	.285**	.146*
OVERALL PERFORMANCE	.222**	.098	.150*	.143*	.139*	.174*	.304**	.178*	.195**	.143*	.222**	.233**	.065	.142*	.118	.170*	.047	.145*	.272**	.172*
TURNOVER 2016	.089	.026	.077	-.018	-.100	-.105	.070	.115	-.074	-.038	-.127	-.056	-.140	-.073	-.004	.012	.228**	.101	.116	-.011
FTE	.140	.048	.028	.066	-.068	-.010	.057	.032	.008	.048	-.098	-.009	-.101	.022	.150*	.109	.227**	.147*	.071	.032

*Table 14. Analysis of correlation between business performance, strategies and CE practices. Note: *p<0.05; **p<0.01. Refer to table 1 for CE practices*

3.2 Focus Groups

The results of the survey provided the basis for conducting two focus groups, which involved 19 SMEs. The focus groups aimed to: 1) validating the results of the survey, and 2) enriching the quantitative results with details on whether and how CE practices were being implemented, which could only be captured through a qualitative method. The main insights derived from the focus groups are presented in Table 15 and furtherly discussed in the following.

N.	Phase 3: main research findings
1	CE represents a business opportunity
2	Waste plays a central role in CE
3	Incentive system supporting the transition of companies toward CE
4	Development of appropriated management tools
5	Stimulating cultural awareness and education on CE

Table 15: main findings of the focus groups, in terms of insights proposed by participants.

The focus groups confirm the result of the survey that CE can be regarded as *a business opportunity* and not just as a tactic to enhance a company's reputation. As stated by one of the participants, *"The circular economy is necessary for us to still be here tomorrow morning" (N.I.C. Srl)*. The business opportunities that emerged from the focus group can be summarized as follows:

- more efficient production processes, attained through adoption of innovative technologies - for example through the use of equipment that requires fewer inputs to deliver the same output, or "4.0" machines that generate data and statistically-controlled results, to achieve more efficient production.
- differentiated strategic positioning vis-à-vis competitors, through the design and manufacture of innovative products based on a circular or "green" design;
- generation of economic and social value (also including the creation of new jobs) through the development of innovative value networks such as those employing biomaterials (for example bio-plastics, bio-fuels) and those employing secondary raw materials (for example paper and cardboard, fossil-based plastics, industrial sludge, steel, organic waste from agriculture or industrial processes). As one entrepreneur stated: *"It's terrible to see so much paper and plastic wasted because we do not yet have a recycling chain" (ZD srl).*
- creation of businesses that "re-pair, re-use and re-imagine" the products that come out of a previous value chain, as: *"It should no longer be cheaper to buy [a new product] rather than repair an old one" (NIC Srl).*

The focus groups also highlighted the central role that "waste" plays in CE, in two main ways: reducing the generation of non-recyclable waste and recovering the waste that can be recycled and re-inserted into a production cycle as secondary raw material. Firms do not yet have a good understanding of these two aspects. As one entrepreneur reports: *"It was thieves who taught us that waste is a resource" (UFI srl)*, since they were, somewhat surprisingly, the first to grasp the value still embedded in objects often regarded as "waste". Findings from the focus groups also underscore the lack of consistency in regulations between European, national and regional levels. Institutions, in general, are perceived by firms as *"a headless monster"* (UFI srl) that is difficult to tackle. Firms lament a lack of clarity in regulation concerning

what counts as waste, as defined by national regulation (Dlgs. 152/06 and further modifications) and what does not: *"Unlike other European countries, the Italian regulators publish lists of what is 'not waste', and consequently everything that is not in those lists is automatically considered waste" (NAM srl).* It is not clear which materials can be reused 'as it is', which can be revalued as secondary raw materials, and which must be disposed in landfills.

Another finding that emerged from the focus groups is related to creating appropriate incentive systems that support firms in a transition towards CE. SMEs find it difficult to identify incentives for a CE. Even if CE is regarded as a business opportunity, it could be more rapidly seized if appropriate incentives were introduced. The need for political support in this direction clearly emerged. Because of the long time-horizon often required, investments in CE may prove difficult to be sustained by SMEs without adequate incentives. Some insights emerged from the focus groups and, in particular: (i) tax credit mechanisms, (ii) reduction in cost of labour or tax on waste for those who use/invest in renewable energy, (iii) discounts on water bills for those who collect and use rain water, (iv) incentives for the repurposing/recovery of old or abandoned industrial warehouses, for example through *"volume expansion only if the renovation achieves energy class A or higher"* (PIC srl), (v) exclude certain types of investments, such as those in renewable energy, from the Basel standards. Another interesting incentive can arise from digital technology, which could be used to create communication platforms for the reuse, recycling and disposal of resources in the different value chains.

A further element that emerged from the focus groups is the need to update existing managerial tools or develop new ones. Updating existing tools means: integrating non-economic financial indicators into the measurement and control tools; changing the unit of analysis, from the individual firm to the entire value chain, to the business ecosystem - *"Bring production back in-house, because although outsourcing may in some cases be cheaper, the overall balance of the system as a whole is negative"* (NIC srl); and integrating diverse competencies (accounting, purchasing, operations management, design) within the firm. With respect to the introduction of new managerial tools into the firm, some suggestions that emerged from the focus groups refer to the implementation of LCA techniques, ISO14000, green procurement processes and supplier selection based on sustainability metrics.

The entrepreneurs also underscored the importance of stimulating cultural awareness and education on CE at every level. Cultural awareness encompasses both managerial tools, that must be more cross-disciplinary, but also education of citizens and final consumers to *"create a common knowledge base" (ANM srl)*, because *"The example we give is fundamental" (ANM srl).* As a final result, it is worth noting that SMEs are more attentive to the local area and community in which they operate, by their very nature: *"Environmental awareness is the future, and social sustainability is also very important, for example in my business I employ all local personnel" (NIC Srl).* Among the interviewed firms, alongside an awareness for environmental issues, a clear ethical motivation to create value for the area where they are located also emerges, because "*You hope to leave a better world to your children" (ABI srl).*

4. Discussion and practical implications

The results of this study show that several CE practices were simultaneously implemented by SMEs, thus supporting the notion that CE entails a systemic approach to strategic value creation. In particular, practices related to waste management, packaging, supply chain, and product/process design represent key elements for *closing-the-loop* of material flows. Firstly, *waste management* plays a prominent role in

the implementation of CE strategies. 84 % of the SMEs included in the sample declared to have already in place a separated collection system for waste that goes beyond the current regulation.

A second group of practices focuses on *packaging*, in terms of both waste prevention and packaging materials. Recovery and reuse of plastic packaging and material reduction are implemented by 39 % and 25 % of the companies in the sample, respectively. However, turning to packaging materials, only 17 % of the sample is committed towards the adoption of innovative solutions (e.g., bio-based and/or bio-degradable). Since packaging waste account for about 20 % (in volume) of the total solid waste produced in EU and US (Chen et al., 2016), innovative packaging materials become a key factor and opportunity for the effective implementation of CE strategies.

Thirdly, considering the *supply chain,* sourcing renewable energy appears to be the most established practice, implemented by twenty-two percent of the sample, followed by the application of environmental criteria for supplier selection (18 %), and by the use of secondary raw materials in the production process (14 %). The latter practice is currently promoted by Italian regulations within the framework of Green Public Procurement, therefore a considerable increase is expected within the next few years.

Additionally, *design tools* play a key role as eighty percent of the environmental impact of a product originates in the design phase (EPRS, 2017). Product life extension and resource savings represent the two main focal areas. Eco-design tools such as Life Cycle Assessment (Rousseaux et al. 2017) (implemented by 23 % of the sample) promote a product's life extension (Bakker et al. 2014) through a variety of modes such as product reuse, remanufacturing (Cuenca-Moyano et al., 2017), part reuse, and predictive maintenance (Linton and Jayaraman, 2005). This sustainability-oriented action is among the most environmentally successful ones since it focuses on waste prevention by "slowing consumption" (Cooper, 2005) and by increasing resource productivity in terms of durability. Considering the challenge represented by resource savings, CE practices focused on increasing energy and material loops appear quite diverse. Energy savings are achieved by thirty-one percent of the companies, while material savings are adopted by only fourteen percent of the sample. The implementation of such resource saving practices requires a complete re-design of the production process and of the product itself (Duflou et al., 2012). As suggested by literature, multiple-loops design strategies such as design to slow the loops, close the loops, bio-inspired loops, and bio-based loops can be considered as opportunities (as suggested by Mestre and Cooper, 2017), with particular regards to material criticality (Hallstedt and Isaksson, 2017).

Finally, results suggested several barriers and challenges to CE implementation, which could be traced back to "hard barriers" outlined by Ormazabal (Ormazabal et al., 2018:164). In particular, unclear regulation, overwhelming bureaucracy, lack of guidelines for SMEs, and lack of coordination among regulations at different levels, emphasise the absence of support coming from public institutions. Also, SMEs find it difficult to approach the renewable energy market, as they perceive a lack of information on this topic. Finally, CE is still widely regarded as a cost, rather than an opportunity and this is perceived as the main barrier to the implementation of CE practices. As confirmed by Ormazabal et al. (2018), CE still appears not sufficiently appealing in terms of financial returns for companies. However, our results suggest that those companies that develop and implement CE practices perceive them not as a cost, but rather as an investment to support their business. In this sense, the economic lever offered by CE implementation appears as the most effective in promoting the transition of companies toward CE, confirming the findings of the study proposed by Gusmerotti et al. (2019) on manufacturing firms. Therefore, by overcoming the aforementioned barriers, companies should be able to integrate environmental values into their strategy, thus not only improving their environmental performance but also becoming financially viable (Manninen et al., 2018). The companies involved in this study manifest a clear combination of both cost leadership and

differentiation strategies and this may represent a key driver for CE implementation. Following the discussion of results, some practical implications, challenges and opportunities are worth noting, as they emerged from results obtained by the survey and discussed in detail into the focus groups in phase 3. In particular, the major challenge represented by regulatory fragmentation is furtherly discussed, as well as opportunities, which are identified into a more effective communication about CE success stories, with the spreading of the culture of sustainability, the development of new value networks, the definition of specific incentive systems and the introduction of innovative management systems.

4.1. Communicate CE as a business opportunity

Our findings suggest different business opportunities, as the development of more efficient production processes, realized through the use of innovative technologies - for example through the adoption of machines that, using the same output, use fewer inputs, or "4.0" plants that, through the production of data and the statistical control of the results, are able to improve efficiency. Some entrepreneurs also highlight how efficiency can be extended to the entire supply chain through appropriate supplier selection policies and a more effective communication to customers and final consumers. An additional opportunity lies in a differential strategic positioning compared to competitors, through the design and the implementation of innovative products conceived in a circular logic. This is the case of Exe.it, the first green data centre in southern Europe, which offers its customers a "Green data storage" certificate.

4.2. Develop new value networks

Business opportunities also emerge through the development of new value networks such as, for example, biomaterials (e.g. bio-plastics, bio-fuels) and secondary raw materials (e.g. paper and cardboard, fossil-based plastics, industrial sludge, steel, organic waste from agriculture or industrial agro-food processes). Within these chains it will be necessary to support the start-up of companies capable of *re-pairing, re-using and re-imagining* the products that come from a company located upstream in the value chain. In particular, the challenge posed by CE consists in building new *value networks*, based not only on the good-service-revenues paradigm, but also on the creation of knowledge assets and intangible value (Allee, 2000). This novel approach may boost the application of CE among SMEs, as the knowledge content of bio-based and secondary raw materials is intrinsically high, and the environmental benefits generated must be explicitly recognised. For these reasons, widening the business scope at network level may represent a major opportunity for SMEs engaging in CE (Jernström et al., 2017). The opportunities offered by CE are explained not only in terms of waste and pollution reduction, but also in terms of lower company risk, such as, for example, reduced volatility of prices for raw materials and increased efficacy of procurement processes.

4.3. Reduce regulatory fragmentation

In order to develop circular value networks - or value loops - it is necessary to reduce legislative fragmentation. The bureaucratic difficulties related to the application of the legislation on sustainability (in particular related to waste and water) and the lack of coordination of different regulations at the EU, national, and regional levels are perceived by companies as a hard barrier and major challenge to the spread of CE. Waste management plays a central role, as it is important to reduce the amount of non-recyclable waste and increase the amount of wastes that can become secondary raw materials. Regulation is crucial, as it represents a common platform providing clear indications on what waste is and what is not, therefore detailing which materials can be reused, recycled, sent to energy recovery (incineration) or to final disposal (landfill). The recent EU directive on waste aims to provide homogeneity in the waste

legislation among member states (EU Commission, 2017) and set common targets for material recovery, as well as maximum levels for final disposal.

4.4. Identify appropriate incentive systems

Effective regulations are closely connected to appropriate incentive systems that may offer support companies in the transition towards CE. Our findings propose some incentive schemes and concrete opportunities, such as: tax credit mechanisms; reduction of tax payment or labour cost for firms investing in renewable energy; discounts in the water bill for companies collecting and using rainwater in their production cycles; incentives on the recovery of abandoned industrial sites, for example through an increase in volume only if the restructuring operation is carried out in energy class A or higher; untying some types of investment – e.g., on renewables - from the Basel agreements.

Digital technologies can also represent a lever to pull in order to create communication platforms to stimulate reuse, recycling and disposal of resources/waste in the various supply chains through identification of virtuous production chains (e.g. paper/cardboard, glass, steel, plastic); incentives to use local suppliers/customers; and the development of relationships between different companies in the ecosystem.

4.5. Introduce innovative management tools

Regulatory adjustment and appropriate incentives should be coupled with the opportunity provided by the application of innovative management tools. This could be accomplished, on the one hand, by updating existing approaches starting from how companies measure their performance. In such contexts, to support the transition towards CE, incremental innovations would be appropriate in terms of: (i) integration of non-financial indicators into company's performance measurement system (e.g., CO2 emissions, waste by unit of product, and percentage of recovered/recycled waste, use of renewable resources by turnover); (ii) modification of the unit of analysis, moving from the individual company, to the value network and to the production ecosystem. As an entrepreneur stated, it is important to *"bring back the production inside the company, because it is true that outsourcing in some cases is cheaper [than vertical integration], but the overall [system] balance is negative"* (NIC srl); and integration of different skills within the company, by stimulating teamwork among accounting, operations, marketing, product design and purchasing departments.

On the other hand, the issue can be addressed by introducing new management tools such as Life Cycle Assessment, in order to extend the life cycle of products starting from the design phase. Life Cycle Assessment tools (Finnveden et al., 2009), which analyse the entire life cycle of the product in terms of environmental impact and use of resources, can be used to develop "from cradle to cradle" (McDonough and Braungart, 2008), products, triggering virtuous circularity dynamics right from the design and product development phases (Zanni et al., 2018). Also, the adoption of certifications such as ISO14000 could help, *"because they stimulate internal efficiency that helps reduce costs and increase the sensitivity of the entire supply chain" (ABCB srl),* for example through procurement processes and supplier selection based on sustainability criteria.

4.6. Stimulate a culture for sustainability at a political, corporate, and citizen's level

SMEs highlight the importance of stimulating communication (Longo and Mura, 2017) and training on these topics. Communication is intended not only in the form of innovative management tools, but also in relation to the education of citizens, customers and final consumers in order to create a common CE knowledge which must focus on citizens awareness. The process of companies' communication, from the

purchasing office to the marketing department, aimed at training suppliers, customers, up to the final consumers, will stimulate awareness towards a new circular economic paradigm and the creation of a shared value (Porter and Kramer, 2006).

4.7. Communicate success stories

SMEs pay great attention to the communities in which they are located (Longo et al., 2005). Besides environmental concerns, the interviewed entrepreneurs show an ethical motivation to create value for the areas in which they operate, as they hope to leave a better world to their children. It is therefore important to communicate the "success stories", virtuous examples and case studies of companies and industrial ecosystems that have implemented circular business models, which have introduced process innovations (e.g. bio-based materials) or digital technologies (through communication platforms which support the establishment of circular ecosystems) in order to demonstrate that this new model of development is actually possible and advantageous.

5. Conclusions

The aim of this study was to understand what actions SMEs are taking to overcome the challenges and exploit the opportunities of the CE. The focus was on identifying CE practices that SMEs put in place, the principal enablers and barriers to the adoption of such practices, and understanding the relationship between CE, strategy and business performance. Through a multi-method approach, based on interviews, surveys, and focus groups, this study identified strengths as well as weaknesses in the process of transition towards the CE in Italian SMEs.

Research findings suggest several implications, which could represent a basis for developing policies to stimulate the adoption and diffusion of CE within SMEs.

Firstly, they suggest that CE practices are not as widely applied among SMEs as would be desired. In fact, only separated waster collection is applied by 84 % of the companies, while the mean application rate for the other practices is 21 %. Based on the insights gathered, this appears to be mostly due to the diffuse perception of sustainability and CE practices as carrier of higher costs for companies, with a mean value of 5.7 over 7 obtained in the survey. A deeper, clearer and more efficient communication on the opportunities offered by CE (e.g. new materials and new value networks) would support the diffusion of CE practices and success stories.

Secondly, CE is perceived as a business opportunity by companies implementing CE practices. In fact, results suggest a positive correlation between CE practices and business performance, especially in terms of business innovation (with statistically significance correlations for 16 practices over 20, p-value<0.05).

This study presents some inherent limitations. The sample focused on SMEs, as they are relevant players in the diffusion of CE practices due to their prevalence in EU countries. Consequently, the extension of the results obtained to large organizations should be considered with caution. Also, the analyses explored a limited number of industrial sectors (i.e. plant engineering, manufacturing, service-based firms, tourism and ICT), mainly manufacturing-based. Future studies could, therefore, consider a wider range of industrial sectors, and also focus on resources- or carbon-intensive industries, as the main contributors to climate change and resources depletion. Moreover, this study was designed with a cross-sectional approach. This methodology allows a deep characterization of the sample, but it limits the identification of causal

relationships between the different variables explored. Further research could, then, extend our results by taking a longitudinal perspective, which could be relevant to identify and properly characterize possible evolutionary patterns and drivers of the CE. Finally, future studies should explore how CE practices can be effectively embedded into the social system in which SMEs operate, as it is still unclear which impacts on social dynamics will result from the implementation of CE practices. Accordingly, it will be necessary to carefully evaluate the impacts of the introduction of new technologies on individuals, and more generally on society.

References

Agyemang, M., Kusi-Sarpong, S., Khan, S., Mani, V., Rehman, S. and Kusi-Sarpong, H., 2019. Drivers and barriers to circular economy implementation. Manag. Dec. 57, 971-994. https://doi.org/10.1108/MD-11-2018-1178

Allee, V., 2000. Reconfiguring the value network. J. Bus. Strateg. 21(4), 36-39. https://doi.org/10.1108/eb040103

Annarelli, A., Battistella, C., Nonino, F., 2016. Product service system: A conceptual framework from a systematic review. J. Clean. Prod. 139, 1011-1032. https://doi.org/10.1016/j.jclepro.2016.08.061

Bakker, C., Wang, F., Huisman, J., den Hollander, M., 2014. Products that go round: exploring product life extension through design. J. Clean. Prod. 69, 10-16. https://doi.org/10.1016/j.jclepro.2014.01.028

Benyus, J.M., 2002. Biomimicry: Innovation Inspired by Nature. Innovation, New York.

Chen, L., Pelton, R.E.O., Smith, T.M., 2016. Comparative life cycle assessment of fossil and bio-based polyethylene terephthalate (PET) bottles. J. Clean. Prod. 137, 667-676. https://doi.org/10.1016/j.jclepro.2016.07.094

Cooper, T., 2005. Slower Consumption: Reflections on Product Life Spans and the "Throwaway Society". J. Ind. Ecol. 9 (1-2), 51-67. https://doi.org/10.1162/1088198054084671

Cuenca-Moyano, G.M., Zanni, S., Bonoli, A., Valverde-Palacios, I., 2017. Development of the life cycle inventory of masonry mortar made of natural and recycled aggregates. J. Clean. Prod. 140, 1272-1286. https://doi.org/10.1016/j.jclepro.2016.10.029

Duflou, J.R., Sutherland, J. W., Dornfeld, D., Jeswiet, C.H.J., Kara, S., Hauschild, M., Kellensa, K., 2012. Towards energy and resource efficient manufacturing: A processes and systems approach. CIRP Annals 61(2), 587-609. https://doi.org/10.1016/j.cirp.2012.05.002

Eisenhardt, K.M., 1989. Building theories from case study research. Acad. Manage. Rev. 14, 532-550. https://doi.org/10.2307/258557

EMF (Ellen MacArthur Foundation), and McKinsey & Co. (2014). Towards the Circular Economy, vol. 3: Accelerating the scale-up across global supply chains. http://www.ellenmacarthurfoundation.org/business/reports (accessed 15/05/2018)

European Commission, 2011. Minimizing Regulatory Burden for SMEs. Adapting EU Regulation to the Needs of Micro-Enterprises; COM (2011) 803 Final; European Commission: Brussels, Belgium, 2011.

European Commission, 2017. Report on the implementation of the Circular Economy Action Plan, European Commission: Brussels, Belgium, 2017.

European Parliamentary Research Service (EPRS), 2017. The Ecodesign Directive (2009/125/EC) / European Implementation Assessment. European Parliament.

European Commission, 2018.Entrepreneurship and Small and medium-sized enterprises (SMEs).

https://ec.europa.eu/growth/smes_en (accessed 21/12/2018).

Finnveden, G., Hauschild, M.Z, Ekvall, T., Guinèe, J., Heijungs, R., Hellweg, S., Koehler, A., Pennington, D., Suh, S., 2009. Recent developments in Life Cycle Assessment. J. Environ. Manage. 91, 1–21. https://doi.org/10.1016/j.jenvman.2009.06.018

Fischer, A., Pascucci, S., 2017. Institutional incentives in circular economy transition: the case of material use in the Dutch textile industry. J. Clean. Prod. 155, 17-32. https://doi.org/10.1016/j.jclepro.2016.12.038.

Geerken, T., Schmidt, J., Boonen, K., Christis, M., Merciai, S., 2019. Assessment of the potential of a circular economy in open economies - Case of Belgium. J. Clean. Prod. 227, 683-699. https://doi.org/10.1016/j.jclepro.2019.04.120

Geissdoerfer, M., Savaget, P., Bocken, N.M.P., Hultink, E.J., 2017. The Circular Economy - a new sustainability paradigm? J. Clean. Prod. 143, 757-768. https://doi.org/10.1016/j.jclepro.2016.12.048.

Ghisellini, P., Cialani, C., Ulgiati, S., 2016. A review on circular economy: the expected transition to a balanced interplay of environmental and economic systems. J. Clean. Prod., 114, 11-32. https://doi.org/10.1016/j.jclepro.2015.09.007.

Global Footprint Network, 2018. Measure what you treasure.

www.footprintnetwork.org/ (accessed 21/12/2018).

Govindan, K. and Hasanagic, M., 2018. A systematic review on drivers, barriers, and practices towards circular economy: a supply chain perspective. Int. J. Prod. Res. 56, 1-2, 278-311. https://doi.org/10.1080/00207543.2017.1402141

Gusmerotti, N., M., Testa, F., Corsini, F., Pretner, G., Iraldo, F., 2019. Drivers and approaches to the circular economy in manufacturing firms. J. Clean. Prod. 230, 314-327. https://doi.org/10.1016/j.jclepro.2019.05.044

Hallstedt, S.I. and Isaksson, O., 2017. Material criticality assessment in early phases of sustainable product development. J. Clean. Prod. 161, 40-52. https://doi.org/10.1016/j.jclepro.2017.05.085

Hillary, R. and Burr, P., 2011. An Evidence-Based Study into the Benefits of EMSs for SMEs. Department for Environment, Food and Rural Affairs: London, UK, 2011.

Hofstra, N., Huisingh, D., 2014. Eco-innovations characterized: a taxonomic classification of relationships between humans and nature. J. Clean. Prod. 66, 459-468. https://doi.org/10.1016/j.jclepro.2013.11.036.

Hoque, Z. and James, W., 2000. Linking balanced scorecard measures to size and market factors: impact on organizational performance. J. Manag. Account. Res. 12, 1-17.

Jernström, E., Karvonen, V., Kassi, T., Kraslawski, A., Hallikas, J., 2017. The main factors affecting the entry of SMEs into bio-based industry. J. Clean. Prod. 141, 1-10. https://doi.org/10.1016/j.jclepro.2016.08.165

Kravchenko, M., Pigosso, D. C. A., McAloone, T. C., 2019. Towards the ex-ante sustainability screening of circular economy initiatives in manufacturing companies: Consolidation of leading sustainability-related performance indicators. J. Clean. Prod. 241, 118318. https://doi.org/10.1016/j.jclepro.2019.118318

Kristensen, H. S., Mosgaard, M. A., 2020. A review of micro level indicators for a circular economy e moving away from the three dimensions of sustainability? J. Clean. Prod. 243, 118531. https://doi.org/10.1016/j.jclepro.2019.118531

Lieder, M., Rashid, A., 2016. Towards circular economy implementation: a comprehensive review in context of manufacturing industry. J. Clean. Prod. 115, 36-51. https://doi.org/10.1016/j.jclepro.2015.12.042

Linton, J.D., Jayaraman, V., 2005. A framework for identifying differences and similarities in the managerial competencies associated with different modes of product life extension. J. Prod. Res. 43(9), 1807-1829. https://doi.org/10.1080/13528160512331326440

Liu, X., Guo, P., Guo, S., 2019. Assessing the eco-efficiency of a circular economy system in China's coal mining areas: Emergy and data envelopment analysis. J. Clean. Prod. 206, 1101-1109. https://doi.org/10.1016/j.jclepro.2018.09.218

Longo, M., Mura, M., Bonoli, A., 2005. Corporate Social Responsibility and Corporate Performance: The Case of Italian SMEs. Corp. Govern. 5(4), 28-42. https://doi.org/10.1108/14720700510616578

Longo, M., Mura, M., 2017. Assessing Sustainability within Organizations: The Sustainability Measurement and Management Lab (SuMM), in: Campana, G., Howlett, R., Setchi, R., Cimatti, B. (Eds.) Sustainable Design and Manufacturing 2017. SDM 2017. Smart Innovation, Systems and Technologies, vol 68. pp.339-346. Springer, Cham. https://doi.org/10.1007/978-3-319-57078-5_33

Lopes de Sousa Jabbour, A. B., Rojas Luiz, J. V., Rojas Luiz, O., Chiappetta Jabbour, C. J., Ndubisi, N. O., Caldeira de Oliveira, J. H., Horneaux Junior, F., 2019. Circular economy business models and operations management. J. Clean. Prod. 235, 1525-1539. https://doi.org/10.1016/j.jclepro.2019.06.349

Manninen, K., Koskela, S., Antikainen, R., Bocken, N., Dahlbo, H., Aminoff, A., 2018. J. Clean. Prod. 171, 413-422. https://doi.org/10.1016/j.jclepro.2017.10.003

McDonough, W., Braungart, M., 2008. Cradle to Cradle: Remaking the Way We Make Things. North Point Press, New York. ISBN 0-86547-587-3.

Mestre, A. and Cooper, T., 2017. A Multiple Loops Life Cycle Design Approach for the Circular Economy. The Des. J. 20(1), 1620-1635. https://doi.org/10.1080/14606925.2017.1352686

Micheli, P., Mura, M, 2017. Executing strategy through comprehensive performance measurement systems, Int. J. Op. Prod. Manag. 37 (4), 423 – 443. http://dx.doi.org/10.1108/IJOPM-08-2015-0472

Milios, L., 2018. Advancing to a Circular Economy: three essential ingredients for a comprehensive policy mix. Sustain. Sci. 13(3), 861-878. https://doi.org/10.1007/s11625-017-0502-9

Morioka, S. N., Boli, I., Monteiro de Carvalho, M., 2018. From an ideal dream towards reality analysis: Proposing Sustainable Value Exchange Matrix (SVEM) from systematic literature review on sustainable business models and face validation. J. Clean. Prod. 178, 76-88. https://doi.org/10.1016/j.jclepro.2017.12.078

Mura, M., Longo, M., Micheli, P., Bolzani, D., 2018. The Evolution of Sustainability Measurement Research. Int. J. Manage. Rev. 20(3), 661-695. https://doi.org/10.1111/ijmr.12179

OECD, 1998. Small businesses, job creation and growth: Facts, obstacles and best practices. http://www.oecd.org/industry/smesandentrepreneurship/2090740.pdf (accessed 12 October 2018).

Ormazabal, M., Prieto-Sandoval, V., Puga-Leal, R., Jaca, C., 2018. Circular Economy in Spanish SMEs: Challenges and opportunities. J. Clean. Prod. 185, 157-167. https://doi.org/10.1016/j.jclepro.2018.03.031

Pieroni, M. P. P., McAloone, T. C., Pigosso, D. C. A., 2019. Business model innovation for circular economy and sustainability: A review of approaches. J. Clean. Prod. 215, 198-216. https://doi.org/10.1016/j.jclepro.2019.01.036

Porter, M. E., 1985. The Competitive Advantage: Creating and Sustaining Superior Performance. Free Press, New York, 557 p

Porter, M., Kramer, M., 2006. Strategy & Society: The Link between Competitive Advantage and Corporate Social Responsibility. Harvard Business Review 84, 78-92.

Prieto-Sandoval, V., Jaca, C., Ormazabal, M., 2018. Towards a consensus on the circular economy. J. Clean. Prod. 179, 605-615. https://doi.org/10.1016/j.jclepro.2017.12.224

Rizos, V., Behrens, A., van der Gaast, W., Hofman, E., Ioannou, A., Kafyeke, T., Flamos, A., Rinaldi, R., Papadelis, S., Hirschnitz-Garbers, M., Topi, C., 2016. Implementation of Circular Economy Business Models by Small and Medium-Sized Enterprises (SMEs): Barriers and Enablers. Sustainability. 8(11): 1212. https://doi.org/10.3390/su8111212

Rousseaux, P., Gremy-Gros, C., Bonnin, M., Henriel-Ricordel, C., Bernard, P., Floury, L., Staigre, G., Vincent, P., 2017. "Eco-tool-seeker": A new and unique business guide for choosing ecodesign tools. J. Clean. Prod. 151, 546-577. https://doi.org/10.1016/j.jclepro.2017.03.089

Sassanelli, C., Rosa, P., Rocca, R., Terzi, S., 2019. Circular economy performance assessment methods: A systematic literature review. J. Clean. Prod. 229, 440-453. https://doi.org/10.1016/j.jclepro.2019.05.019

Sihvonen, S., Ritola, T., 2015. Conceptualizing ReX for aggregating end-of-life strategies in product development. Procedia CIRP 29, 639-644. https://doi.org/ 10.1016/j.procir.2015.01.026.

Ünal, E., Shao, J., 2019. A taxonomy of circular economy implementation strategies for manufacturing firms: Analysis of 391 cradle-to-cradle products. J. Clean. Prod. 212, 754.765. https://doi.org/10.1016/j.jclepro.2018.11.291

UNEP, 2011. Decoupling natural resource use and environmental impacts from economic growth, A Report of the Working Group on Decoupling to the International Resource Panel. Fischer-Kowalski, M., Swilling, M., von Weizsäcker, E.U., Ren, Y., Moriguchi, Y., Crane, W., Krausmann, F., Eisenmenger, N., Giljum, S., Hennicke, P., Romero Lankao, P., Siriban Manalang, A. United Nations Environment Programme, ISBN: 978-92-807-3167-5

Venkatraman, N., Grant, J.H., 1986. Construct measurement in organizational strategy research: A Critique and Proposal Published. Acad. Manag. Rev. 11, 71-87.

Villena, V.H., Revilla, E. and Choi, T.Y., 2011. The dark side of buyer-supplier relationships: a social capital perspective. J. Oper. Manag. 29(6), 561-576. https://doi.org/10.1016/j.jom.2010.09.001

Virtanen, M., Manskinen, K., Uusitalo, V., Syvänne, J., Cura, K., 2019. Regional material flow tools to promote circular economy. J. Clean. Prod. 235, 1020-1025. https://doi.org/10.1016/j.jclepro.2019.06.326

Wang, Y., Hazen, B.T., 2016. Consumer product knowledge and intention to purchase remanufactured products. Int. J. Prod. Econ. 181, 460-469. https://doi.org/10.1016/j.ijpe.2015.08.031

Winn, M.I., Pogutz, S., 2013. Business, ecosystems, and biodiversity: new horizons for management research. Organ. Environ. 26 (2), 203e229. https://doi.org/10. 1177/1086026613490173.

World Economic Forum, 2018. Push to pick up the pace on the circular economy.

http://www.resourcepanel.org/news-events/push-pick-pace-circular-economy (accessed 21/12/2018)

Zanni, S., Simion, I. M., Gavrilescu, M., Bonoli, A., 2018. Life Cycle Assessment applied to circular designed construction materials. Procedia CIRP. 69, 154-159. https://doi.org/10.1016/j.procir.2017.11.040

APPENDIX A

Tab. A1 - Open interviews held during G7 enterprises

	Role
1	President
2	Senior Vice President
3	CEO
4	CEO
5	Secretary General

Tab. A2 - Enterprises included into focus groups

Enterprise code	Number of full-time employees (Full Time Equivalent - FTE)	Turnover (million €)
A	35	3
B	35	2
C	15	1.8
D	n.a.	18
E	2-5	1
F	100	35
G	3	0.2
H	5	16
I	20-49	0.5-1.5
J	n.a.	n.a.
K	n.a.	n.a.
L	10	0.103
M	20-49	n.a.
N	20	6
O	9000<	1792
P	20-49	3
Q	n.a.	51
R	722	2000<
S	4	n.a.
T	700	21
U	20-49	17.5
V	n.a.	n.a.

1. The study involved 254 Italian SMEs through interviews, surveys, and focus groups
2. Actions taken by SMEs to meet challenges and opportunities of CE are investigated
3. CE Practices focused on waste management, packaging, supply chain and design
4. Sustainability results an opportunity rather than a cost for CE-oriented firms
5. Business opportunities emerge from the development of new value chains within CE

Declaration of interests

☒ 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.

☐The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Matteo Mura
Mariolina Longo
Sara Zanni