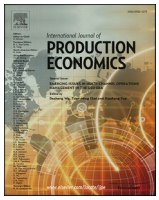
Int. J. Production Economics 248 (2022) 108496

Contents lists available at ScienceDirect

International Journal of Production Economics

journal homepage: www.elsevier.com/locate/ijpe



Adoption of circular economy practices in small and medium-sized enterprises: Evidence from Europe

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ARTICLE INFO

Keywords:
Circular economy
Sustainability performance
Small and medium sized enterprises
Closed loop supply chain
Resource-based view

ABSTRACT

Circular Economy (CE) practices have the potential to enhance sustainability performance of organisations and therefore can help respond to United Nations Sustainability Development Goals. The aim of this research is to examine the adoption of CE in Euroepan small and medium sized enterprises (SMEs) and its impact on sustainability performance. We analyse the current state of CE practices and its impact on sustainability performance across key CE fields of action (design, procurement, production, distribution, consumption and recover) for SMEs in France, Greece, Spain and the UK A mixed-methods approach (survey, interviews, case studies) is undertaken to collect data from around 100 SMEs in each country, employing resource-based view as the theoretical lens. Our findings reveal that CE adoption can result into superior environmental performance through energy and resource efficiency, and waste reduction. Moreover, the 'design' function contributes the most towards the adoption of CE in SMEs, whereas the 'recover' function contributes the least, considering the current state-of-practices. From a theoretical perspective, we outline the issues and challenges, impact of support from customers and policymakers, and self-motivation of SMEs to adopt CE. Based on the findings, we propose an implementation framework for SMEs to develop organisation wide strategic initiatives for CE adoption in business operations.

1. Introduction

The European Union's (EU) target to become carbon neutral by 2050 is not achievable unless larger companies include small and medium sized enterprises (SMEs) in their supply chain within formers' carbon reduction programmes. SMEs account for the majority of businesses worldwide and are important contributors to job creation and global economic development. They represent about 90% of businesses and more than 50% of employment worldwide (World Bank Finance, 2021). For the EU, the average value that SMEs contribute to the economy is around 56 percent. During 2017, SMEs in the EU (approximately 25.1 million) employed over 94 million people, or approximately 66 percent of the workforce (Statista, 2021). In the UK, there are 6 million SMEs employing more than 16 million people, contributing close to 47% of the GDP (UK Small Business Statistics., 2021). The UK SMEs are likely to contribute more than £250 billion by 2025 to the GDP, which is 19% more than the current figure (OECD 2020 Economic Surveys).

SMEs create opportunities across wide range of geographical sectors and areas through employment and value creation, provide skills development opportunities and drive innovation, contributing directly to inclusive growth and social goals (OECD, 2017a and 2017b). However, existing literature and government reports estimate that SMEs have high environmental footprint (for e.g., contribute 60–70% of industrial pollution in Europe), particularly in the manufacturing sector (OECD, 2018a and 2018b). Manufacturing SMEs are reported to account for 64% of air pollution, whereas only a small proportion of 0.4% of these SMEs comply with an environmental management programme (Bonner, 2019). This can be attributed to the fact that a manufacturer spends more than 60 percent of its income on materials and services (Krajewski et al., 2010). This spending accounts for a large share of

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https://doi.org/10.1016/j.ijpe.2022.108496
Received 16 September 2020; Received in revised form 26 February 2022; Accepted 27 March 2022
Available online 31 March 2022
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global resource consumption, pollution, and waste generation, which genitively impact green transformation (EU Commission Sustainability, 2021; EU Greed Deal, 2020). Therefore, original equipment manufacturers (OEMs), SMEs (supply chain partners) and other business customers directly and indirectly contribute to environmental pollution. Although 8 out of 10 SMEs plan to introduce more ethical and sustainable practices, 40% thought that sustainable practices were too costly to implement, while 42% claimed that the UK Government was not doing enough to encourage sustainable business practices (Edie newsroom, 2018). It is estimated that cost-effective energy efficiency measures could shave off as much as 30% of their consumption, namely 22 EJ, which is more energy consumed by Japan and Korea combined per year (IEA, 2015). Climate change issues are the major threat to mankind, which are caused by global warming through greenhouse gas emission. SMEs have the potential to become eco-innovators by enhancing their environmental performance through lean and green improvement measures.

The EU defines a SME as a business with fewer than 250 employees, a turnover of less than €50 million, or a balance sheet total of less than €43 million (European Commission, 2020). Within this umbrella, here are three different categories: medium-sized, small, and micro-businesses. These categories are defined by turnover and number of employees. SMEs' businesses are characterised by numerous competitions, demand side uncertainties, cash flow issues, lack of standardized business practices, skill shortage, and higher employee turnover (Dey et al., 2020a). Hence, SMEs, decisions on adopting environmental and social friendly practices (e.g. lean approach, eco-design, green procurement, employee wellbeing measures etc.) are governed by their economic performance. However, pressures from their customers and policymakers also play an important role in their strategic decision-making. There are several barriers to adopt advanced environmental measures within SMEs' businesses such as a lack of financial support, inadequate information management system, lack of proper technology, technical and financial resources, lack of consumer interest in the environment, lack of support from public institutions, lack of access to qualified professionals in environmental management, and lack of senior management commitment, which collectively lead to slower and/or unsuccessful uptake of circular economy within these organisations (Prieto-Sandoval et al., 2018; Ormazabal et al., 2016; Ritzén & Sandström, 2017; Rizos et al., 2016). This negatively impacts the long-term sustainability of SMEs which is critical for economic development, reducing environmental degradation resulting in climate change (referred to as code red for humanity by United Nations - UN 2021), and non-adherence to the low carbon action plans framed by the policy makers (e.g., EU carbon tax, EU ETS, 2021), which will be detrimental to global climate action plans.

The concept of circular economy (CE) has emerged as a major paradigm shift in the way that human society interacts with nature (Geissdoerfer et al., 2017). Attaining circular model requires cyclic and regenerative environmental innovation in the way society legislates, produces and consumes. It constitutes four emerging components to achieve sustainability: (1) recirculation of resources and energy; (2) the minimisation of demand for resources, and the recovery of value from waste (namely reuse, reduce, and recycle); (3) the need for a multi-level (micro, meso and macro) approach; and (4) its importance as a path to achieve sustainable development (Kristensen and Mosgaard, 2020). CE then manifests through closed loop supply chain functions – design, procurement, production, distribution, usage/consumption and recover (Stahel, 2016), and these functions are often referred to as CE fields of action.

Recent evidence suggests that CE is being adopted across the industries covering manufacturing (Lieder and Rashid, 2016), construction (Benachio et al., 2020; Dadhich et al., 2015), power (Wang et al., 2020), maritime sector (Milios et al., 2019), textile and apparel industry (Saha et al., 2021; Jia et al., 2020), and services sector (Fernandes et al., 2020). The current research focuses on design, implementation, and operations of CE (Suárez-Eiroa Suárez-Eiroa et al., 2019; Dey et al., 2020a) including performance analysis (Sassanelli et al., 2019; Malesios et al., 2018a) and raising awareness among the employees through training (Dey et al., 2019). Theoretically, prior research has contributed towards conceptualising CE (Suárez-Eiroa Suárez-Eiroa et al., 2019), its definitions (Farooque et al., 2019), business models (Pieroni et al., 2019), taxonomy of CE indicators (Kristensen and Mosgaard, 2020; Saidani et al., 2019), relationship between sustainability and CE (Liu et al., 2018), eco-innovation pathway to a CE (de Jesus et al., 2019), and cost-benefit analysis of CE (Gigli et al., 2019). Additionally, there are cross disciplinary approaches towards smart, resilient and sustainable CE through energy and water management, waste management, green policy and pollution minimisation strategy (Fan et al., 2019). Studies have also linked theory and practices of CE (Suárez-Eiroa Suárez-Eiroa et al., 2019) for digitization (Schalkwyk et al., 2018), product designing and business modelling (Pieroni et al., 2019), carbon footprint calculation (Wang et al., 2020), exploring the potential of additive manufacturing for product design (Lieder and Rashid, 2016), and reuse and remanufacturing (Suárez-Eiroa Suárez-Eiroa et al., 2019). Although the above studies are not particularly related to SMEs, the constructs are relevant to SMEs' CE adoption that covers various industries, multiple stakeholders' perspectives, technology enablers, and sustainability-oriented innovation.

Despite of the above mentioned developments, there is a strong scarcity of research in the field of CE from a multi-disciplinary perspective that facilitate real life applications (Nasir et al., 2017). Recent research indicates wide scope for further contributions covering – common way of measuring micro level CE and development of industry specific indicators (Saidani et al., 2019); consideration of social sustainability within the CE framework (Pieroni et al., 2019); developing business model for each phase of businesses (e.g. construction projects - Benachio et al., 2020); degree of circularity of the companies (Sassanelli et al., 2019); societal aspects of CE including social innovation and alternative economies (Türkeli et al., 2018); design for circularity, procurement and circular supply chain, biodegradable packaging, circular supply chain collaboration, drivers and barriers for circular supply chain, circular consumption, product liabilities, and producers' responsibility (Farooque et al., 2019); critical success factors, barriers, new business models and innovative framework for circular supply chain management (Lahane et al., 2020); case studies and prototypes using consensus building among the stakeholders through feasibility analysis to enable environmental sustainability (Fan et al., 2019); how green supply chain management theories facilitate to adopt CE and help build CE theories that not only help achieve environmental sustainability but also social sustainability (Liu et al., 2018); industry specific work on design, implementation and operational tools for 6R (redesign, reduce, reuse, recycle, remanufacture and repair) (Jia et al., 2020); revealing 3 levels of industrial ecology contribution to CE – conceptual, technical and policy aspects (Saavedra et al., 2018); circular business model through integration of waste, natural resources, environmental and economic aspects (Rosa et al., 2019; Battini et al., 2017). This research intends to address some of the above highlighted challenges.

Although, research has been undertaken on CE adoption in larger organisations (e.g., Lieder and Rashid, 2016), studies examining adoption of CE in SMEs are relatively scant (Dey et al., 2019). Additionally, prior research reveals the relationship between sustainability practices and performances along with the impact of various enablers, drivers, and external and internal pressures on economic, environmental, and social performance (Panda et al., 2017; He, 2017). However, there is lack of comprehensive approach for facilitating SMEs to adopt CE practices that objectively reveals current state of CE adoption, analyses issues and challenges, and derives improvement measures. Furthermore, comparative analysis of CE across geographical locations to reveal the best practices and means for achieving sustainability in SMEs is scant. A CE approach in the EU countries will encourage sustainability and competitiveness in the longer term. It will help preserving resources – including some of which are increasingly scarce (raw materials), or

subject to price fluctuation; reduce costs for European industries; unlock new business opportunities; build a new generation of innovative, resource-efficient enterprises – making and exporting green products and services around the globe; create local low and high-skilled jobs; and create opportunities for social integration and cohesion (EU Commission Sustainability, 2021).

As articulated above, although CE has been adopted in the industrial supply chains of European companies, there is still huge scope of enhancing circularity performance of SMEs supply chain in the EU countries. Considering recent conceptualizations and empirical studies, this research will address the following research questions (RQs) in the context of SMEs.

- **RQ1:** How CE fields of action (design, procurement, production, distribution, consumption and recover) are contributing towards sustainability (economic, environmental, and social) performance in the UK, France, Greece, and Spain?
- **RQ2:** Which CE field of action contributes to achieving superior sustainability performance in SMEs? What are the issues and challenges of each CE field of action to achieve superior sustainability performance? Do they vary across the research countries?
- **RQ3:** What measures across the CE fields of action in each participating country can be adopted to improve sustainability performance?

The rest of the paper is structured in six sections. Section 2 presents the theoretical framework and hypotheses for this research. Section 3 elaborates the methodology of the research including data analysis. Section 4 presents the results of the analysis, key findings, and validation of the model. Section 5 discusses the key findings linking them to the literature answering the three questions. Section 6 presents the theoretical and practical implications of the study. Section 7 concludes with the limitations of this research and future research directions.

2. Theoretical framework and hypotheses development

2.1. Background review

CE is proving to alter the traditional linear business model to circular (design, procurement, production, consumption, and recover) using reduce, reuse and recycle principles (Prieto-Sandoval et al., 2018). Prior research has looked into the impact of CE fields of action on sustainability performance (e.g., Dey et al., 2020a). Adhering to desired environmental and social goals as per legal regulations often makes the SMEs economically inferior as not only many environmental and social projects are cost intensive, but also these may not help them to attract customers. Scholars (e.g. Türkeli et al., 2018; Katz-Gerro and Sintas, 2019) have studied the effectiveness of circular economy model in China and some countries in the EU to resolve the dilemma between continuous top line growth, environmental and social goals. Businesses and in particular SMEs can achieve CE by transforming their linear business processes to circular (Prieto-Sandoval et al., 2018). Closed loop supply chain functions (i.e., design, procurement, production, distribution, usage and reverse logistics) enable to adopt CE which will enhance the sustainability performance. There are several benefits and opportunities (Prieto-Sandoval et al., 2018) for the SMEs adopting CE such as increased brand reputation, cost reduction (operational), business growth, higher productivity (throughput), recovery of environment through reduced CO2 emission, and greater sustainability. However, successful implementation of CE will depend on several internal and external organisational factors. External factors include public policy, market conditions, technological development, and stakeholders' actions, whereas internal factors are the firm's resources, capabilities, and competencies (Prieto-Sandoval et al., 2018).

Research by Katz-Gerro and López Sintas (2019) within 11,000 SMEs in EU-28-member states reveals that SMEs in the EU are likely to undertake waste minimisation, energy efficiency measures, redesigning products and services, using renewable energy, and water usage in descending order. The study by Prieto-Sandoval et al. (2018) reveals that the most motivating aspect of CE adoption is cost savings compared to building brand reputation and regulatory pressure. Kirchherr et al. (2017) identify cultural barriers such as lack of consumers' interest and awareness, which along with a hesitant company culture are considered as main barriers to adopt CE. They further reveal that these are driven by market barriers, which in turn are induced by a lack of governmental interventions. Rizos et al. (2016) present business models for adopting CE within SMEs' businesses and reveal that despite the various policy interventions, both organisational and policy barriers act as obstacles to implement CE. The study recommends emphasizing on company culture, consumer preference, and company's green business model. Prieto-Sandoval et al. (2018) demonstrate key strategies, resources, and capabilities for implementing CE in SMEs. Garcés-Ayerbe et al. (2019) analyse the CE practices of EU SMEs for facilitating implementation. They also identify the barriers to CE implementation as administrative processes, regulations, and lack of trained human resources. Ü; nal et al. (2019) have developed business models for designing CE using a case of an Italian SME in office supply industry.

Our study considers measuring the impact of circular economy fields of action on sustainability (economic, environmental, social) performance of SMEs in the research countries. The components of closed loop supply chain – design, procurement, production, distribution, consumption, and recover are considered as latent variables for CE fields of action. Revenue, business growth and contribution to local economy; energy efficiency, resource efficiency, waste management; employee wellbeing, health and safety, and social wellbeing are considered as proxies for economic performance, environmental performance, and social performance, respectively. The theoretical framework for examining the relationships between CE fields of action and sustainability performance of SMEs is shown in Fig. 1. Table 1 shows the constructs, sub-constructs and proxies of CE and sustainability performance along with their sources derived from extant literature (Ünal et al., 2019; Kumar et al., 2019; Prieto-Sandoval et al., 2018; Katz-Gerro and López Sintas, 2019; Zhu et al., 2007; Sassanelli et al., 2019; Geissdoerfer et al., 2017; Dey et al. 2018, 2019; Malesios et al. 2018, De et al., 2020). Appendix A provides the narratives of all constructs and sub-constructs for circular economy fields of action and sustainability performance.

2.2. Theoretical lens

The study is developed on the tenets of resource-based view (RBV) of the firm (Barney, 1991). The RBV is a strategic managerial framework often used to determine the internal resources that an organisation can exploit to achieve enhanced sustainability performance. The RBV focuses on the organisation's internal resources such as assets, capabilities and competencies with the potential to deliver superior competitive advantages (Hooley et al., 2001). While traditionally RBV is focused on intra-organisational resources and capabilities, research has also pointed out the importance of inter-organisational routines that facilitates enhancing the ability to manage inter-organisational relationships to improve business performance (Dyer and Singh, 1998; Kale et al., 2002). RBV focuses not only on the intra-organisational capabilities but also supply chain collaboration through strategies, resources, and competences of all the concerned stakeholders that can enhance sustainability performance. Fig. 2 presents the conceptual framework of this research stemming from the literature discussed in the subsequent sections and by adopting the RBV theoretical lens.

2.3. Hypotheses

The closed loop supply chain functions (discussed in the preceding sections) contribute towards transforming SMEs supply chain from linear to circular through eco-design, green procurement, green

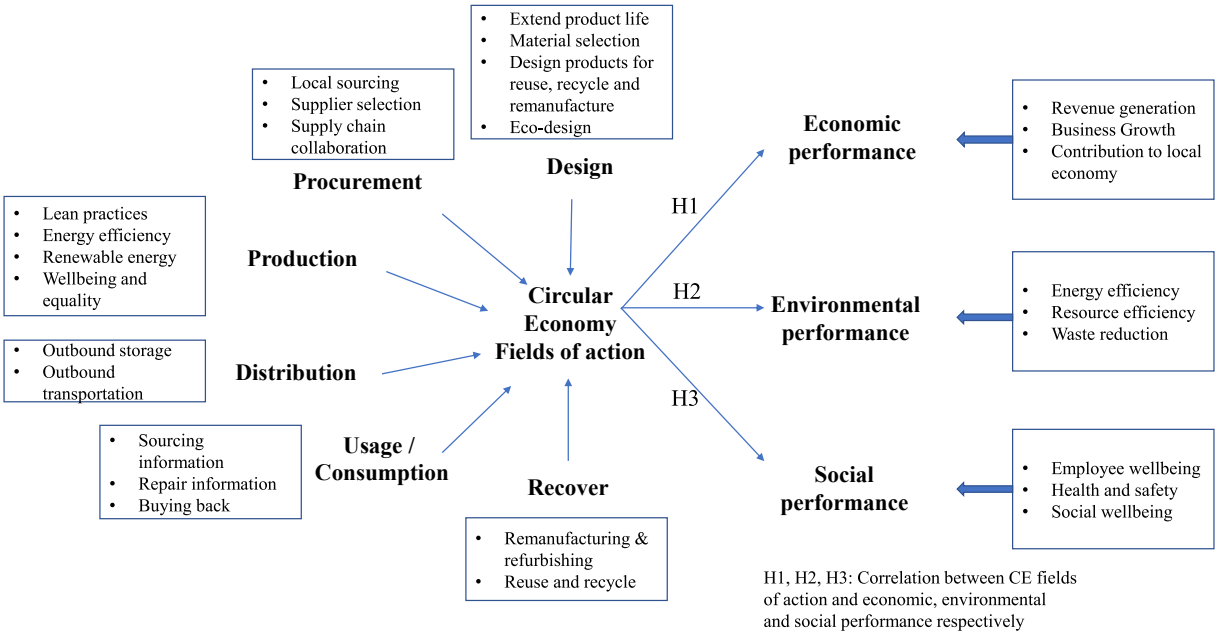

Fig. 1. Theoretical Model relating constructs and latent variables of circular economy and sustainability performance.

manufacturing, green logistics, and recycling products (Tseng et al., 2018; De et al., 2020). These require transforming the products, processes, people and facilities. For many SMEs, they are very capital-intensive projects, their payback period is lengthy, and return on investment is likely to be uncertain. However, the customers (e.g. original equipment manufacturers [OEM], public sector units, retailers etc.) of SMEs might prefer green suppliers (i.e. SMEs) that enhances businesses of SMEs with CE (Dey et al., 2015; Ho et al. 2010, 2011; Scott et al., 2015). Therefore, there are instances of SMEs with CE principles in their supply chain that will help them to achieve higher revenue and business growth in the long run (Dey et al., 2020a). Additionally, material and supplier selection, reducing risks of price volatility in materials, supply chain collaboration, lean practices, energy efficiency measures, third party logistics, reuse and recycle may be cost effective (Lee, 2008; Kumar et al., 2019). Hence, this research intends to reveal whether in SMEs in the EU countries, CE supported by closed loop supply chain variables will lead to achieving higher economic performance. Accordingly, we hypothesise that:

H1. *Circular economy fields of action* are positively correlated to *economic performance*.

Although SMEs emphasize on economic performance over environmental and social to remain competitive, products design is largely guided by customers, and if SMEs have long term relationship with their customers, production processes are also aligned with customers' requirements. The environmental performance of SMEs in this situation is likely to be higher than the other two (i.e. social and economic) if customers follow the principles of CE. Procurement decisions are made predominantly with economy focused by SMEs to keep the production cost lower, unless customers have specific requirements. However, SMEs' customers (e.g. OEM) may specify materials from specific source that leads them to give up their economy focused approach. Lean practices, energy efficiency measures, and use of renewable energy for production help achieve higher environmental performance (Liu et al., 2018; Tseng et al., 2016; Zhu et al., 2007; Malesios et al. 2018; Dey et al., 2020b), though these are all predominantly economy focused. Wellbeing measures of for SMEs' workforce create a positive impact on environmental performance of SMEs, as wellbeing fosters a conducive productive climate across the various functions of the organisation (Dey et al., 2019, 2020a). For many SMEs, the third party logistics reduces carbon footprint drastically. Various initiatives such as making product information on sources of raw materials, repair opportunities available, provision for buy back, etc. contribute toward lowering carbon footprint with higher environmental performance. Additionally, reverse logistics always contributes to higher environmental performance, although they may be capital intensive (Zhang et al., 2015). However, there are instances of SMEs that have also implemented several measures for practicing closed loop supply chain without achieving desired environmental performance (e.g. lean approach helped many SMEs to be efficient but not environmentally responsive). Based on such assumptions, we hypothesise that:

H2. *Circular economy fields of action* are positively correlated to *environmental performance*.

Training workforce for undertaking all the functions of closed loop supply chain following reduce, reuse and recycle principles foster a conducive environment for CE that leads to achieve higher social performance. Although, sourcing locally may help to enhance the social performance by facilitating growth of local economy, but it is unlikely to result in superior economic performance (Blome et al., 2014; Testa et al., 2016). However, many SMEs prefer this to reduce risk of supplies. Although use of regenerative materials, eco-design, additive manufacturing, lean approach etc. are predominantly adopted due to achieve superior environmental performance, they also contribute to higher social performance as SMEs adopting various advanced environmental measures are likely to transform their manpower culturally. These also contribute to achieve higher competitiveness and in turn economic performance. Additionally, closed loop supply chain activities leading to CE adoption transform organisations from efficient to resilient and form a collaborative environment across their supply chain (Dey et al., 2019). However, prior research has also seen contradictory outcomes, where most of the closed loop supply chain activities could not contribute to achieving higher social performance even if they are exclusively implemented for superior social performance (Asif and Searcy, 2014; Morioka and de Carvalho, 2016). Hence, we hypothesise that:

H3. *Circular economy fields of action* are positively correlated to *social performance*.

Table 1
Constructs and variables of CE and sustainability performance of SMEs.

Constructs	Closed loop supply chain functions/ variables	Proxies	Sources (References)
Circular Economy	Design	Design aim is to extend product life Material selection Design products for reuse, recycle and remanufacture Eco-design	Ünal et al., 2019; Kumar et al., (2019); Prieto-Sandoval et al. (2018); Katz-Gerro and López Sintas (2019);
	Procurement	Applying environmental and social criteria in the selection of suppliers Local sourcing to mitigate risks Supply chain collaboration	Zhu et al. (2010); Sassanelli et al., (2019); Geissdoerfer et al., (2017); Dey et al., (2019); Dey et al., (2018); Malesios et al. 2018; De et al. (2020)
	Production	Lean practices Energy efficiency Use of renewable energy Wellbeing and equality	
	Distribution	Outbound storage Outbound transportation	
	Usage/ consumption	Providing repair information Providing sourcing information Buying back used products from customers	
	Reverse Logistics	Remanufacturing and refurbishing Reuse and recycle	
Sustainability performance	Economic performance	Revenue Business growth Contribution to local economy	Dey et al., (2019); Dey et al., (2018); Malesios et al. 2018; De et al. (2020)
	Environmental performance	Energy efficiency Resource efficiency Waste reduction	
	Social performance	Employee wellbeing Health and safety Social wellbeing	

3. Methodology

3.1. Methodological steps

The study adopts both quantitative and qualitative methods. Firstly, through literature review the constructs and sub-constructs for CE fields of actions (e.g. SMEs' closed loop functions and their proxies) and sustainability performance (economic, environmental and social performance) are identified (see Table 1) and a framework (see Fig. 2) for analyzing their relationship is designed along with development of hypotheses. Appendix A provides narratives of the constructs and sub-constructs. Secondly, a questionnaire survey in line with the proposed framework and hypotheses is developed to examine the correlation among the proposed constructs. Thirdly, a survey is conducted with SMEs in each of the four countries – the UK, Greece, France and Spain. Fourthly, the responses are processed using structural equation modelling (SEM) to reveal the relationships among each CE field of action and sustainability performances. Fifthly, this leads to identifying the issues and challenges pertaining to each CE field of action to achieve sustainability performance. Sixth, the improvement measures (resources, strategies, and competences) are captured using focus groups with the managers of selected SMEs in each participating country. Finally, the results are validated through a case study in each country.

3.2. Survey, focus groups and case study methods

The survey responses were received from around 100 SMEs' representatives in each country. The countries have been chosen on the basis of their economies (e.g. similarities and differences). The UK is a highly developed economy with industry contributing 19.2% of the GDP and very low unemployment rate (3%), compared to other EU countries. France is also a highly developed economy (second after Germany in the EU) with slightly higher (9%) unemployment rate and 19.5% contribution to the GDP by the industry. Spain is less developed compared to France and the UK but % GDP contribution by industry is higher (23.2%), but unemployment rate is more than France (13%). Greece is relatively a smaller economy. However, its GDP contributions by industry is 15.28%, which is close to the UK and France, but with a higher unemployment rate (16% in 2019) due to ongoing financial crisis. Therefore, these four countries could represent other EU countries in terms of economy and other characterises to further help generalise the findings of this study for other EU countries.

The responses were analysed to estimate the relationship of the variables within the model using SEM (Bollen, 1989; Hussey and Eagan, 2007) via AMOS. The SEM technique models the causal relationships between variables (constructs). Their distinguishing feature is that variables in contrast to typical regression analysis techniques can be either directly observed or latent or a mixture of both of these. This type of modelling is deemed to be most suitable for testing hypotheses and establishing correlations in our paper.

The SEM model was fit by the method of weighted least squares (Joreskog, 1994), which is the estimation method that is most suitable for the type of non-normal data gathered by the survey. Regarding the fit assessment of the fitted SEM model, we test its validity by using several alternative fit statistics (Marsh and Balla, 1994), such as the GFI (goodness-of-fit index), the AGFI (adjusted goodness-of-fit index) and the PGFI (parsimonious goodness-of-fit index), with AGFI adjusting the GFI for the complexity of the fitted model. Typically, for a good fit the

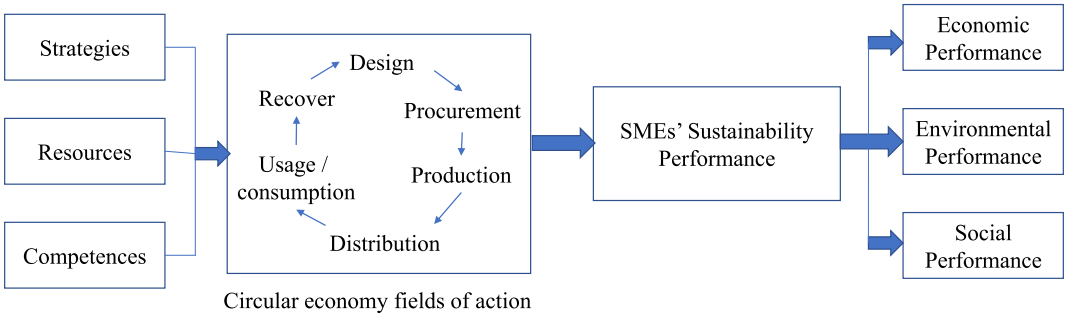

Fig. 2. Conceptual Model for Resource Based View of SMEs Sustainability Performance through Circular Economy Fields of action.

indices should be above 0.9, however this cut-off threshold has been often criticized. The demographic details of the sampled SMEs are provided in Table 2.

The focus groups were undertaken involving representatives of SMEs, their customers and suppliers, policymakers, and researchers. Table 3 provides demographic information of the focus groups in each country. Four focus groups were conducted. Other than the SMEs representatives each focus group was attended by minimum five researchers from the participating universities to facilitate the focus groups. For case studies, four SMEs were chosen randomly, one from each country. For undertaking case studies, a team of four persons (two researchers and one senior manager from the case study company) was formed. They interacted with concerned people in the company following the templates for information gathering and a report was developed. In an average, each case study required 20 h hands on time with around a week elapsed time.

3.3. Data collection and analysis

A questionnaire (Appendix B) is developed using the theoretical model (Fig. 2) for the survey to test the three hypotheses and address the research questions. The study adopts a quantitative research approach to analyse the responses gathered from a total of 401 EU SMEs (98 in Greece, 104 in France, 99 in Spain and 100 in the UK). The questionnaire was filled by the selected SMEs managers, directors and/or owners (see Table 2). The items utilized for SEM modelling are tested for reliability and validity performance. In particular, the Cronbach's α (Bollen, 1989) along with the percentage of variance of the selected items explained by each of the latent factors are calculated and they are within the acceptable limits.

The survey was completed using an on-line survey platform (www.qualtrics.com) through third party. All the contacted persons responded to the questionnaire. All data were saved anonymously on the Qualtrics platform database. Certain quotas included in the design of the survey have ensured that the sample collected is representative of SMEs in each of the four countries, including the wide geographical distribution of companies in each country. The questionnaire included questions on both the assessment of sustainability performance (i.e., economic, environmental and social), as well as items associated with the circular economy fields of action implemented in these companies using the functions of closed loop supply chain (see Appendix B). The conceptual model for CE and sustainability performance proposed in this paper is tested through the SEM approach (Bollen, 1989). All the latent variables used in our SEM analyses are measured via the indicator variables developed from the responses obtained. To ensure a high degree of validity, we used multiple indicators to measure each construct, based on prior literature. We explore the direct connections between the CE constructs and the latent variables of economic, environmental and social performance, by fitting four SEM models, employing the data related to each country.

Table 2
Demographic Details of SMEs, who participated in survey.

Title	Number			
Type of employees	Greece	France	Spain	The UK
Owner	23	19	10	22
Production manager	25	15	17	13
Marketing manager	14	19	12	11
Supply chain manager	12	17	15	15
Purchasing manager	4	11	11	19
Quality manager	10	12	15	10
Maintenance manager	10	11	19	10
Total	**98**	**104**	**99**	**100**
Industry category				
Primary metal manufacturing	25	13	17	24
Fabricated metal product manufacturing	15	17	11	12
Machinery manufacturing	13	21	13	17
Electrical equipment and components manufacturing	13	5	12	9
Chemical manufacturing	10	12	16	13
Food and beverage manufacturing	7	17	9	13
Apparel manufacturing	10	11	11	7
Wood product manufacturing	5	8	10	5
Total	**98**	**104**	**99**	**100**

Table 3
Demographic Details of SMEs, who participated in Focus groups.

Title	Number			
Type of employees	Greece	France	Spain	The UK
Owner	2	0	0	3
Production manager	2	2	1	3
Marketing manager	1	3	2	0
Supply chain manager	3	3	2	3
Purchasing manager	1	2	3	3
Quality manager	1	2	2	2
Maintenance manager	1	1	0	2
Total	**11**	**13**	**10**	**16**
Industry category				
Primary metal manufacturing	1	3	2	3
Fabricated metal product manufacturing	3	1	0	3
Machinery manufacturing	1	2	0	2
Electrical equipment and components manufacturing	1	3	3	2
Chemical manufacturing	1	1	2	1
Food and beverage manufacturing	2	1	2	3
Apparel manufacturing	2	0	0	1
Wood product manufacturing	0	2	1	1
Total	**11**	**13**	**10**	**16**

4. Results

4.1. Results of reliability and validity analysis

Table C1 in Appendix includes the percentage of variance explained by the corresponding constructs and sub-constructs as fitted in the SEM model as well as the Cronbach's alpha values, for evaluating the validity and reliability of the questionnaire. In general, results show that the utilized constructs are adequately addressing the reliability and validity prerequisites with only few exceptions. The collected data from the four countries do not suffer from common method bias, with variance explained by each construct being higher than 50%, with few exceptions near the borderline.

4.2. Checking goodness-of-fit for the country-level SEM models

Goodness-of-fit (GoF) statistics for all the examined models show that the path analysis structures tested provided a good fit, since that most of the values are above the acceptable limits or at the borderlines (see Table 4). Among the four fitted SEM models, the best fit has been observed to relate to the Greek SME data (See Table 4).

4.3. Estimated parameters

In order to test the influence of the CE on the three sustainable

Table 4
Goodness-of-fit statistics for the four SEM models.

Country	GoF measures			
	RMR	GFI	AGFI	PGFI
Spain	0.07	0.918	0.887	0.825
France	0.10	0.875	0.824	0.793
UK	0.09	0.887	0.857	0.806
Greece	0.06	0.927	0.901	0.882

Table 5
Estimated standardized path coefficients of the SEM models (Greece, France, Spain, UK).

Constructs			Country							
			Greece		France		Spain		UK	
			Estimate	P	Estimate	P	Estimate	P	Estimate	P
Circular economy	→	Economic performance	0.450	**	0.702	***	0.446	**	0.278	**
Circular economy	→	Environmental performance	0.805	***	0.685	***	0.622	***	0.795	***
Circular economy	→	Social performance	0.334	*	0.726	***	0.275	*	0.488	**
Distribute	→	Circular economy	0.308	*	–	n.s.	–	n.s.	–	n.s.
Reverse logistics	→	Circular economy	–	n.s.	–	n.s.	–	n.s.	−0.348	**
Usage/consumption	→	Circular economy	–	n.s.	–	n.s.	–	n.s.	0.222	*
Design	→	Circular economy	0.478	**	0.536	***	0.671	***	0.891	***
Procurement	→	Circular economy	−0.335	**	0.232	*	0.579	***	–	n.s.
Production	→	Circular economy	0.403	**	0.445	***	–	n.s.	–	n.s.

*: p < 0.1; **: p < 0.05; ***: p < 0.01; n.s.: non-significant.

performance constructs (economic, environmental and social) that contribute to the SMEs' enhanced sustainability, a total of four SEM analyses were performed respectively, testing the hypothesized model structure of Fig. 2, deriving results separately for the SMEs in the UK, France, Spain and Greece data in order to identify possible geographical similarities and diversifications (see Table 5). The path diagrams obtained by the fit of the four country-specific models are shown in Figs. 3–6. The single-headed arrows in the path diagrams are used to imply a direction of assumed causal influence while the numerical values next to each arrow correspond to the standardized regression weights of the corresponding item on the latent construct while the statistical significance of each weight is also indicated. The dashed lines in the path diagrams indicate no statistical significance for the specific associations.

4.4. SEM analysis

Table 4 summarizes the results of the fit of the structural equation models on the SME data, broken down at the country level (Table C2 in the Appendix presents a more detailed picture of estimations from SEM model, with all standardized path coefficients between (sub)-factors and observed items in the model).

By examining the separate SEM models' results we observe certain differentiations regarding the results of estimated standardized path coefficients. First, the model based on the SME data in Greece shows a statistically significant effect of the CE factor on all three sub-constructs of sustainability performance, with most dominant effect being on the environmental performance sub-construct of sustainability (beta = 0.805; p-value<0.01). It seems that for Greek SMEs, the main positive effect of CE practices is on the environmental aspect, second on the economic aspect (beta = 0.45; p-value<0.05) and to a less extend on the social aspect (beta = 0.334; p-value<0.1). Therefore, SMEs in Greece with CE implemented are quite likely to have greater environmental performance than economic and social performances. Additionally, CE is likely to contribute to achieving SMEs' business growth, energy efficiency, resource efficiency, waste reduction, employee wellbeing and health and safety. However, they are likely to not facilitating revenue generation, contributing to local economy and social wellbeing. Additionally, the factor loading of latent variables of SMEs in Greece reveals that design, operations, and distribution contribute to CE, whereas procurement negatively affects CE, and usage and reverse logistics are not related to CE at all. Therefore, it implies that 'procurement' needs substantial improvement, and 'use' and 'recover' could also be improved to contribute to CE. In other words, design, production and distribution functions of closed loop supply chain contributes to CE implementation, procurement function is negatively relating to CE, and usage and reverse logistic are neutral for CE implementation in SMEs in Greece. Fig. 3 depicts the correlations between CE and economic, environmental and social performances of SMEs in Greece with factor loading for all the variables related to CE and sustainability performances.

We found a highly positive association between CE and all three sub-factors of sustainability performance. CE is highly positively related to economic performance (beta = 0.702; p-value<0.01), environmental performance (beta = 0.685; p-value<0.01) and social performance (beta = 0.726; p-value<0.01). Therefore, any SME in France implementing CE is likely to have higher economic, environmental, and social performances. Hence, a more balanced and important effect of CE on sustainability performance is observed for the French SMEs. The analysis

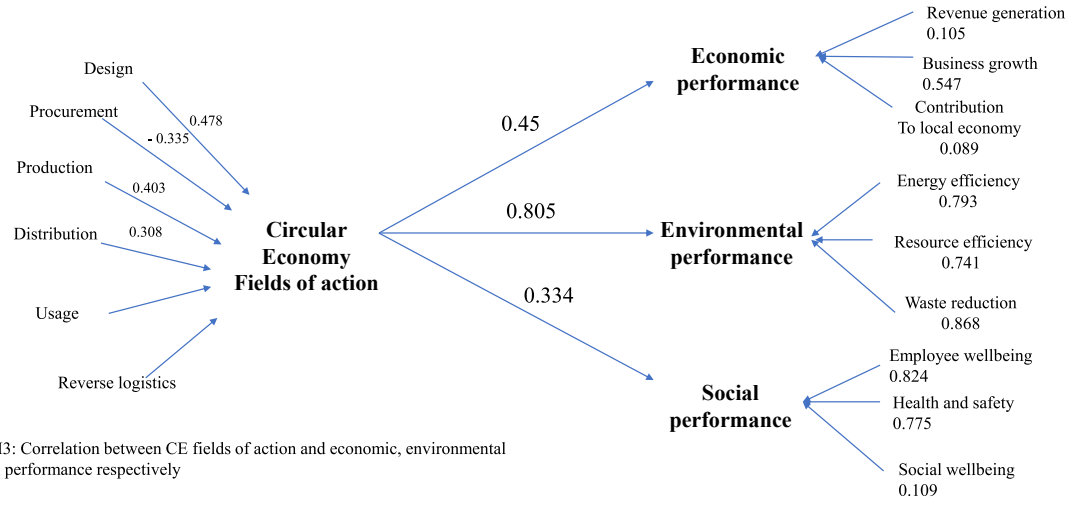

Fig. 3. Results showing among the constructs and latent variables of circular economy and sustainability performance of SMEs in Greece.

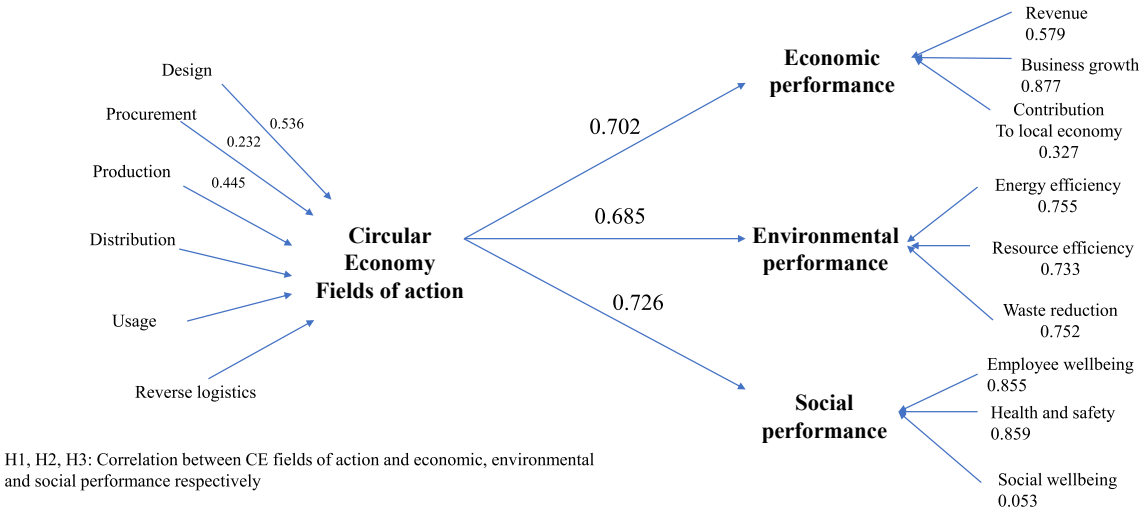

Fig. 4. Results showing among the constructs and latent variables of circular economy and sustainability performance of SMEs in France.

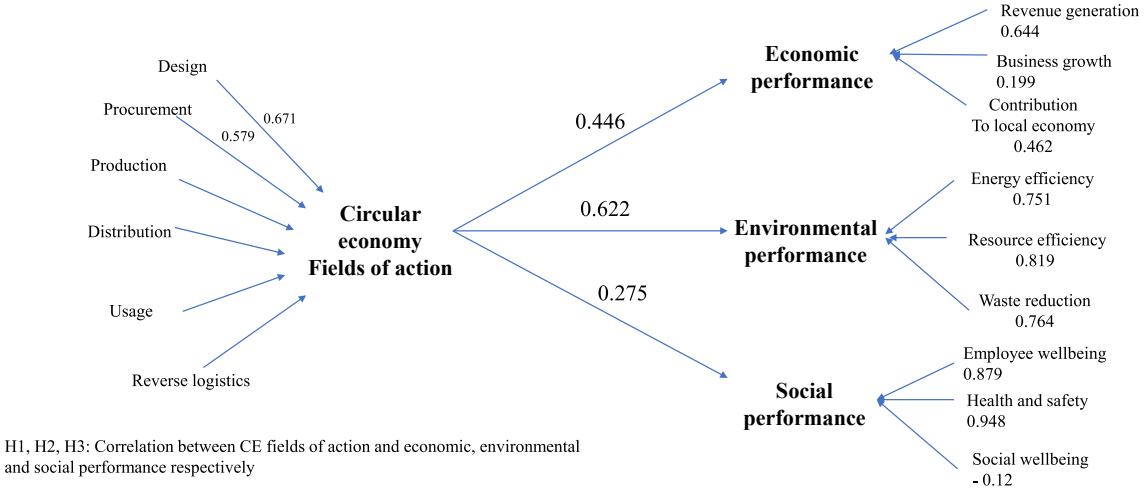

Fig. 5. Results showing among the constructs and latent variables of circular economy and sustainability performance of SMEs in Spain.

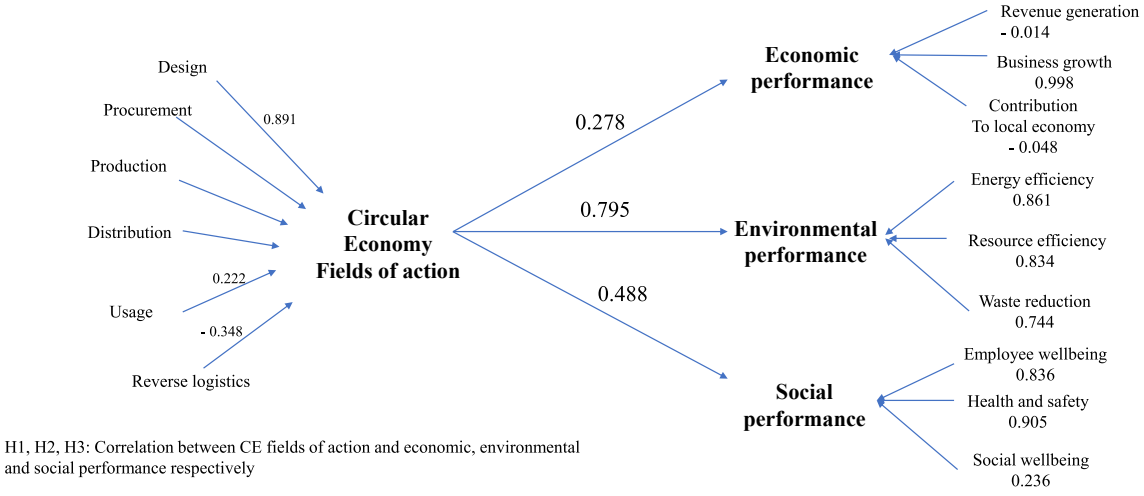

Fig. 6. Results showing among the constructs and latent variables of circular economy and sustainability performance of SMEs in the UK.

reveals that SMEs in France are also likely to achieve higher revenue, business growth, energy and resource efficiency, waste reduction, employee wellbeing, health and safety standard, but without any impact on contribution to the local economy and social wellbeing through CE adoption. Among the closed loop supply chain functions of SMEs in France, only design and production contribute to CE. Other functions

(procurement, distribution, usage, and reverse logistics) have room for practicing circularity more effectively. In other words, SMEs in France are likely to have only design and production function following circular economy principles closely, which is sufficiently strong enough to contribute to enhancing the overall sustainability performance. If other functions could be improved alongside, there is opportunity to further enhance the sustainability performance of SMEs in France. Fig. 4 demonstrates the relationship between CE and sustainability performance along with their latent variables for SMEs in France.

The SMEs in Spain are also likely to achieve higher environmental performance (beta = 0.622; p-value<0.01) through CE adoption compared to economic (beta = 0.446; p-value<0.05) and social (beta = 0.275; p-value<0.1) through CE adoption. Although higher revenue, energy and resource efficiency, waste reduction, employee wellbeing, and health and safety are likely to enhance but business growth, contribution to economy, and social wellbeing outcomes may remain unchanged with CE implementation and operations. Design and procurement functions contribute to CE adoption within SMEs in Spain. Other functions are quite unrelated to CE. As there is room for improving economic and social performance, SMEs in Spain are likely to achieve enhanced sustainability performance through improving practicing CE principles in production, distribution, usage, and reverse logistics functions. Fig. 5 reveals the relationship between CE and sustainability performance along with their latent variables for SMEs in Spain.

The environmental performance is likely to be higher (beta = 0.795; p-value<0.01) than economic (beta = 0.278; p-value<0.05) and social performance (beta = 0.488; p-value<0.05), for SMEs in the UK, Greece and Spain. While business growth of the UK SMEs is assured through CE adoption, higher revenue and contribution to local economy are less likely. Social performance with respect to employee wellbeing, and health and safety are likely to be higher but social wellbeing has room for improvement. Design is likely to be the only closed loop supply chain function that contributes to adopt CE within the UK SMEs. On the contrary, reverse logistics is likely to hinder the CE adoption. While usage is weekly related to CE, other three functions – procurement, production, and distribution are not related to CE. Therefore, procurement, production, distribution and usage could be improved for enhancing economic and social performance. Fig. 6 demonstrates the relationship between CE and sustainability performance along with their latent variables for SMEs in the UK.

4.5. Hypothesis results

Hypothesis 1 proposed a positive correlation between *CE fields of action* and *economic performance*. The results of each country reveal that CE is positively related to economic performance of SMEs. Therefore, SMEs in the research participating countries are likely to achieve higher economic performance if they adopt the practice of CE. However, SMEs in France are likely to achieve much higher economic performance than SMEs in the other three countries. Hence, there is room for improving economic performance of SMEs in Greece, Spain and the UK. Economic performance related to higher revenue generation and greater contribution to local economy of SMEs in Greece and the UK need attention, whereas, business growth is the greatest challenge to SMEs in Spain. The findings of this research thus support hypothesis 1 and are aligned with previous research but make useful and novel contextual (for the four countries) empirical contribution.

Hypothesis 2 proposed a positive linkage between *CE fields of action* and *environmental performance*. The results reveal that SMEs of all the participating countries are likely to achieve higher environmental performance upon adopting the practice of CE. All energy and resource efficiency, and waste reduction are likely to be quite higher with CE implementation. Thus, contributing towards national 'net zero' initiatives. Therefore, the results support hypothesis 2.

Hypothesis 3 proposed a positive correlation between *CE fields of action* and *social performance*. Our results indicate that the adoption of CE practices is likely to positively contribute towards social performance of the sample SMEs in our research, but not equally in each participating country. While SMEs in France are likely to achieve very strong social performance through CE adoption, there is room for improvement for SMEs in other countries. SMEs in Greece, Spain and the UK are likely to be performing well in employee wellbeing, and health and safety performance, but less in social wellbeing. Hence, SMEs in these countries could improve their social performance by deriving means for improving social wellbeing. Nevertheless, the study results support hypothesis 3.

Table 6 consolidates the findings of this research with respect to each hypothesis along with related references to the current literature, which show the current state of performance of SMEs in each country and their comparative positions.

The CE fields of action correlate and contribute to the economic performance. The study outcome is aligned with previous research Lee (2008), Kumar et al. (2019), Dey et al. (2020a), Lieder and Rashid (2016). The study also finds that CE strongly correlates to the environmental performance, which is aligned with Liu et al. (2018), Tseng et al., 2016; Zhu et al. (2007), Dey et al. (2020b), Rashid, et al., 2013 Geissdoerfer et al. (2017). There are few studies (e.g. Andersen, 2007; Allwood, 2014), which negatively contribute to the environmental performance. The negative correlation is due to the parameters consider in the above-mentioned study. Andersen (2007) and Allwood (2014) argue about the increase in energy consumption in the process of recycling products. Circular economy is correlated with social performance in line with the studies like Blome et al. (2014); Testa et al. (2016), Asif and Searcy (2014), Morioka and de Carvalho (2016), and Dey et al. (2019a,b). However, many studies do not correlate circular economy with social sustainability (Gray et al., 2014; Haynes and Murray, 2015).

Table 7 shows comparative analysis of correlation of the closed loop supply chain functions with CE philosophy of SMEs in each country along with issues and challenges so as to derive improvement measures. The design function of closed loop supply chain contributes to CE adoption in SMEs in each participating country. In other words, SMEs across the participating EU countries are likely to have design function aligned with CE requirements to contribute to sustainability performance. Procurement function negatively contributes to CE adoption in turn sustainability performance of SMEs in Greece, partially in France, strongly in Spain, but doesn't contribute towards CE adoption at all in SMEs in the UK. Production function of closed loop supply chain facilitates SMEs in Greece and France partially to adopt the practice of CE and in turn sustainability performance, whereas and surprisingly, the production function of SMEs in the UK and Spain is not aligned with CE requirements to achieve higher sustainability performance. Similarly, the distribution function helps only SMEs in Greece to partially adopt the practice of CE but there is no linkage between distribution and CE adoption in SMEs in other countries. Also, usage and reverse logistics do not relate to CE adoption in SMEs in Greece, France and Spain. However, while usage helps SMEs in the UK partially, reverse logistics negatively links to CE adoption. Therefore, reverse logistics function needs substantial improvement within SMEs in the UK in order to enhance CE adoption and in turn to enhance sustainability performance.

4.6. Improvement measures to enhance circular economy adoption in SMEs

To further develop our empirical and contextual contributions and complement our survey findings, we utilized the conceptual model, survey questionnaire and results to develop a focus group template (see Appendix D) to derive improvement measures to enhance sustainability of SMEs' business through CE adoption. A focus group in each country was organized to determine the issues and challenges of adopting CE from the design, procurement, production, distribution, usage and recover perspectives and sustainability performance as shown in Fig. 2. The outcomes of the focus groups are summarised in Table 8.

Table 6
Comparative analysis of contribution of circular economy on sustainability performance.

Hypotheses	Countries				Previous research
	Greece	France	Spain	The United Kingdom	
H1: Correlation between circular economy and economic performance	CE is partially correlated to economic performance. Although SMEs in Greece are likely to get economic benefits with CE adoption, there are rooms for improvement in revenue generation and contributing to local economy.	CE is strongly correlated to economic performance. SMEs in France get economic benefits with CE adoption.	CE is partially correlated to economic performance. Although SMEs in Spain are likely to get economic benefits with CE adoption, there are rooms for improvement in business growth and contributing to local economy.	CE is partially correlated to economic performance. Although SMEs in the UK are likely to get economic benefits with CE adoption, there are rooms for improvement in revenue generation and contributing to local economy.	The findings are aligned with previous research (Lee 2008; Kumar et al., 2019; Dey et al., 2020a)
H2: Correlation between circular economy and environmental performance	CE is strongly correlated to environmental performance. SMEs in Greece improve their environmental performance substantially with CE adoption.	CE is strongly correlated to environmental performance. SMEs in France improve their environmental performance substantially with CE adoption.	CE is strongly correlated to environmental performance. SMEs in Spain improve their environmental performance substantially with CE adoption.	CE is strongly correlated to environmental performance. SMEs in the UK improve their environmental performance substantially with CE adoption.	The findings are aligned with previous research (Liu et al., 2018; Tseng et al., 2016; Zhu et al., 2007; Dey et al., 2020b)
H3: Correlation between circular economy and social performance	CE is partially correlated to social performance. Although SMEs in Greece are likely to achieve desired social performance with CE adoption, there are rooms for improvement in social wellbeing	CE is strongly correlated to social performance. SMEs in France enhance social performance through CE implementation.	CE is partially correlated to social performance. Although SMEs in Spain are likely to achieve desired social performance with CE adoption, there are rooms for improvement in social wellbeing	CE is partially correlated to social performance. Although SMEs in the UK are likely to achieve desired social performance with CE adoption, there are rooms for improvement in social wellbeing	The findings are aligned with previous research (Blome et al., 2014; Testa et al., 2016; Asif and Searcy, 2014; Morioka and de Carvalho, 2016; Dey et al., 2019)

Table 7
Comparative analysis of contribution of closed loop supply chain functions on circular economy.

Closed loop supply chain functions	Countries				Previous research
	Greece	France	Spain	The United Kingdom	
Design	Partially contributes to achieve CE	Strongly contributes to achieve CE			Dey and Cheffi (2013); Dey (2012); Howard et al., (2019); Atabaki et al., (2020); Tseng et al., (2020)
Procurement	Negatively contributes to CE	Partially contributes to achieve CE	Strongly contributes to achieve CE	Currently does not contribute to achieve CE	
Production	Partially contributes to achieve CE		Currently does not contribute to achieve CE		
Distribution	Partially contributes to achieve CE	Currently does not contribute to achieve CE			
Usage/consumption	Currently does not contribute to achieve CE			Partially contributes to achieve CE	
Reverse Logistics	Currently does not contribute to achieve CE			Negatively contributes to CE	

The participants also discussed on various best practices from their experience. As a result of their brainstorming, innovative improvement measures for CE adoption were derived that would likely to enhance sustainability performance. These have been presented in Table 9.

4.7. Validation of the results

We further validated the results from survey and focus groups through case studies in four SMEs, one each in Greece, France, Spain and the UK by conducting interviews with senior managers, in order to achieve robustness in our research findings. The interview protocol (Appendix E) was developed in line with the theoretical model (see Fig. 2). First, a supply chain mapping was done for each SME covering materials and information flow to understand their business. Second, information related to latent variables for economic, environmental, and social performance, and CE fields of action (functions of closed loop supply chain - design, procurement, production, distribution, usage and reverse logistics) were gathered through informal interviews. The key themes emerging from the analysis are summarised in Table 10. The observations using case studies from each randomly selected SME in four participating countries validates the findings from both the surveys and focus groups on current state of CE, issues and challenges, and improvement measures.

5. Discussion

5.1. Current state, issues and challenges, and improvement measures

This study considers the closed loop supply chain functions – design, procurement, production, distribution, consumption and recover as latent variables for implementing CE practices. The analysis reveals that the knowledge on current state of closed loop supply chain functions of SMEs in the four countries will facilitate identifying the challenges to adopt CE and deriving improvement measures. In Greece, while CE principles (reduce, reuse and recycle) is embedded in closed loop supply chain functions – design, production and distribution to achieve high economic, environmental and social performance, procurement acts negatively, and consumption, and recover do not contribute towards sustainable performance. These are attributed to lack of support from SMEs suppliers and customers along with SMEs' self-motivation. Policymakers also have a role to provide conducive environment for CE adoption through appropriate support (financial) and initiatives (training, certifications, and regulations). Therefore, there is sufficient room for improving procurement, consumption and recover functions of closed loop supply chain in Greece.

Adopting a lean approach (i.e. zero waste policy), long term collaboration with customers and suppliers, conducive regulations and

Table 8
Comparative analysis of issues and challenges of closed loop supply chain processes of SMEs in four participating countries.

Closed loop supply chain processes	Countries				Previous research
	Greece	France	Spain	The United Kingdom	
Design	Product, process and facility designs are often governed by economic consideration due to competitive business environment resulting sacrifice of a few CE requirements (mainly the social and environmental factors). Hence, there is room for improvement in design function.	Product, process, and facility designs are aligned with CE principles. Nothing to address at this stage.			Bocken et al., (2016); Hollander et al., (2017) Rios and Charley (2017); Franco (2019)
Procurement	Emphasizing on price in procurement is the major issue for SMEs in Greece. Tremendous competitive environment due to recent economic recession could be the cause of this. SMEs need to provide equal emphasize on social factors along with environmental and economic to achieve CE.	Although along with economic factors, both environmental and social aspects are being considered in procurement following customers' specification, often priority remains on economic factor.	Customers specify the procurement procedure when there is long term relationship established leaving less room for innovation. As the OEMs have already adopted CE, their supply chains have also transformed to practice CE in procurement.	Supplier are selected predominantly on the basis economic factor including quality. Many SMEs are yet to consider both environmental and social factor in their procurement practices.	Alhola et al., (2018); Braulio-Gonzalo and Bovea (2020)
Production	Through ISO accreditation and lean approach, production is both economy focused and environmentally friendly. However, there are rooms for adopting other advanced methods (e.g. additive manufacturing) and social-oriented accreditations (e.g. SA 8000 for social sustainability).	Through ISO accreditation and lean approach, production is both economy focused and environmentally friendly. However, there are rooms for adopting other advanced methods (e.g. additive manufacturing).	SMEs try to be competitive in production processes through efficient inventory management, better capacity utilisation, labour productivity etc., which reduce their agility substantially. Flexibility results achieving higher CE allowing SMEs to become more environmental and social friendly.		Moktadir et al., (2018); Sousa-Zomer et al., (2018)
Distribution	Mostly third-party logistics are used resulting in a quite balanced CE performance.	There is no standard policy established. Decisions are arrived on logistics selection predominantly with economic consideration. Hence, CE principles are sacrificed.			Seroka-Stolka and Ociepa-Kabicka (2019); Kuo et al., (2019)
Usage/ consumption	End users' requirements are looked from immediate customers' perspectives and necessary information is provided for usage, repair and recycling. There is room for improvement for CE perspectives with information on environment (e.g. waste management) and social perspectives.			Due to pressure from policymakers and customers SMEs in the UK are more environmentally friendly. They provide information on recycling, repairing and reusing of the products.	Tunn et al., (2019); Tseng et al., (2020)
Reverse Logistics	Although there are strategies and policies for disposing unused materials, and machines and equipment, practices need improvement in terms of adding value to the society.			This is a major issue for the SMEs in the UK. Both materials, and unused machines and equipment recycling depends on local council's infrastructure and process. There is hardly any policy set by individual SMEs for disposing their unused machines and materials.	Bernon et al., (2018); Guarnieri et al., (2020)

Table 9
Proposed improvement measures to enhance CE practices across the closed loop supply chain to enhance sustainability performance in each participating country.

Closed loop supply chain processes	Countries				Previous research
	Greece	France	Spain	The United Kingdom	
Design	SMEs in Greece must strengthen their relationship with their customers and emphasize on adopting green philosophy across the supply chain. Policymakers may also encourage green initiatives across the supply chain through additional funding.	Design related to products, processes, facilities and people of closed loop supply chain that are aligned with CE and in turn enhanced sustainability performance. Customers (e.g. OEMs, PSUs, retails) play a major role for this as they predominantly specify SMEs to adhere to CE principles related to environmental and social requirements. No action required.			Bocken et al., (2016); Hollander et al., (2017) Rios and Charley, 2017; Franco (2019)
Procurement	SMEs' customers might influence them to source from more environmentally friendly suppliers. Policymakers must also create a conducive environment for green initiatives across the industrial supply chains.	SMEs must give higher priority to green suppliers	Green procurement strategy in fully operational within SMEs' supply chains across the industry in cooperation with all the stakeholders. No action required.	SMEs must adopt green strategy in their procurement. SMEs' customers, suppliers and policymakers must also push green agenda across the supply chains	Alhola et al., (2018); Braulio-Gonzalo and Bovea (2020)
Production	SMEs must adopt formal ISO 14000, SA8000 accreditations, implement lean approach, and additive manufacturing method, where applicable. If they have already implemented these, they must make it better functional to achieve higher sustainability performance. SMEs' customers must provide incentives to their suppliers with various green initiatives.		SMEs must adopt formal ISO 14000, SA8000 accreditations, implement lean approach, additive manufacturing method, and/or similar methods where applicable. Customers' may formally announce to prefer green suppliers. Policymakers may provide incentives (e.g. match funding for resource and energy efficiency, waste reduction)		Moktadir et al., (2018); Sousa-Zomer et al., (2018)
Distribution	Develop long term relationship with third party logistics service providers	SMEs need decision support system to select the most appropriate logistics for their product distribution that has equal emphasize on economy, environment and social consideration, which is aligned with their customers and policymakers.			Seroka-Stolka and Ociepa-Kabicka (2019); Kuo et al., (2019)
Usage/ Consumption	All the stakeholders including the end customers must be integrated digitally to receive information related operations, repair and recycle of the products.			Although the stakeholders are integrated but there are rooms for engaging more so as improve CE through higher sustainability performance	Tunn et al., (2019); Tseng et al., (2020)
Reverse Logistics	SMEs must operationalised this to get the advantage of higher sustainability performance through improving economic, environmental and social performance. Policymakers must regulate this through incentives and penalties. Customers may also force SMEs to provide this information for bid submission and factor them in their bid evaluation process.			SMEs must make strategy, policy and operational plan to address this. This should be integrated with forward logistics of the company. Policymakers must regulate this through incentives and penalties. Customers may also force SMEs to provide this information for bid submission and factor them in their bid evaluation process.	Bernon et al., (2018); Guarnieri et al., (2020)

sustainability audit helps SMEs in France to be more open towards adopting CE practices. However, they can improve their sustainability performance by addressing the challenges in distribution, consumption and recover functions. Strengthening the presence of third-party logistics and collaboration with customers along with their self-motivation towards CE might enhance their sustainability performance. Similarly, SMEs in Spain need to pay attention to their production function along with distribution, consumption and recover functions. This is mainly due to macro-economic challenges (e.g. stagnant economic growth, and institutional external pressures) of the country. Additionally, all the stakeholders need to be responsive towards environmentally friendly practices. Finally, SMEs in the UK need to improve their procurement, production, distribution and recover functions. As customer-supplier relationship across the manufacturing supply chain of SMEs is conducive, design function of the UK SMEs is aligned with CE philosophy. Additionally, government is also very responsive for reducing carbon footprint of SMEs through policies, training incentives, and capital support. However, SMEs' self-motivation for environmental and social friendly practices will play a major role for effective and efficient CE adoption resulting in higher sustainability performance.

Overall, while the design function of SMEs in these countries contributes to CE adoption and higher sustainability (economic, environmental, and social) performance, recover function needs serious attention in every country. As design is mainly governed by SMEs' customers, it implies that SMEs' customers can drive CE implementation within organisations (through their green preferences). The effectiveness of the recover function however will depend on SMEs' self-motivation and/or pressure from policymakers, which seems low within the SMEs industries in these countries due to their efficiency (economic) focused business approach. This results in lower contribution to recover function. Therefore, policymakers can potentially promote all facets of CE practices through policy reforms, training programmes (creating awareness among suppliers, distributors, and consumers), periodic audits (as in France), benchmarking performance relative to climate action plans (e.g. energy and resource consumption, reusability, and recyclability), and financial support (for e.g. based on SMEs' self-motivation, performance and achieving audit targets).

Although SMEs' stakeholders (e.g. customers, suppliers, and policymakers) play important roles to aid adopting CE along with SMEs' self-motivation, each function may need support from specific stakeholder. This study reveals that design is governed predominantly by SMEs' customers, which is aligned with previous research (Bocken et al., 2016; Hollander et al., 2017; Rios and Charley, 2017; Franco 2019). However, CE implementation in procurement function is driven mainly by their suppliers and individual SMEs' self-motivation in line with previous studies (Alhola et al., 2018; Braulio-Gonzalo and Bovea, 2020). CE initiatives in production, and distribution functions are practiced mainly through SMEs' self-motivation along with customers' pressures and competitive market environment, which aligns with the prior research (Moktadir et al., 2018; Sousa-Zomer et al., 2018; Seroka-Stolka and Ociepa-Kabicka, 2019; Kuo et al., 2019). CE practices pertaining to consumption and recover functions are mostly driven by policymaker, but SMEs' self-motivation will also enhance successful adoption (Tunn et al., 2019; Tseng et al., 2020; Bernon et al., 2018; Guarnieri et al.,

Table 10
Case studies on CE implementation through closed loop supply chain and sustainability performance of SMEs in four EU countries.

Constructs	Functions/ Variables	Countries			
		Greece	France	Spain	The United Kingdom
General Information		Industry: Processing/trading sector Location: Orestiada, Northern Greece Employee number: 20 Business start: 2002 Business type: Consumer market	Industry: Manufacturing Location: Normandi Employee number: 35 Business start: 1956 Business type: B2B	Industry: manufacturing and trading sector Location: Madrid, Spain Employee number: 140 Business start: 1950 Business type: B2B	Industry: Manufacturing, Aerospace industry Location: Birmingham Employee number: 45 Business start: 1983 Major customer: Rolls Royce Business type: B2B
Closed loop supply chain	Design	SMEs' products are currently more and more developed towards environmental friendly way. Also, design, manufacture and decorations of glass containers in the company are approved and getting accreditations for being environmentally friendly. The company does not currently have ISO 90001 or ISO 14001, due to the lack of interest by the customers.	Design is constantly implemented into the SMEs' CE strategic plans. The company has ISO 9001 accreditation, which is a significant advantage of the company in relation to competition in the sector since the majority of competitors do not have ISO 9001 or other similar accreditations.	The SME is a fast moving business that sets the quality of products as a first priority. They have a product quality department and the company has ISO 14001 accreditation. However, design of products is not underestimated and efforts are given towards this closed loop supply chain CE practice.	Products and production process design is specified by the customers and as customers are predominantly have environmentally friendly practices, all CE principles are followed strictly. The company has ISO 14001 accreditation. Facility planning and design are economy, environmental and social friendly
	Procurement	Procurement is a major concern for the company, with special attention on the economic performance, being a priority over environmental and social part. A major drawback is the difficulty to engage with local suppliers, since they are struggling to find local suppliers and most of the times resort to suppliers further distant apart.	A major concern in the company is the old age of tools and machinery, which needs replacement. This is a first priority in the near future for the SME. Financial part and innovation part are the two most important targets for the company in order to differentiate from the large competition (there are at least 20 competitors within a range of 100 km).	Procurement is of concern in the company, especially due to the large supply and demand uncertainty in this sector. The major issue is due to that the company produces large customer stock which is not easy to manage in case of losing a large customer.	Procurement is focused towards economy of scale without sacrificing quality. Therefore, they tend to have more raw material inventory. They prioritise cost over environmental and social criteria. They do consider risk factor in procurement and intend to develop long term relationship with local suppliers.
	Production	Production is more and more demanding for the company, due to the large expansion during the last decade. The company emphasizes on covering the needs for larger demands in production. Large emphasis is also put minimizing waste through their production process, with large gains in both the economic and the environmental performance of this Greek SME.	Recently, production has arisen due to new clients and innovations applied to their old products. There is much room for improvements in the environmental management and waste management. The latter is the most important for them and they will seek to fix in the coming years.	Production is large and heavily depends on large suppliers. Supply uncertainty is mostly met in terms of delivering times. Although they try to minimize uncertainty, there is still room for improving inventory management and capacity utilisation.	Production processes are reasonably agile to accommodate and customise varied customers' needs. Through lean approach they emphasize on resource and energy efficiency, and waste reduction all through their production processes. There are rooms for improving inventory management, capacity utilisation and quality of products.
	Distribution	Warehousing is serviced within the company, whereas third party logistics mixed with internal transporting is utilized for distribution of the produced goods.	Third party logistics service providers are used for warehousing and transportation for materials and end products.	The SME has significantly improved the transport of goods and products within the company in recent years, with the use of trucks and lorries. Also, they are making use of more automatic transport through HUVs (automated guided vehicles). External transport is also improving in terms of economic and environmental terms, by attempting shifting from trucks to train transportation.	Third party logistics service providers are used for warehousing and transportation for inbound raw materials and outbound finished products giving emphasize on economy.
	Usage	The SME seeks to have long term relationships with most of their immediate customers in the supply chain. The company combines half-century traditional techniques and experience with modern equipment. Newly developed modern facilities based on all National & European regulation, are constantly expanded with more tanks and machinery.	The company has long term relationship with their local customers since first years of establishment. However in the recent years, and due to expanding to new products through innovations, they have gained new clients boosting the economic performance of the company.	They are using approximately 60% of recycled carton board for their production. However recycling also depends on the specific client. There is an inherent difficulty in finding and engaging with local clients, since the suppliers are mostly outside the country.	They have long term relationship with most of their immediate customers in the supply chain. They make the desired product information available to their customers. Products are repaired, reused and recycled following customers' instructions. They are also involved in new product development along with their major customers, when they

(*continued on next page*)

Table 10 (*continued*)

Constructs	Functions/ Variables	Countries			
		Greece	France	Spain	The United Kingdom
					consider end customers' requirements directly.
	Reverse Logistics	Reverse logistics in the closed loop supply chain of the company is currently not implemented at a high level within the SME. Waste is handled within the company.	Innovation has recently helped improve the reverse logistics in the company, although much more improvement is required. Recycling of waste is mixed procedure, using internal process and third party.	Reverse logistics is a closed loop supply chain CE aspect that currently has been not given fully attention in the company.	Reverse logistic needs substantial improvement in terms of raw materials inventory management and recycling old machines and equipment. Production waste recycling is done through third party.
Sustainability performance	Economic performance	Greek economic crisis in the last 10 years has large negative impacts in the financial performance of the SME, however during the last years there have been positive indications of stabilization in their financial results and even increases in turnover and profits.	The company operates since 1956 and performs generally well in the economic aspect of sustainability. Performance on spending on local suppliers is quite high, according to the manager of the company, ranging between 35 and 50% of total spending on suppliers.	Economic crisis in Europe in the last decade has affected the company in terms of economic performance, however there are significant signs of improvement. Funding for SMEs in Spain is a priority as was revealed by our case study analysis, although there are specific problems and challenges, mainly due to issues related to bureaucratic bottlenecks and administrative burden. Contribution to the local economy is rather limited due to difficulties in engaging with the local suppliers.	Economic performance with respect to revenue generation, and business growth are constantly high over last five years. However, contribution to local economy could be improved through more local sourcing. As their procurement is driven by customers they have constraints to contribute to local economy.
	Environmental performance	Regarding their environmental management, the company is currently improving their efficiency regarding waste management and disposal in an environmentally friendly way. No third party is utilized, however there are procedures implemented within the company for handling waste residuals from wine and relevant material processing. These practices are of high importance for the company and the local community towards an environmental friendly environment.	The SME is putting much importance in the environmental part of sustainability, achieving already low levels of energy consumption and further seeking to improve in various aspects of energy reduction and waste management. Especially, the utilization of recycling materials as inputs in production process is an environmental practice that considered of high importance. The waste management is currently managed both internally and by a third party.	Environmental improvement is of high importance within this Spanish small-and-medium sized enterprise, with much emphasis given in the recent years in improving recycling practices within the company, although currently the basic focus is on resource efficiency.	They have ISO 14000 accreditation and lean approach in production processes, which help them be both energy and resource efficient. Additionally, facilities are also made energy efficient with Government funding. Production waste has been considerably reduced all through production processes substantially using technology and training their manpower. However, as recycling is being managed through third party there is room for improvement.
	Social performance	There is lack of advanced social performance, since that the general sense on behalf of the managerial staff in the company is that their customers are not interested in certifications such as ISO 9001. Regarding health and safety issues for the employees, their level has significantly improved in the last years, as a result of both governmental drivers and within company managerial orientation.	In the social performance aspects, the SME reported that the clients often demand high health and safety standards and following this demand it substantially improves their image to the customers. Also, no penalty and sanction from the regulatory bodies received in last five years. Wages of the employees is at the average country and industry level.	Regarding the social aspect of the SMEs' sustainability management, the company faces difficulties in finding local suppliers although their target is on putting emphasis on collaboration with local suppliers. However, in most of the cases they are forced to seek other sources for materials since local supply is expensive. Salaries in the company as the per the industry are higher. No fines or other incidents are reported concerning non-compliance to health and safety rules in the last five years of the company's operations. Also their clients demand high health and safety standards.	Improvement in facilities layout and environment friendly facilities helped improve work culture within the employees. Higher economic performance enables company to maintain high salary for their employees. Therefore, morale of the employees is very high. Absenteeism in last five years is within the limit. There is no health and safety issue exist. No penalty and sanction from the regulatory bodies received in last five years. Also promotes local and national charities. Runs an apprentice scheme to train young people. Works with local schools and Universities.

2020).

5.2. Responses to research questions stemming from the empirical evidence

RQs 1 and 2 are addressed by examining the three hypotheses, i.e., positive, and significant correlation between CE fields of action, and economic, environmental, and social performance. With regards to RQs 1 and 2:

- Our analysis shows that CE fields of action are strongly related to all economic, environmental, and social performance of SMEs only in France. However, although, CE is strongly related to environmental performance of SMEs, but only moderately impacted by the economic and social performance. SMEs in France can further improve their sustainability performance in 'contribution to local economy'

through engaging with local suppliers, and 'social wellbeing' through corporate social responsibility initiatives (Cheffi et al., 2021).

- Similar to France, SMEs in Greece can enhance their performance in both 'contribution to local economy' and 'social wellbeing', along with 'revenue generation'. While SMEs in Spain need to pay attention to 'business growth' and 'social wellbeing', SMEs in the UK need to focus on achieving higher performance in 'revenue generation', 'contribution to local economy', and 'social wellbeing'.
- Overall, the output latent variables - 'contribution to local economy' and 'social wellbeing' are the common factors that needs attention from the SMEs in the four participating countries for facilitating CE adoption. In this context, Haj Mohammad (2013) has shown the positive impact of lean practices on and Dey et al. (2020b) has further shown latter's positive influence on sustainability performance of the UK SMEs. In this context, CE practices and strategies concerning human resources (well-being, rewards, and equality) will enhance the innovation capability of organisations (Lei et al., 2021), intellectually stimulate employees' ability to perform their tasks and embrace change (Gui et al., 2021). Skills and competencies harnessed through training for wider adoption and diffusion of CE practices (Schroeder et al., 2019) will positively influence psychological immunity of the employees (organisational commitment, job satisfaction, meaningfulness, and productivity), i.e., social performance.

These findings are unique compared to the existing literature (Panda et al., 2017; Manninen et al., 2018; Nasir et al., 2017; Dey et al., 2019), where preference is more on achieving environmental performance. These are due to the major uncontrollable external forces (economic, demographic, technological, natural, social, and cultural, legal, and political) that vary across the countries (geographical locations), influencing a firms' strategic decision making and business priorities, which will impact their sustainable performance. Although incorporating the three dimensions of sustainable performance is complicated (Bom et al., 2019), existing research does not necessarily account for the trade-offs between economic, social and environmental performance (Aktin and Gergin, 2016; van Loon et al., 2021). Studies have focused on a single performance measure (Lee and Raschke, 2020; Wagner, 2015; van Loon et al., 2021) rather than holistically considering the social, economic, and environmental performance, which we have addressed in our study.

RQ3 was answered using focus groups among the SMEs' participants. First, various issues and challenges are identified in Table 7 and subsequently improvement measures are derived in Table 8. The issues and challenges that are derived from the focus groups exactly match with the findings from the survey data analysis. The CE function wise improvement measures in each participating country are as follows.

SMEs in Greece must strengthen their relationship with their customers and emphasize on adopting green philosophy across the supply chain including products, processes and facilities of all the concerned stakeholders. Policymakers must also encourage green initiatives across the supply chain through additional funding. Design aspects with respect to products, processes and facilities of SMEs in other participating countries are currently aligned with the CE philosophy.

The procurement function of SMEs in Greece, France and the UK also needs attention. SMEs must adopt green procurement principles emphasizing on selecting environmentally friendly suppliers. SMEs' customers might create a pressure and influence them to source from more environmentally friendly suppliers. Policymakers must also create a conducive environment for green initiatives across the industrial supply chains. SMEs in all the participating countries must adopt formal ISO 14000, SA8000 accreditations, implement lean approach, and additive manufacturing method, where applicable. With increased awareness regarding the benefits of adopting CE principles, customers may formally prefer green suppliers. Policymakers may provide incentives (e.g. match funding for resource and energy efficiency, waste reduction) facilitating green practices.

The distribution function within closed loop supply chain of SMEs in every participating country can be improved through selecting most appropriate third-party logistics service providers and developing long term relationship with them. A digital multi-stakeholder platform could also be established to integrate all the stakeholders of the supply chain including end users and customers. This will enhance the consumption function of the closed loop supply chain to achieve desired sustainable performance. Most of the SMEs suffer from achieving desired performance outcome from the consumption function, therefore, SMEs must make strategies, policies and operational plans to address this. It should be integrated with forward logistics of the company. Policymakers must regulate this through incentives and penalties. Customers may also force SMEs to provide this information during bid submission and factor them in their bid evaluation process.

6. Implications

6.1. Theoretical implications

This research makes several contributions. First, it provides empirical evidence regarding the positive correlation between the adoption of CE principles and sustainability performance in SMEs in the four participating countries. Second, it offers a robust framework (see Fig. 7) for CE adoption in SMEs' supply chain by analysing the current state of CE, identifying issues and challenges, deriving improvement measures through strategies, resources, and competences, and deriving roles of each concerned stakeholder using design, plan, implement and evaluation (principles). The framework has leading factors – the functions of closed loop supply chain (e.g. design, procurement, production, distribution, usage and reverse logistics) and lagging factors – economic, environmental and social performance along with their sub-constructs. These variables might vary across scenarios (e.g., regions, consortia, individual company). The proposed framework (Fig. 7) is the extension of the RBV of CE (Figs. 1 and 2), where life cycle approach of CE has been incorporated along with both intra and inter-organisational strategies, resources, and competences with the involvement of concerned stakeholders. Third, the study reveals the current state of CE adoption in SMEs in four diverse countries - Greece, France, Spain and the UK along with the impact of CE adoption on sustainability (economic, environmental, and social) performance. This enables individual SME, SMEs' consortia and policymakers to make decisions that will enhance CE implementation (e.g., prioritising initiatives through strategy formulation, policy deployment, resource allocation and competence building). Although this research is limited to four countries, but it could be extended in other countries across the globe, via the proposed framework (Fig. 7), measures derived and robust methodology. The findings could be compared to derive desired actions that can improve sustainability performance of SMEs in any industry and geographical location. The findings also support the RBV theory (Barney, 1991) as it reveals strategies, resources, and competences necessary for SMEs using intra and inter organisational strengths (to enhance dynamic capability).

6.2. Practical implications and impact

This research has also significant practical implications. Implementing CE across the industrial supply chains has been quite popular in recent years in line with the climate change policy of most countries globally (Dey et al., 2020a; Kristensen and Mosgaard, 2020; Saidani et al., 2019). However, the knowledge about implications of CE adoption on economic, environmental, and social performance were limited for SMEs in Greece, France, Spain and the UK. The means for improving sustainability performance through CE adoption is extremely value added for SMEs and their stakeholders to adopt right approach for tackling and responding to contemporary climate change issues. This research provides a pathway to implement CE across the industrial

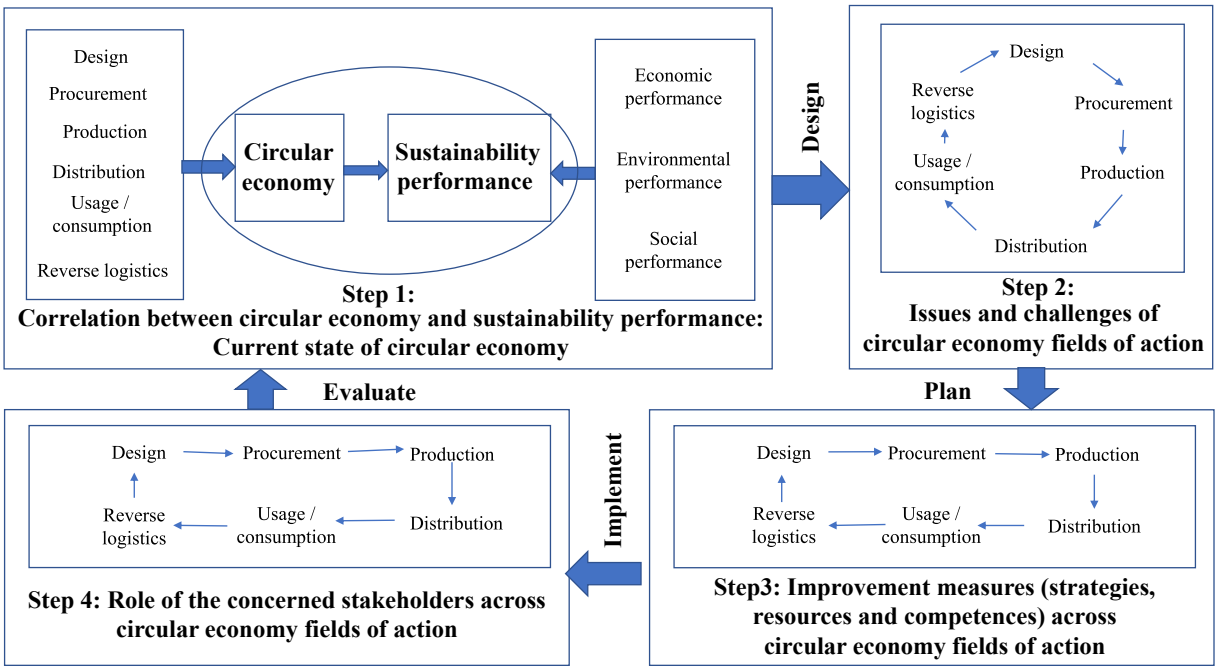

Fig. 7. Framework for CE adoption in SMEs in region, industry consortia and individual levels.

supply chain in regional, industry consortia and individual SME levels (see Fig. 7).

While undertaking this research, the team has worked directly and indirectly with more than 400 SMEs and their supply chain across the four countries through survey, focus groups, and interviews including relevant policymakers of each country. The project reports are made available to them through University website enabling them to adopt the findings and recommendations of the study. Therefore, the companies are likely to be benefited from the project due to their closed association throughout the project delivery. The findings are being communicated to policymakers so as to facilitate them to adopt CE in SMEs. Additionally, with follow on workshops and other communications through research articles and webinars, SMEs and their supply chain across the EU region are likely to get further benefits. Diagnostic aspects of the methodology and enhancing SMEs employees' awareness on environmental challenges and remedies particularly have greater impact to adopt CE implementation in all the participating countries. The case study SMEs in each participating country are planning to implement the improvement measures that are derived from the analysis. An informal interview with the representatives of the SMEs who participated in the focus groups reveal that each SME has undertaken plans for adopting CE and currently in varied phases of implementation.

7. Conclusion

Although from prior research, there is evidence of SMEs achieving superior environmental performance by adopting CE, economic and social performances are not assured (Türkeli et al., 2018; Katz-Gerro and Sintas, 2019). This motivated us to undertake empirical research to reveal the means for achieving higher sustainability performance (economic, environmental, and social) through CE adoption. Data was gathered from around 100 SMEs from each of the four selected countries – Greece, France, Spain and the UK using a survey to study the current state of CE adoption, and subsequently, focus groups were organized which involved SMEs owners and managers, policymakers, SMEs' customers and suppliers, in each country to derive means for improving the impact of CE on sustainability performance. The study reveals that SMEs in the participating countries are likely to achieve higher environmental performance through CE adoption, although economic performance and social performance may not be fully assured other than in France. This study specifically contributes to objectively determining the means for improving SMEs' sustainability in the participating countries. Products, processes and facilities design is likely to facilitate SMEs most in all the participating countries to adopt CE. In other words, SMEs in the EU countries are likely to have sustainable design practices aligned with the CE philosophy. On the contrary, SMEs in the participating countries are likely to have worst recover function. This implies that customers' pressure works for SMEs to adopt CE principles as design function in most of the SMEs' businesses is governed by SMEs' customers. Whereas effective recover function depends on SMEs' self-motivation and policymakers' pressure. There is also room for improving other closed loop supply chain functions – procurement, production, distribution and usage/consumption in SMEs across these countries in order to enhance their sustainability. However, the means for improving each function varies across industries, sizes, turnover, and geographical locations. The study proposes a comprehensive framework (see Fig. 7) extending RBV theory for adopting circular economy in SMEs businesses across regional, consortia and individual SME levels through diagnostic for designing, planning, implementation and evaluation.

7.1. Research limitations

The research has a few limitations in the form of sample size, selection of geographical locations, research methodology, selection of statistical technique etc. that has implications on the results and findings. In order to address the above limitations, we have always compared our findings with contemporary literature, and referred to experts' views and opinions. Additionally, by adopting the mixed methods approach and triangulation (data acquisition), we have addressed most of the methodological issues concerning research validity and applicability. As indicated in the preceding sections, all constructs and corresponding proxies for the analysis are identified through both secondary and primary research methods. Therefore, they might vary across the scenarios (i.e., primary context of the study). The potential beneficiaries and researchers should keep in mind the above limitations while adopting the proposed research methodology, and the outcomes.

7.2. Scope for further research

The findings of this research warrant several new research questions in the area of CE and sustainability pertaining to SMEs and their supply chain encompassing all the concerned stakeholders (i.e. SMEs owners and managers, industry consortiums, and policymakers). As the design function was found to be the strongest closed loop supply chain function for adopting CE in SMEs' supply chain in the EU countries, a detailed work could be undertaken on the critical success factors of the design aspects (e.g. products, processes, facilities) that will significantly contribute to CE in practice. Additionally, recover function is the weakest function of SMEs in the EU countries that contributes least to CE adoption, thus examining the root causes for this could be an interesting study. Moreover, the roles of other functions in closed loop supply chain are also interesting to design, implementation, and operationalisation a fully operational CE strategy in SMEs' business networks across the nations. Additionally, roles of each stakeholder SMEs, customers, and policymakers across the supply chain is always an important question to examine. The role of organisational human resource factors (such as employee wellbeing, commitment, leadership, skills utilization, co-worker sustainability support and job characteristics) on the adoption of CE practices and subsequently the impact on sustainability performance, organisational resilience, and dynamic capability can be examined to help develop sustainability culture within SMEs' organisations.

Acknowledgments

This research has received funding from: (1) European Regional Development Fund (reference OC12R16P0367) for the project Support the Shift Towards a Low Carbon Economy in Greater Birmingham and Solihull Local area Enterprise Partnership; (2) MARIE SKŁODOWSKA-CURIE ACTIONS, EU Horizon 2020 (Agreement No. 788692) for the project Enhancing Sustainability Performance of Small and Medium sized Enterprises' Supply chain.

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