Sustainable Production and Consumption 40 (2023) 122–134

Contents lists available at ScienceDirect

Sustainable Production and Consumption

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

Thematic analysis of circular economy practices across closed-loop supply chains: An institutional theory perspective

Matloub Hussain [a], Mehmood Khan [a,*], Hussein Saber [b]

[a] College of Business Administration, University of Sharjah, P.O Box 27272, Sharjah, United Arab Emirates
[b] College of Business Administration, Abu Dhabi University, P.O Box 59911, Abu Dhabi, United Arab Emirates

ARTICLE INFO

Editor: Prof. Beatriz Lopes de Sousa Jabbour

Keywords:
Circular economy
Circular supply chains
Institutional theory
SIPOC (suppliers
Inputs
Process
Outputs
Customers)

ABSTRACT

A circular economy (CE) presents an alternative solution to the scarcity of natural resources and environmental concerns. Institutional pressures motivate adopting and developing CE practices in various supply chain stages (SC), and successful implementation across the SC is challenging and risky. The situation is more complicated in the closed-loop supply chain (CLSC) structure. This study explores CE practices at different SC stages and the impact of their implementation on CLSC performance. This study uses a mapping tool for decision-making: SIPOC (suppliers, inputs, process, outputs, customers). We adapt and rename this tool as "circular SIPOC" based on the feed-forward and feedback flow of the complete material across different CLSC tiers. A circular SIPOC chart, coupled with institutional theory, is used to identify CE techniques from the three manufacturing CLSCs of the United Arab Emirates (UAE), supported by thematic analysis. The findings indicate two unique and standard practice classifications in SCs. They further show that traditional practices are easy to implement, while individual practices have medium to great difficulty in implementation and related SC performance. This study's contribution is the detailed list of CE-based practices in three CLSCs and the criticality of their implementation. Following the institutional theory, government institutions may use the findings of this study to put coercive, normative, and mimetic pressure on organizations, encouraging the adoption of these CE practices and helping bring the CE a step closer.

1. Introduction

The circular economy (CE) is a restoring and regenerating concept that maintains the materials, products, and components in cycles for value creation. The CE concept has recently gained more recognition and has been increasingly seen as a stepping stone toward sustainability (Hussain and Malik, 2020; Kravchenko et al., 2019; Geissdoerfer et al., 2017). Integrating these CE-based practices into supply chain (SC) activities is called circular supply chain management (CSCM). Various stakeholders are compelling SCs to adopt circularity practices, from manufacturing easy-to-repair, sustainable products espousing solutions to extending product lifetime and endorsing remanufacturing and materials recycling (Calzolari et al., 2021).

A closed-loop supply chain (CLSC) is also a significant enabler of sustainability across the value-creating links (Stindt and Sahamie, 2014). CLSCs differ from traditional SCs in reprocessing and after-sale recovery operations (Van Engeland et al., 2020). CSCM deals with implementing multiple CE practices in an SC to reduce waste and improve resource efficiency to gain a competitive advantage (Hussain and Malik, 2020). A CLSC follows some of these reduce, recycle, and reuse practices. On the other hand, CSCM deals with the triple bottom line (TBL) approach and is an extension of restorative and regenerative dimensions (Ellen MacArthur Foundation, 2017). Open-loop, cross-sector collaborations (Weetman, 2016). Zhang et al. (2021) demarcated the boundaries between CLSC and CSCM, whereas CSCM emphasizes the value recovery from all the tiers, and CLSC can hardly recycle and reuse all the materials. CSCM is an all-inclusive business strategy aiming to accomplish a higher level of circularity across all the tiers and extends the margins of green SCM, sustainable SCM, and CLSC. For further details, the reader is referred to the work of Mahmoum Gonbadi et al. (2020) and Zhang et al. (2021).

One can argue that adopting CE practices depends on the extent of circularity and CLSCs reconfiguring their strategies and operations to embrace CE techniques to obtain economical, social, and environmental benefits. However, such reconfiguration would need a significant investment (Nagasawa, 2017) and could be risky. Concurrently it also

* Corresponding author.
E-mail addresses: matloub.hussain@sharjah.ac.ae (M. Hussain), mehmood.khan@sharjah.ac.ae (M. Khan), hussein.saber@adu.ac.ae (H. Saber).

https://doi.org/10.1016/j.spc.2023.06.017
Received 22 February 2023; Received in revised form 15 June 2023; Accepted 18 June 2023
Available online 20 June 2023
2352-5509/

depends on the readiness of the organizations to embrace CE practices (Pigosso and McAloone, 2021); e.g., Chowdhury et al. (2022) highlighted the importance of internal organizational factors; Bertassini et al. (2022) focused on changes needed in cultural and technological domains; Gennari (2022) emphasized the importance of integration among various stakeholders. Besides, SCs cannot quickly shift toward the CE from their existing linear methods without a comprehensive knowledge of the challenges and appropriate techniques. Corporates can adopt different CE strategies and techniques, but planning and designing proper CE practices for CLSCs requires a careful assessment (MahmoumGonbadi et al., 2021).

Rossi et al. (2020) summarized the pertinent literature on CE indicators. Their work failed to provide insight into CE practices in the CLSC context. Similarly, Ayati et al. (2022) categorized the CSCM barriers across 3Rs (i.e., remanufacturing, reusing, and recycling) in linear supply chains. Likewise, de Lima et al. (2022) recognized the uncertainties and uncertainty management approaches, and Taddei et al. (2022) reviewed remanufacturing, recycling, reuse, material and energy efficiency, and waste management across linear CSCM. Also, the transition toward the CE accrues many challenges, including selecting the right partners, mechanism of reverse supply logistics, new market selections, and product and process redesigning (van Loon and Van Wassenhove, 2020). Qazi and Appolloni (2022) have discussed the barriers and enablers of adopting CE practices at the procurement level. Still, we argue that the situation is more complicated in CLSCs where feedforward and feedback loops increase complexities and uncertainties by creating multi-locations and multi-fold collection and recovery processes. Therefore, the present study focuses on the following research questions:

RQ1: What are the critical circular economy (CE) practices across various nodes of closed-loop supply chains (CLSCs)?

RQ2: How do these practices impact the performance of closed-loop supply chains (CLSCs)?

The Gulf Council of Countries (GCC) has lately been quite concerned about the conventional linear models in supply chains that rely on a take-make-dispose strategy (Al-Alawi et al., 2020). The countries in the region have adopted various programs to foster reduced consumption and recycling (Bejjani et al., 2019). United Arab Emirates (UAE) is one of the most major developing countries in this region and has recently announced a CE policy to identify its priorities across several sectors. This study sheds light on how the efforts of different stakeholders in the UAE are integrated toward CE, as pointed out by Taddei et al. (2022) that an extended focus on the exploration of appropriate CE practices, including many stakeholders, will effectively contribute to the needs of present and future generations.

CLSCs are complex structures in which different tiers significantly affect performance. To deal with this level of complexity, this work modifies a SIPOC (suppliers, inputs, process, outputs, customers) tool to a circular SIPOC, incorporating the institutional theory perspective. A significant benefit of SIPOC is that it follows a systematic approach and provides a common language to control, manage, and improve critical processes (Al-Aomar and Hussain, 2018). Using institutional theory is an additional theoretical lens for focusing on sustainability. The application of this theory is in its infancy in the context of SCs (Ebrahimi and Koh, 2021; Glover et al., 2014). The reason for choosing institutional theory is that it provides a comprehensive understanding of the various organizations/tiers in CLSCs and justifies the selection of some CE practices without an apparent economic return. A SIPOC chart was initially used to explore multiple CE practices, their impact, and criticality in implementation from the perspective of experts within different tiers of SCs in the United Arab Emirates (UAE). Subsequently, QDA Miner and abductive reasoning through the thematic analysis technique helped us discover several themes. This study contributes explicitly to the literature in two ways.

— It comprehensively lists the CE practices across all the SC tiers.

— It uses a systematic approach to explore implementing these practices in CLSCs.

As a result, this study provides a theoretical underpinning for all stages of SC (more than two tiers) in the context of developing countries, which has been missing in the available literature.

The remainder of this paper is organized as follows. Section 2 deals with the literature review for the concepts used; Section 3 describes the analytical framework; Section 4 analyses the results; Section 5 discusses the results. Section 6 provides conclusions and suggests future research recommendations.

2. Research context

2.1. Circular supply chains (SCs)

Sustainability is meeting a society's present needs without compromising future generations' requirements. It encompasses preserving the world's resources and reducing environmental pressure. In the Kyoto Protocol, the United Nations (1998) specified reducing greenhouse gas emissions to a minimum of 5 % lesser than their 1990 levels. The Paris Agreement (United Nations, 2015) suggested decisive actions and investment requirements for a sustainable future. Sustainability has three pillars (profit/economic, planet/environment, and people/social), commonly called the triple bottom line (TBL). For example, an SC with the strategic integration of environmental dimensions is a green supply chain (GSC) (Frota Neto et al., 2008), while a CLSC that encompasses all dimensions of the TBL is a sustainable supply chain (SSC). Liu et al. (2018) clarified the difference between the notion of green supply chains (GSC) and circular economy (CE). More recently, COVID-19, a global pandemic, has impacted several social, environmental, and economic dimensions and their interplay with CE approaches. There is a dire need to redesign the present linear economic model in line with planet-before-profit in favor of CE (Ibn-Mohammed et al., 2021). A CLSC differs from a GSC as it conceptualizes value creation within the original SC rather than collaborating with auxiliary members (Moula et al., 2017).

CSCM calls for integrating the CE paradigm into the SC (Genovese et al., 2017). The CE expands the boundaries of environmental sustainability through a restorative and regenerative design-based production system (Moreau et al., 2017). Unlike the predominant linear economy, the CE provides a solution for the depletion of natural resources (D'Amato et al., 2020). The controlled use of natural resources is based on eco-friendly product design, which can be made by following the 3Rs (reduce, reuse, recycle) from the *Circular Economy Promotion Law of the People's Republic of China* (Government of the People's Republic of China, 2008) or the 4Rs (reduce, reuse, recycle, recover) from the *Waste Framework Directive of the European Union* (2008). Ramkumar (2019) presented seven critical elements for CE: "prioritize regenerative resources, preserve and extend what is already made, use waste as a resource, rethink the business model, design for the future, incorporate digital technology, collaborate to create joint value." As a result, CSCM integrates circular thinking into SC activities to restore technical materials and regenerate biological materials based on innovative business models, eco-friendly product design, service design, product leasing, collaboration with all SC partners, and involvement of all stakeholders for zero waste and legitimacy of social practices (Farooque et al., 2019; Chedrawi et al., 2020).

Emergent digitalization and information technologies are helping designers and strategists to move from a linear to a circular economy (Bocken et al., 2016; Sarkis et al., 2020). Thus, the regenerative dimension in CSCM enhances green and sustainable supply chain management practices by closing their loops of collaborations (Weetman, 2016). CSCM remains an effective way to minimize waste, reduce negative environmental impacts, and complete critical resource loops (Geissdoerfer et al., 2018). Therefore, CSCM provides a promising way to improve resource efficiency and reduce the load on the environment, which helps organizations achieve zero-emission and consequently enhance their profits. Circularity in CSCM is also a tool for combatting risks and uncertainties that may impact a few or all stakeholders in their network (Agyabeng-Mensah et al., 2022). Several external factors, such as COVID-19 and Russia-Ukraine conflict, may adversely affect the capabilities and, thus, the performance of a CSCM (Nikolopoulos et al., 2021; Spears et al., 2022). Thus CE, in the context of CSCM, helps us move a step further in achieving the sustainable development goals of the Paris Agreement (United Nations, 2015). However, the literature on this topic remains limited.

2.2. Theoretical background

The institutional theory encompasses the diffusion phenomenon of specific management practices or organizational structure and deals with the vital aspects of the social network. It addresses the question of the corporate trend to look and act alike (DiMaggio and Powell, 1983). Scott (1995) discussed the critical concept of institutions as "regulative, normative and cognitive structures and activities that provide stability and meaning for social behavior." These institutions can exert pressure on organizations for environmental management, known as isomorphism (Hawley, 1968). There are three types of organizational forces: coercive, normative, and mimetic (Greenwood and Hinings, 1996). Coercive isomorphism is the pressure from entities on which resources depend. Normative isomorphism refers to the established standards and practices by professional networks, education and training methods, and firm employee movement. Mimetic isomorphism refers to imitation behavior during times of uncertainty. Singh et al. (2018) added environmental commitment and green economic incentives to extend the theory of planned behavior for supply chain readiness to a circular economy (CE).

Organizations must follow these institutional pressures to obtain legitimacy and ensure their survival. Hoffman (1997) highlighted that legitimate firms are part of a broader community and follow social norms, values, and beliefs. This makes organizations adopt international standards (Darnall et al., 2008) and act similarly (Suchman, 1995). As a result, institutional theory has become a popular and influential explanation for individual and organizational actions. There have been several reviews of institutional theory in the last few years (Scott, 1995, 2001; Tolbert and Zucker, 1996).

The institutional theory deals with adopting management practices or organizational structures for legitimacy. It shows that corporate motivation for adoption is an external pressure (Naveh et al., 2004; Schoenherr and Talluri, 2013; Wang, 2014). Institutions exert this pressure through coercive, normative, and mimetic isomorphism. However, the institutions themselves are the outcome of an institutionalization process (Berger and Luckmann, 1967) that reciprocates the typification of habitual action by various actors (Schütz, 1962). Thus, the theory deals with the advantages of first and second movers in the new information age and brand equity from a positive perspective (Jacobs et al., 2015). However, there remains uncertainty regarding the adoption time of management practices (Su et al., 2015).

CSCM guides institutions to adopt CE practices as a first mover and obtain social legitimacy, solving economic and environmental concerns. CSCM also provides a concept to reduce the load on natural resources, protect the environment, and generate a competitive advantage for organizations, resulting in a win-win situation. Geissdoerfer et al. (2018) commented on the practices of CSCM for waste minimization, efficiency improvement, and reduction in environmental damage and resource use. The regenerative and open-loop collaboration dimensions of CSCM help institutions accomplish these improvements (Weetman, 2016).

The literature sheds light on two ways to adopt CSCM practices. First, institutions may put coercive and normative pressure on other organizations to change the business model and implement CSCM-based practices as organizations act upon external pressure (Wang, 2014). Government and international organizations assert the shift toward CE via legislation, directives, and incentives (Bressanelli et al., 2019). One can argue that institutional pressures, including coercive ones, moderate the relationship between adoption and change across the SCs (Gupta et al., 2020). Second, institutions may voluntarily follow CSCM practices as the first mover to access the new information and thus gain a competitive advantage. Multiple studies have indicated reducing waste and improving efficiency by following CSCM procedures in different sectors. Examples of practical ways to reduce waste and improve efficiency include waste photovoltaic modules (Farrell et al., 2020), electric vehicle batteries (Alamerew and Brissaud, 2020), food provisioning (Borrello et al., 2020), bridge construction (Anastasiades et al., 2020), product licensing (Zhu et al., 2016), and technology licenses (Aurelius Environmental, 2016).

We argue that Institutional theory is the most appropriate and is vital in providing legitimacy to adopting the norms of CLSCs (González-Sánchez et al., 2020). Building upon the CE, institutions may even revolutionize their day-to-day operations' social culture and practices (Sylvestre et al., 2013). These norms also entail reduced costs and increased productivity. Circularity helps institutions harmonize their social welfare, economic efficiency, and environmental legitimacy (Murray et al., 2017). Besides, circularity paves institutional pressure for environmental innovations (Berrone et al., 2013). The advantage of circularity in the context of modern institutions is its structured and holistic view that analyses the unique configurations of their business and allows them to distinguish from each other. Thus, circularity provides institutions with a framework to propose, create, and capture value while applying the principles and practices of the circular economy (Bocken et al., 2016). While this concept has been successful for several institutions, validating its vitality for a circular supply chain still needs further research and exploration. The present study, therefore, aims to fill this gap by providing an institutional theory approach for CSCM practices resulting in a win-win strategy.

Table 1 indicates several management theories in the context of CSCM. Multiple theories have been applied in the CE setting; however, institutional theory has limited application. The institutional theory offers a theoretical lens to explore and scrutinize the stimuli that help the sustainability and legitimacy of organizational practices encompassing factors like regulations, environmental, social, and legal (Glover et al., 2014). The present study explores various CE techniques adopted by different tiers of the SCs, their criticality, and the level of impact. Subsequently, the institutional theory is the most appropriate theoretical approach, which has been widely applied in exploring issues like environmental sustainability (Bansal, 2005), sustainable practices (Glover et al., 2014), blockchain adoption (Hartley et al., 2021), and green supply chain (Rezali et al., 2021).

Another stream of research developed system dynamics simulation models to explore the various notions of CE. The idea of CE identifies several persistent problems in our industry, such as higher consumption and waste of material, lower life cycles, and moderate recycling rates. System dynamics (SD) helps us model such a complex system for better decision-making. Their models include the detailed flow of materials (metals, plastics, paper, cardboard, and glass) relevant to a system. A system dynamics framework also models stages within a system with significant detail (Ghosh et al., 2023). One can assess circularity, life cycle cost, and environmental cost with the help of these models/frameworks. System dynamics also advocate reusing wastes and reinstating secondary resources in a material supply chain. Simulation modeling is a standard tool to attempt closed-loop experiments with dynamic complexities that may be required for transitioning to CE (Guzzo et al., 2022). For example, a simulation analysis of the integration of waste cooking oil in the biodiesel production chain helps reduce water pollution and the emission of CO_2 (Freitas et al., 2022). Therefore, one could examine the positive and negative effects of systematic change from the perspective of different stakeholders, including individuals, organizations, the environment, and society.

Table 1
A review of the multiple theories used in circular economy context.

Author	Theory	Research Objective	Methodology
(Boiral and Henri, 2012)	Institutional Theory	Compares the validity of this instrumental model with two alternative models: the legitimacy-based model and the hybrid model.	SEM
(Christmann and Taylor, 2006)	Transaction Cost Theory	To contribute to a better understanding of the conditions under which international certifiable standards are effective governance mechanisms.	Regression Analysis
(Darnall et al., 2009)	Stakeholder Theory	Draws on stakeholder theory to explore organizations' use of different types of environmental audits	Regression Analysis
(Darnall and Edwards Jr, 2006)	Resource-Based View	Explores why some facilities accrue higher costs when adopting an environmental management system (EMS) and why prices vary among three different ownership structures.	Regression Analysis
(Ma et al., 2012)	Attitude Theory	To examine young female consumers' purchase behaviors related to non-food fair trade products.	Path Model Analysis
(Montiel and Husted, 2009)	Signaling Theory	Analyzes the adoption of voluntary environmental management programs by firms operating in Mexico.	Logit Regression
(Kalverkamp and Young, 2019)	Grounded Theory	Expand the environmental sustainability paradigm of the reverse supply chain.	Systematic literature review
(Hussain and Malik, 2020)	Organizational Enablers	To study the relationship between sustainability and circular economy in the context of supply chains	Structural Equation Modeling (SEM)
(Ashton, 2008)	Social Network Theory	To show the prevalence of industrial symbiosis linkages in Barceloneta, Puerto Rica.	Statistical Analysis
(Belhadi et al., 2022)	Dynamic Capability Theory	Develop a self-assessment model to evaluate the systemic level of integration of CE and Industry 4.0 within organizations using a dynamic capabilities perspective.	Graph Theoretic Approach
(Delpla et al., 2021)	–	Propose a CLSC model to maximize the total profit of a manufacturing company by selecting the treatment to be applied to the collected products according to their condition as estimated by life cycle data collection enabled by IoT.	Mixed Integer Programming
(MahmoumGonbadi et al., 2021)	Game Theory	Assessing whether the current modeling approaches for CLSC problems can support the transition toward a Circular Economy at a supply chain level	Systematic Literature Review
(Mishra et al., 2018)	Management Theory	Assess the value created and challenges for four circular economy-led closed-loop product case examples from a primary European fast-moving consumer goods (FMCG) company	Case Study
(González-Sánchez et al., 2020)	Agency Theory	Develop a conceptual framework to study circular supply chains from a theoretical perspective in strategic management literature.	Systematic Literature Review

An additional important avenue for using SD circular supply chains is reverse logistics (RL). In reverse logistics, one can evaluate the environmental impacts of value-adding and non-value-adding activities. Emission rates such as CO_2, NO_x, and SO_2 cause a substantial effect on business performance in a circular economy (Kazancoglu et al., 2021). One may also model the social, environmental, and economic factors in reverse logistics of post-used products at their end-of-life stage. This helps simultaneously analyze the dynamics of cost, revenue, and strategic and regulatory decisions (Alamerew and Brissaud, 2020). The potential use of wastes and by-products would synergize and broaden the scope of product value by exploiting their residual value by reuse, refurbishing, and remanufacturing (Franco, 2019). The systematic literature review of SD in circular supply chains by Sudusinghe and Seuring (2022) presents a framework for supply chains sustainably. It highlights the need for a more balanced triple-bottom-line approach to achieve sustainability. The framework helps supply chain practitioners understand the evolution of supply chain relationships with external parties.

3. Methods

3.1. Research approach

This study aims to explore existing CE practices across various nodes of CLSCs and the impact (low/medium/high) of these practices on performance. CLSCs consist of many interacting feed-forward and feedback loops, so a qualitative exploratory research approach was considered suitable. Qualitative interviews provide a richer understanding gleaned from personal interactions. The participants can easily share their points of view while the researcher probes them to elaborate further (Nowak and Haynes, 2018). This approach increases access to informants and, as a result, helps discover latent variables that might contribute to a better understanding of how participants see the world around them (Henn et al., 2009). Consequently, a qualitative perspective offers an opportunity to develop the extant theory further.

3.2. Semi-structured interviews

The institutional theory suggests that the main actors pressure the organization to embrace new changes (DiMaggio and Powell, 1983). In the CLSC structure, many interacting nodes relate to each other, end customers, governmental agencies, and other stakeholders that establish pressures in their decision-making related to CE practices. Implementing CE effectively across CLSC requires amalgamating methods across various nodes. Consequently, we have used the SIPOC tool to draw the linkage among the different nodes of CLSC. The structure of the interviews was developed based on the circular SIPOC tool. The SIPOC chart lists the relevant information regarding the various nodes of the SC (Al-Aomar and Hussain, 2018). SIPOC is a widely used tool for diagnostic and improvement in business planning, re-engineering, and continuous improvement (Hussain et al., 2019). SIPOC is a systematic procedure to explore all relevant process elements in an organized, tabulated format.

We have extended the SIPOC chart in this research by adding "collection and disposal" and "recycling and recovery" nodes, referring to it as "circular SIPOC." The original SIPOC only presents the feed-forward material and information flow across the SC. At the same time, the proposed circular SIPOC comprises feed-forward, feedback, and circular connections across the SCs. Fig. 1 shows the different nodes of CLSCs, along with various circular connections among these nodes. A circular SIPOC chart is used in this research to explore the CE practices and allocate them across the SC. The circular SIPOC chart can be applied to the list of suppliers, the inputs/planning (such as employees) supplied and used by main processes, the outputs (products and services) of these processes, their customers, collection and disposal, other wastes, and finally, the recycling and recovery of the collected trash. Exploratory data collected across these nodes were sorted and analyzed.

The first part of the exploratory questionnaire focused on demographic questions, including the type of SC (manufacturing service, oil, and gas) and the number of employees (less than 500 or more than 500), years of experience, management position, department, etc. The second section explored the CE techniques across various nodes of CLSCs (i.e., sourcing, planning, logistics, products/services, etc., as shown in Fig. 1). Then we explored the difficulty in implementation and the impact (low, medium, high) of the mentioned technique. We targeted predominantly middle or top managers of different departments (procurement, strategic, manufacturing, customer service, distribution, and logistics) of the SC, as shown in Table 2.

3.3. Data collection

We collected data through semi-structured interviews. This type of interview is suitable when the planned study includes an exploratory element (Saunders et al., 2009). Additionally, this mode of interviewing can help illuminate the current situation, generate new perspectives and questions, facilitate easier sorting, comparison, and analysis of the material, and identify opportunities for future improvement (Alvesson and

Table 2
Respondents' demography.

	Frequency	Percent
Management Level		
- Senior	19	58 %
- Director	14	42 %
Years of Experience		
- Between 15 and 20 years	21	67 %
- More than 20 years	11	33 %
Number of Employees		
- Less than 500	10	30 %
- Between 500 and 1000	17	52 %
- More than 1000	6	18 %
Sales Volume (Million $)		
- 1–5 Million ($)	11	33 %
- 5–10 Million ($)	16	49 %
- More than 10 Million ($)	06	18 %
SC Function		
- Purchasing	6	18 %
- Manufacturing	11	34 %
- Strategy	3	9 %
- Logistics	9	27 %
- Customer management	4	12 %

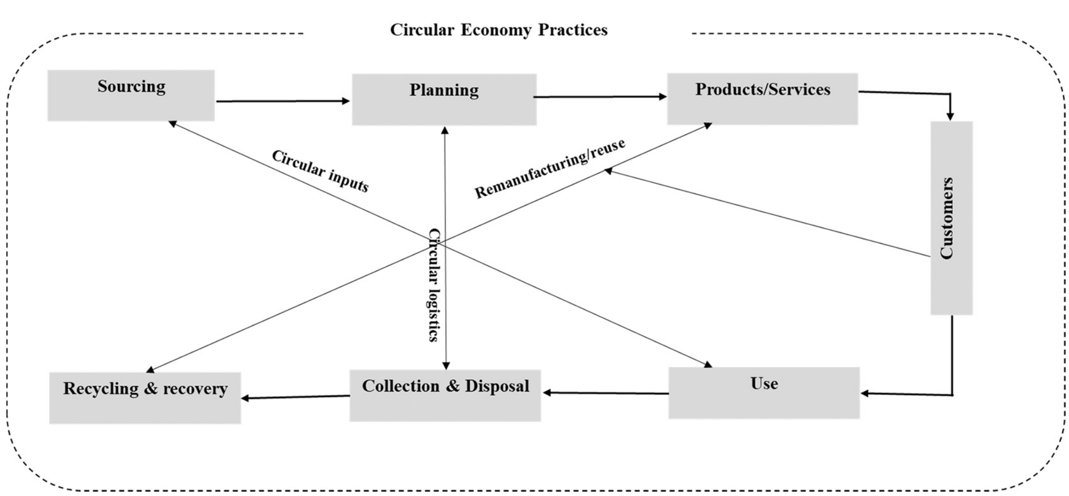

Fig. 1. Circular SIPOC (suppliers, inputs, process, outputs, customers) for supply chains.

Ashcraft, 2012). Given the exploratory character of the study, deductive and inductive approaches were used, resulting in an overall abductive strategy (Czarniawska, 2014). We applied a purposive sampling method to select the participants. This sampling method is a core characteristic of a qualitative approach (Creswell, 2013). Three closed-loop manufacturing (aluminum, steel, and plastic) SCs, implementing circularity and sustainability, were shortlisted from the UAE National Bureau of Statistics website. These companies embraced sustainability and circularity across their SCs and are strategically aligned with the UAE Circular Economy Policy 2021–2031 (Government of the United Arab Emirates, 2021).

We ensured that selected SCs implemented sustainability and circularity practices, as highlighted in their annual report submitted to the UAE National Bureau of Statistics. The target population was senior CEOs, directors, and senior management (with more than 15 years of experience) belonging to different tiers, including purchasing, manufacturing, distribution, logistics, strategy, etc. Initially, 53 potential participants were purposively selected from the websites of the shortlisted SCs. The shortlisted participants were contacted by telephone and briefed about the research's content. A total of 41 participants agreed to participate, and appointments were made with these participants. This exercise resulted in 33 formal interviews held at the participants' offices, and each interview lasted 1 to 2 h. The remaining nine participants were not reachable. According to Eisenhardt (1989), a saturation of newly gained knowledge occurs after approximately 12 interviews; therefore, 33 interviews were considered appropriate. Table 2 presents the statistics of the participants' profiles. A sample of responses to our interview is included in Appendix A.

Furthermore, the researchers confirmed that all data would be treated with high confidentiality and used for scientific research only. Besides these data, an opportunity to review the manuals on the procedures and processes implemented in the different organizations provided multiple sources of evidence.

3.4. Data analysis

The overall approach to the data analysis followed abductive reasoning through thematic analysis, searching for shared generic topics

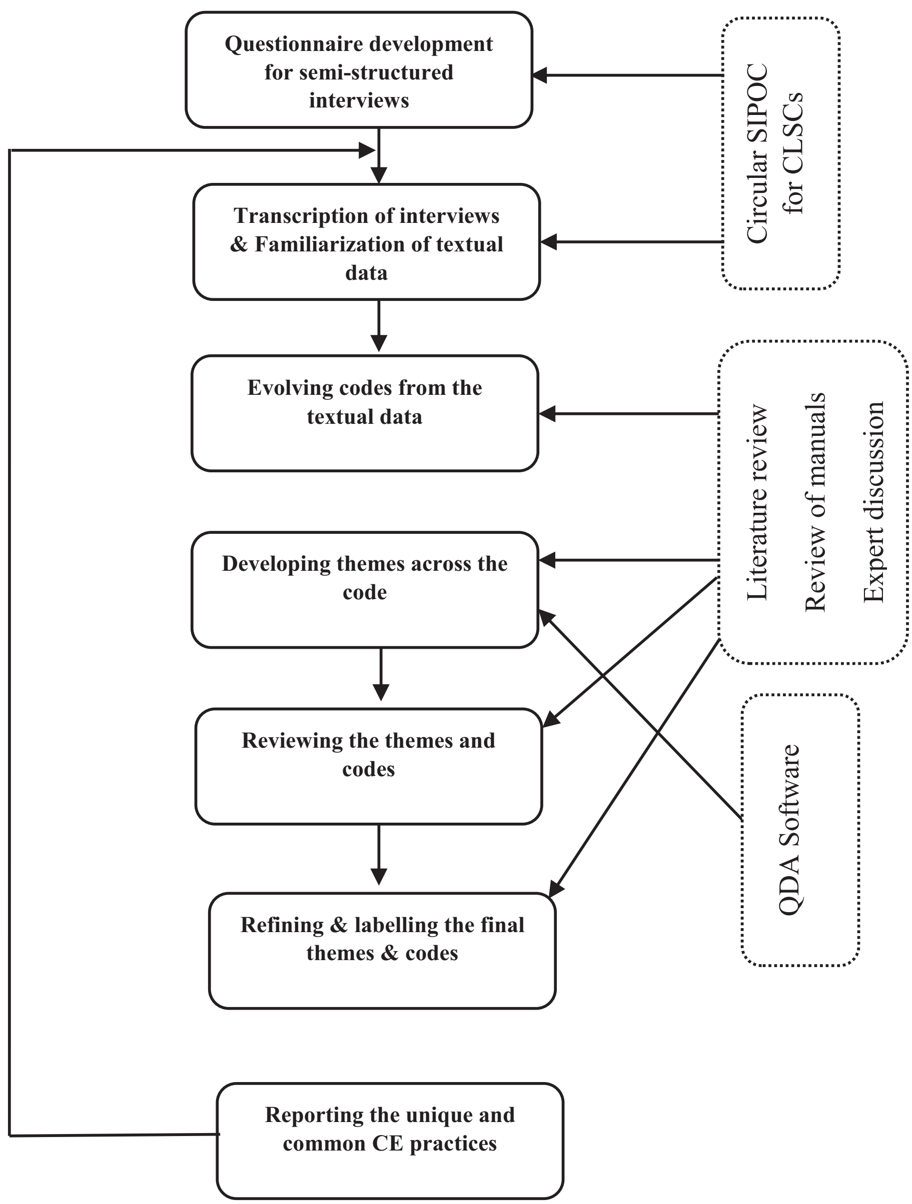

Fig. 2. Steps of thematic analysis.
(Adopted from Braun and Clarke, 2006).

that appeared necessary across the dataset (Fereday and Muir-Cochrane, 2006). The abductive approach helps the researchers to heuristically examine the itemizations, to expose research gaps in theoretical understanding. It does not require fitting the exploratory data within a conventional theoretical framework (Thompson, 2022). Thematic analysis is widely applied in psychology, business, and management (Braun and Clarke, 2006). This analysis is a flexible and valuable research tool for rich, detailed, and complex data (Ayres et al., 2008). We followed the steps of thematic analysis recommended by (Braun and Clarke, 2006), as shown in Fig. 2. An open-ended questionnaire was developed using the Circular SIPOC chart, and the initial raw data was collected through semi-structured and recorded interviews. The next step was to get familiar with the raw data by listening, transcribing, and writing down each interview into textual data. Once we became acquainted with the patterns of the textual information then, this data was exported to the QDA Miner software to organize and interpret the data, identify the codes, and later on discover themes; (e.g., "the elements of digital communication in purchasing, integrated communication, digital connectivity, digitalization, information sharing, and digitalization of information channels were continuously repeated by 6 participants of the procurement department. We generated the code "*Integrated communication system*" following the uniformity of the text and linked this code with the procurement stage of the supply chain. Likewise, the transcripts "ensuring that the design of products is sustained throughout their lifecycle, a steady revival of the procedural design policies, and effluent treatment plants (ETP) designed to handle wastewater and sanitary" were linked to the *Design process enhancement*, a category of the *Planning Stage*. Similarly, the text "natural decay, biodeterioration, assimilation, and compostable were linked with the code of "*Biodegradable process*" of the collection and disposal stage. These codes were acclimatized from the literature, manuals, and experts. Each participant's transcript was considered a separate case, and categories represented the broader themes, helping quickly identify unique and common themes. Besides, the four CE experts from industry

Table 3
Supply chain nodes and respective circular economy practices.

Sourcing Stage – Group A	Planning Stage– Group B
1. Waste generation	1. Design process enhancement
2. Energy consumption	2. Optimal recycling
3. Integrated communication system	3. Virtualization
4. Recycling activities	4. Procedural revisal policies
5. Electronic devices usage	5. Quality improvement training
6. High-quality equipment	
7. Inventory management	
8. Supply orders maintenance	
9. *E*-procurement software	

Manufacturing/Service Stage– Group C	Customers Stage– Group D
1. Maintain KPIs	1. Customer relations
2. Leadership support	2. Lead time reduction
3. Promoted response	3. Quality of service
4. Strategy aligned manufacturing	4. Pleasant environment
5. Quality control	
6. Quality management system	
7. Waste generation management	
8. Waste management reflection	
9. Systematic disposal	
10. Waste reduction guidelines	
11. Technology Improvement	

Usage Stage– Group E	Collection & Disposal Stage– Group F
1. Adopting O&M instructions	1. Reusable packing materials
2. Building Management System (BMS)	2. Awareness of plastic usage
3. Client energy-saving education	3. Reuse and recycle
4. Prioritize assets' defects	4. Biodegradable process
5. Spares and inventory	5. Waste management training
6. Efficiency and effectiveness	6. Waste contamination awareness
7. Benchmarking	7. Waste management policies
8. New contracts mobilization	8. Waste management campaigns
	9. Proper disposal awareness
	10. Strategic collaboration

Recycling & recovery Stage– Group G
1. Prompt communication
2. Waiting time reduction
3. Customer quality service
4. Friendly environment maintenance
5. Environmentally friendly recycling
6. Quick response
7. Waste generation management
8. Maintaining recycling & recovery costs
9. Quality assurance
10. High progressive rates

and academia confirmed these codes and themes.

4. Results

This section defines themes proposed and verified by the interviewees. These themes and their underlying standard practices were analyzed with QDA Miner for further exploration. This resulted in initial codes and categories of sub-themes coming from each participant.

4.1. Unique practices

Based on the interview findings and the thematic analytical process, 57 different CE practices across various nodes of CLSCs were identified, as shown in Table 3. We must note that we extracted these tabulated CE techniques from the interview data for three CLSCs. The unique practices were energy consumption, quality improvement training, technology improvement, efficiency, effectiveness, quick response, and strategic collaboration. These CE practices can help organizations improve efficiency and effectiveness, and the industry uses these techniques. In this context, DESSO (2015) highlighted the recovery of expensive nylon six material for upcycling into new fibers for new high-quality products. Hewlett–Packard shifted their thinking about consumer returns from a problem to an opportunity. The efficient integration of CE practices is a core part of its business strategy, and remanufacturing brings a strategic advantage (Atasu et al., 2010). Conscious consumption based on technology improvement and innovation is considered in China (Su et al., 2013). Pay-per-lux is a collaboration between Philips and TurnToo with a lighting service owned and maintained by Philips instead of the property (Ellen MacArthur Foundation, 2014). Transparent information was considered for 280 green product organizations during 2013–2016 (European Commission, 2015). The EU Packaging and Packaging Waste Directive (PPWD) recommended introducing a 45 % recycling target for plastic packaging in 2020 and 60 % in 2025 (European Commission, 2014). The planning and customer nodes of CLSCs have a minimum number of CE techniques, while manufacturing/service nodes have the highest number.

4.2. Common practices

We anticipated that different nodes of CLSCs would be using standard CE techniques—accordingly, the next step aimed to explore commonalities among the various nodes. Scrutinizing the data in Table 3, some methods were unique, and some were common among multiple nodes. As shown in Fig. 1, there are seven nodes of CLCs, and these nodes have been grouped from A to G in Table 3. These groups contain the techniques uniquely identified by each node, i.e., Table 3 shows that the sourcing node has identified nine different CE techniques; however, some were common in other groups and were removed from Table 3. Therefore, Table 4 lists only the practices unique to each node (A to G). Groups H to J (not representing any stakeholder in Fig. 1 and Table 3) reflect standard CE techniques among various nodes.

The groups from H to J in Table 4 represent the standard CE practices in the organizations interviewed. These commonly followed practices belong to the sourcing and customer groups of the value chain, namely quality of service, friendliness to the environment, lead time reduction, waste generation management, and recycling activities. Recycling activities are used for value creation or the optimization of stock. Stock optimization has already been discussed as a successful CE strategy (Stahel, 2013), and products must be used repeatedly for value creation rather than disposal (Wijkman and Skånberg, 2017). The same is valid for waste generation management (Douglas and Isherwood, 1979) and cradle-to-cradle (Braungart et al., 2007). Some common environmental strategies are the Rs (reduce, recover, recycle, reuse, refuse, repair, refurbish, remanufacture, and repurpose). Many organizations, such as Xerox, Caterpillar, and Toyota, have incorporated CE practices into their operations, using them as strategic tools to improve profitability (Abbey and Guide, 2018).

Table 4
Unique and common circular economy practices.

Value chain stage	Common factor/s	Group
Sourcing	• Energy consumption • Integrated communication system • Electronic devices usage • High-quality equipment • Inventory management • Supply orders maintenance • *E*-procumbent software	A
Planning	• Design process enhancement • Virtualization • Procedural revisal policies • Quality improvement training	B
Manufacturing/Services	• Maintain KPIs • Leadership support • Promoted response • Strategy aligned manufacturing • Quality control • Quality management system • Waste management reflection • Systematic disposal • Waste reduction guidelines • Technology Improvement	C
Customers	• Customer relations • Lead time reduction • Quality of service • Pleasant environment	D
Usage	• Adopting O&M instructions • Building Management System (BMS) • Client energy-saving education • Prioritize assets' defects • Spares and inventory • Efficiency and effectiveness • Benchmarking • New contracts mobilization	E
Collection & Disposal	• Reusable packing materials • Awareness of plastic usage • Biodegradable process • Waste management training • Waste contamination awareness • Waste management policies • Waste management campaigns • Proper disposal awareness • Strategic collaboration	F
Recycling & Recovery	• Prompt communication • Environmentally friendly recycling • Quick response • Maintaining recycling & recovery costs • Quality assurance • High progressive rates	G
Customers/patients - Recycling & recovery	• Quality of service • Friendly environment maintenance • Lead time reduction	H
Sourcing- Recycling & Recovery-Services	• Waste generation management	I
Sourcing- Collection & Disposal-Planning	• Recycling activities	J

4.3. The impact of unique practices

It should be noted that Tables 3 and 4 highlight the unique practices for institutions to adopt a circular economy in the context of CLSCs. Thus, organizations may choose their pathway for transformation in their regional and international scope of business. This pathway for the institutions would be based on (i) the location of their physical assets, (ii) the diversity of their business, and (iii) their terms of cooperation with other stakeholders (Henrysson and Nuur, 2021).

During the interviews, the researchers asked the participants to identify the criticality of implementing the given CE techniques and suggest the impact of each practice as low, medium, or high. We can see from Table 5 that most of the methods are easy to implement, while their impacts are comparatively high. For example, energy consumption at the sourcing node of the SC can easily be implemented, resulting in a high impact on performance. For instance, the Kroger Recovery System transforms waste into biogas through anaerobic digestion. Six thousand five hundred tons of food waste have been processed, and 3.5 million kWh of energy has been used for the distribution center (Vitharana and Kandegama, 2020). Reusable packing material was a unique CE practice in the interviewed organizations. The implementation difficulty is low for this practice, thereby creating a high impact on the performance of the SC. As previously stated, the EU PPWD recommended introducing a 45 % recycling target for plastic packaging for 2020 and 60 % for 2025 (European Commission, 2014). The PPWD also suggested introducing a 70 % recycling target for metal packaging in 2020 and 80 % in 2025, and

Table 5
Criticality and impact of identified circular economy techniques.

Value chain stage	Unique factor/s	Criticality	Impact
Sourcing	• Energy consumption	Low	Medium
	• Integrated communication system	Low	High
	• Electronic devices usage	Medium	High
	• High-quality equipment	Low	High
	• Inventory management	Medium	High
	• Supply orders management	Low	High
	• *E*-procumbent software	Medium	High
Planning	• Design process enhancement	Medium	High
	• Virtualization	Medium	Medium
	• Procedural revisal policies	High	High
	• Quality improvement training	Medium	High
Manufacturing/ services	• Maintain KPIs	Low	High
	• Leadership support	Low	High
	• Promoted response	Medium	High
	• Strategy aligned manufacturing	Medium	Medium
	• Quality control	High	High
	• Quality management system	Medium	High
	• Waste management reflection	Low	High
	• Systematic disposal	Low	High
	• Waste reduction guidelines	High	High
	• Technology Improvement	Medium	High
Customers	• Customer relations	Medium	High
	• Lead time reduction	High	High
	• Quality of service	High	High
	• Pleasant environment	Medium	High
Usage	• Adopting O&M instructions	Low	High
	• Building Management System (BMS)	Medium	High
	• Client energy-saving education	Low	High
	• Prioritize assets' defects	Low	High
	• Spares and inventory	Medium	High
	• Efficiency and effectiveness	Medium	High
	• Benchmarking	Low	High
	• New contracts mobilization	Low	High
Collection & disposal	• Reusable packing materials	Low	High
	• Awareness of plastic usage	Low	Medium
	• Biodegradable process	Medium	High
	• Waste management training	Medium	Medium
	• Waste contamination awareness	High	High
	• Waste management policies	Low	High
	• Waste management campaigns	Medium	High
	• Proper disposal awareness	Medium	High
	• Strategic collaboration	Medium	High
Recycling & recovery	• Prompt communication	Low	High
	• Environmentally friendly recycling	Medium	High
	• Quick response	High	High
	• Maintaining recycling & recovery costs	Medium	High
	• Quality assurance	Low	High
	• High progressive rates	High	High

90 % in 2030 (European Commission, 2014). We can thus infer that managers can substantially improve the performance of CE across their SCs with little effort.

One should notice that this section responds to the two research questions outlined in Section 1 (introduction). Tables 3, 4, and 5 summarize the CE practices across various nodes of a CLSC, while Section 4.3 highlights the impact of these practices on the performance at several nodes of a CLSC.

5. Discussion and implications

This study's theoretical and practical implications are presented in the following sub-sections.

5.1. *Theoretical implications*

First, empirical exploration is scarce in the domain of the CE in CLSCs. One primary reason for this scarcity could be the complex structure of CLSCs. The transition toward CSCM involves uncertainties and challenges (de Lima et al., 2021), exacerbated in complex systems such as CLSCs. To minimize these risks, we argue that management/operational researchers should explore the relevant CE techniques and the intensity of their impact on the performance of SCs. Our work also responds to the current call in the literature (Tapia et al., 2021) concerning the fact that, although researchers and policymakers are showing great interest in applying CE techniques, this domain has not yet been fully explored. We have tried to cover this critical literature gap by exploring CE techniques in the manufacturing SCs of a developing country (the UAE). This methodology paves the path for a comprehensive framework for investigating the extent of circularity in a closed-loop supply chain.

Second, while CE principles are applied across multiple tiers of CLSCs, there is a need to use a systematic tool/approach. We have extended the SIPOC chart to a circular SIPOC tool to list the relevant CE practices across various CLSC nodes. Fig. 1 shows a modified circular SIPOC chart to identify CE techniques across CLSCs. Different arrows indicate the feed-forward and feedback flows of the material exchange across various levels. The recognized CE techniques were later analyzed using a systemic thematic analysis approach. We have thus presented a systematic investigation approach to explore the CE across CLSCs.

Third, our work also responds to calls in the literature (Allen et al., 2021) regarding the fact that theory development is limited, and there is a strong need to expand the theoretical boundaries of the CE across SCs. Table 1 also shows that institutional theory has little application in the context of CSCM, and there is a need to investigate the field through the lens of institutional theory. Institutional theory suggests the main actors are putting normative pressure on organizations regarding this development and that organizations will follow and become similar (DiMaggio and Powell, 1983). The institutional theory also highlights multiple institutional pressures, i.e., coercive, normative, and mimetic. Organizations depend on the social system of norms, values, and beliefs for legitimacy and social purposes. This practice leads organizations to adopt international standards (Darnall et al., 2008) and acts similarly (Suchman, 1995). Thus, institutional theory pressures organizations to adopt CE-based practices across different SC nodes.

5.2. *Practical implications*

This study guides practitioners by providing a detailed list of comprehensive CE practices and their difficulty in implementation, resulting in improved SC performance. We found that quality of service, friendliness to the environment, lead time reduction, waste generation management, and recycling activities are standard in the three SCs under study. However, the most critical and unique CE techniques include energy consumption, high-quality equipment, virtualization, efficiency, effectiveness, and reusable packing materials. Incorporating the fundamentals of CE into a product/service requires substantial changes in the design (Farooque et al., 2019). The CE paradigm espouses a holistic production system that is restorative and regenerative by design (Hussain and Malik, 2020). It necessitates minimizing resource waste, usage, and energy leaks by tightening, slowing, and closing material and energy loops (Geissdoerfer et al., 2017). The regenerative tenet of CE emphasizes the closure of the resources loop by prioritizing reuse and recovery enabled by product designs allowing repair, reuse, and remanufacturing (Bocken et al., 2016). The additional nascent literature on circular design suggests various design strategies; e.g., Den Hollander et al. (2017) indicated that circular product design relies on design for product integrity and recycling. The importance of design process enhancement, strategy-aligned manufacturing, and reusable packing materials, which are integral components of circular product design, has been explicitly stated by different tiers of CLSCs. Consumer electronics SCs have started realizing modular product design as a sustainable and circular strategy for devices, watches (e.g., Blocks, 2021), headphones (e.g., Gerrard, 2021), and phones (Fairphone, 2021). SC and operations managers should focus on these activities.

Secondly, this research provides knowledge about the difficulty in implementing and related performance improvements across the various nodes of the SC. We recommend that organizations focus on standard practices with a low criticality to start the transition toward the circular concept. Further, CE techniques such as maintaining KPIs, leader support, benchmarking, waste management reflection, etc., are easy to implement, but their impact is high. Table 5 presents a complete road map for the gradual transition of a manufacturing organization toward circularity. Managers and policymakers can start with an activity with a low level of difficulty but a high impact on performance.

Third, the exploratory data was collected from the extensive manufacturing SCs of UAE. These SCs are well-advanced in their strategies and operations. One can easily infer that explored CE techniques, their impact, and criticality can apply to other manufacturing companies worldwide.

Fourth, in light of institutional theory, legislative and governmental bodies can provide guidance and training to organizations based on the findings of this study. For example, government bodies can identify the scope of the CE, translate this scope into policy, and plan the implementation steps for society's overall well-being. Institutions may also use coercive, normative, and mimetic pressure on organizations to encourage them to adopt these CE practices in their respective SCs. This practice can help conventional linear economies transition into a CE, which supports closing the loops of resources and reducing environmental impacts. Similarly, organizations may voluntarily adopt CE practices based on the criticality and available budget to improve performance and competitive advantage.

6. Conclusions

The CE is a restoring and regenerating concept that maintains the materials, products, and components in cycles for value creation, and the connection has recently attained great attention from scholars and practitioners. Embracing CE practices across the entire supply chain depends on several factors, including the extent of circularity, preparedness, selection of appropriate CE techniques, readiness, reconfiguration, budget, etc. Most of the pertinent literature explored the barriers, motivators, and enablers of CE across linear supply chains. However, little work is accomplished in terms of CLSCs. A CLSC significantly differs from liner supply chains in reprocessing and after-sale operations and involves complex feed-forward and feedback loops. We argue that the successful implementation of CE depends on selecting the most appropriate techniques across various tiers of supply chains. After that, this research focuses on exploring CE techniques, their impact, and their criticality across CLSCs. A CE helps deal with the scarcity of resources and environmental issues. There is an increased need to understand CE strategies and their related steps for implementation in regional and global production sectors. Furthermore, legislative and governmental institutions need to understand the integration of the CE into SC activities and the related scope, policies, and planning for implementation in different sectors based on research.

The limitation of this work remains in the number of interviewed organizations. Also, the budget constraint for adopting the respective CE practice can provide helpful insight, which is the limitation of this study. In future research, one can address this limitation by adding a budget requirement for adopting low to high implementation difficulty of CE practice. Also, future studies can consider the quantitative approach to measure these CE practices' impact on the supply chain's performance. An index that involves the implementation difficulty and its effect on the performance of the supply chain would be helpful for this purpose. Goltsos et al. (2019) highlighted the fundamental need for empirical research in this area of the Circular supply chain. Finally, government financial interventions in terms of incentives or tax credits may produce some valuable insights to help this linear to circular transition.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration of competing interest

None.

Appendix A

Sample Data- Case 1

Sourcing			
S1.No	Use of techniques	Level of difficulty	Degree of impact
1	Level of Consumption energy	Low	Medium
2	An integrated system of communication	Low	High
3	Use electronic devices	Medium	High
4	*E*-communication or digital	High	High
5	Usage of High-quality Equipment	Low	High
6	Inventory Management	Medium	High
7	Managing supply orders	Low	High
8	Zero Waste Management	High	High

Table 2.

Manufacturing/service			
S1.No	Use of techniques	Level of difficulty	Degree of impact
1	Enhancing design process	Medium	High
2	Optimal Recycling	Medium	Medium
3	Virtualizing	Medium	Medium
4	Procedural Revisal Policies	High	High
5	Quality improvement training	Medium	High

Table 3.

Usage			
S1.No	Use of techniques	Level of difficulty	Degree of impact
1	Improvement of KPIs	Low	High
2	Applied leadership methods	Low	Medium
3	Assertion Quality control	Medium	Medium
4	Quality management techniques	High	High
5	Technology improvement	Medium	High
6	Environmental principle to manage waste	High	High

Table 4.

Distribution and sale department			
S1.No	Use of techniques	Level of difficulty	Degree of impact
1	Use design thinking	High	Medium
2	Highly cooperating with product development.	Medium	High
3	Ongoing staff education	Medium	High
4	Quality service offering	Low	High

Table 5.

Collection and disposal department			
S1.No	Use of techniques	Level of difficulty	Degree of impact
1	Reusable packing that is already used	Low	High
2	Plastic waste can not be destroyed	Low	Medium
3	Using Biodegradable process	Medium	High
4	Organize campaigns to manage waste.	Medium	High
5	Waste contaminates are and water	High	High

Table 6.

Customer department			
S1.No	Use of techniques	Level of difficulty	Degree of impact
1	Customer quality service	High	High
2	Customer relationship improvement	Medium	High
3	Improve and motivate a friendly Environment.	Medium	High
4	Reduce lead time	High	High
5	Customer feedback	Medium	High

Table 7.

Recycling department			
S1.No	Use of techniques	Level of difficulty	Degree of impact
1	Urgent communication for recycling and reusing	Low	High
2	Quality in a circular economy	Low	High
3	Good cooperation with recycling and recovery	Medium	High
4	Improve the green environment by recycling.	Medium	Medium
5	Quality assurance	Low	High
6	High progressive rate	High	High

References

Abbey, J.D., Guide, V.D.R., 2018. A typology of remanufacturing in closed-loop supply chains. Int. J. Prod. Res. 56 (1–2), 374–384.
Agyabeng-Mensah, Y., Afum, E., Baah, C., Essel, D., 2022. Exploring the role of external pressure, environmental sustainability commitment, engagement, alliance and circular supply chain capability in circular economy performance. Int. J. Phys. Distrib. Logist. Manag. 52 (5/6), 431–455.
Alamerew, Y.A., Brissaud, D., 2020. Modelling reverse supply chain through system dynamics for realizing the transition towards the circular economy: a case study on electric vehicle batteries. J. Clean. Prod. 254, 120025.
Al-Alawi, B., Cavallari, G., Cindric, H., Gargallo, M., Hegazy, N., Saqib, S., Tibi, G., 2020. Circular Built Environment.
Al-Aomar, R., Hussain, M., 2018. An assessment of adopting lean techniques in the construct of hotel supply chain. Tour. Manag. 69, 553–565.
Allen, S.D., Zhu, Q., Sarkis, J., 2021. Expanding conceptual boundaries of the sustainable supply chain management and circular economy nexus. Clean. Logist. Supply Chain 2.
Alvesson, M., Ashcraft, K.L., 2012. Interviews. In: Symon, G., Cassell, C. (Eds.), Qualitative Organizational Research: Core Methods and Current Challenges. Sage, London, pp. 239–257.
Anastasiades, K., Bloma, J., Buyleab, M., Audenaerta, A., 2020. Translating the circular economy to bridge construction: lessons learned from a critical literature review. Renew. Sustain. Energy Rev. 117.
Ashton, W., 2008. Understanding the organization of industrial ecosystems: a social network approach. J. Ind. Ecol. 12 (1), 34–51.
Atasu, A., Guide Jr., V.D.R., Van Wassenhove, L.N., 2010. So what if remanufacturing cannibalizes my new product sales? Calif. Manag. Rev. 52 (2), 56–76.
Aurelius Environmental, 2016. A battery recycling revolution is approaching. Available at: https://ael.global/battery-recycling/. (Accessed 11 June 2020).
Ayati, M.S., Shekarian, E., Majava, J., Wæhrens, B.V., 2022. Toward a circular supply chain: understanding barriers from the perspective of recovery approaches. J. Clean. Prod. 131775.
Ayres, C.E., Jha, B.S., Meredith, H., Bowman, J.R., Bowlin, G.L., Henderson, S.C., Simpson, D.G., 2008. Measuring fiber alignment in electrospun scaffolds: a user's guide to the 2D fast Fourier transform approach. J. Biomater. Sci. Polym. Ed. 19 (5), 603–621.
Bansal, P., 2005. Evolving sustainably: a longitudinal study of sustainable corporate development. Strateg. Manag. J. 26 (3), 197–218.
Bejjani, M., Anouti, D., Klat, A., Batal, J., 2019. Putting GCC Cities in the Loop.
Belhadi, A., Kamble, S.S., Venkatesh, M., Jabbour, C.J.C., Benkhati, I., 2022. Building supply chain resilience and efficiency through additive manufacturing: an ambidextrous perspective on the dynamic capability view. Int. J. Prod. Econ. 249, 108516.
Berger, P., Luckmann, T., 1967. The Social Construction of Reality: A Treatise in the Sociology of Knowledge. Allen Lane, London.
Berrone, P., Fosfuri, A., Gelabert, L., Gomez-Mejia, L.R., 2013. Necessity as the mother of 'green' inventions: institutional pressures and environmental innovations. Strateg. Manag. J. 34 (8), 891–909.
Bertassini, A.C., Calache, L.D.D.R., Carpinetti, L.C.R., Ometto, A.R., Gerolamo, M.C., 2022. CE-oriented culture readiness: an assessment approach based on maturity models and fuzzy set theories. Sustain. Prod. Consum. 31, 615–629.
Blocks, 2021. 'Blocks modular smartwatch. www.chooseblocks.com. (Accessed 18 October 2021).
Bocken, N.M., De Pauw, I., Bakker, C., Van Der Grinten, B., 2016. Product design and business model strategies for a circular economy. J. Ind. Prod. Eng. 33 (5), 308–320.
Boiral, Olivier, Henri, Jean-François, 2012. Modelling the impact of ISO 14001 on environmental performance: a comparative approach. J. Environ. Manag. 99, 84–97.
Borrello, M., Pascucci, S., Caracciolo, F., Lombardi, A., Cembalo, L., 2020. Consumers are willing to participate in circular business models: a practice theory perspective to food provisioning. J. Clean. Prod. 259.
Braun, V., Clarke, V., 2006. Using thematic analysis in psychology. Qual. Res. Psychol. 3 (2), 77–101.
Braungart, M., McDonough, W., Bollinger, A., 2007. Cradle-to-cradle design: creating healthy emissions – a strategy for eco-effective product and system design. J. Clean. Prod. 15 (13), 1337–1348.
Bressanelli, G., Perona, M., Saccani, N., 2019. Challenges in supply chain redesign for the circular economy: a literature review and a multiple case study. Int. J. Prod. Res. 57 (23), 7395–7422.
Calzolari, T., Genovese, A., Brint, A., 2021. The adoption of circular economy practices in supply chains – an assessment of European multi-national enterprises. J. Clean. Prod. 312.
Chedrawi, C., Osta, A., Osta, S., 2020. CSR in the Lebanese banking sector: a neo-institutional approach to stakeholders' legitimacy. J. Asia Bus. Stud. 14 (2), 143–157.
Chowdhury, S., Dey, P.K., Rodríguez-Espíndola, O., Parkes, G., Tuyet, N.T.A., Long, D.D., Ha, T.P., 2022. Impact of organisational factors on the circular economy practices and sustainable performance of small and medium-sized enterprises in Vietnam. J. Bus. Res. 147, 362–378.
Christmann, P., Taylor, G., 2006. Firm self-regulation through international certifiable standards: determinants of symbolic versus substantive implementation. J. Int. Bus. Stud. 37, 863–878.
Creswell, J.W., 2013. Steps in Conducting a Scholarly Mixed Methods Study.
Czarniawska, B., 2014. Social Science Research: From Field to Desk. Sage.
D'Amato, D., Veijonaho, S., Toppinen, A., 2020. Towards sustainability? Forest-based circular bioeconomy business models in Finnish SMEs. Forest Policy and Economics 110.
Darnall, N., Edwards Jr., D., 2006. Predicting the cost of environmental management system adoption: the role of capabilities, resources and ownership structure. Strateg. Manag. J. 27 (4), 301–320.
Darnall, N., Henriques, I., Sadorsky, P., 2008. Do environmental management systems improve business performance in an international setting? J. Int. Manag. 14 (4), 364–376.
Darnall, N., Seol, I., Sarkis, J., 2009. Perceived stakeholder influences and organizations' use of environmental audits. Acc. Organ. Soc. 34 (2), 170–187.
de Lima, F.A., Seuring, S., Sauer, P.C., 2021. A systematic literature review exploring uncertainty management and sustainability outcomes in circular supply chains. Int. J. Prod. Res. 1–34.
de Lima, F.A., Seuring, S., Sauer, P.C., 2022. A systematic literature review exploring uncertainty management and sustainability outcomes in circular supply chains. Int. J. Prod. Res. 60 (19), 6013–6046.
Delpla, V., Kenné, J.P., Fall, A.M., Balalpour, M., Hof, L.A., 2021. Metal Scrap Recycling 4.0: Towards Smart Operation and Production of High-quality Alloys.
Den Hollander, M.C., Bakker, C.A., Hultink, E.J., 2017. Product design in a circular economy: development of a typology of key concepts and terms. J. Ind. Ecol. 21 (3), 517–525.
DESSO, 2015. Cradle to cradle achievement. Available at: http://www.desso.com/c2c-corporateresponsibility/cradle-to-cradle/.
DiMaggio, P.J., Powell, W.W., 1983. The iron cage revisited: institutional isomorphism and collective rationality in organizational fields. Am. Sociol. Rev. 48 (2), 147–160.
Douglas, M., Isherwood, B., 1979. The World of Goods Towards an Anthropology of Consumption. Basic Books, New York, NY.
Ebrahimi, S.M., Koh, L., 2021. Manufacturing sustainability: institutional theory and life cycle thinking. J. Clean. Prod. 298, e126787.
Eisenhardt, K.M., 1989. Building theories from case study research. Acad. Manag. Rev. 14 (4), 532–550.
Ellen MacArthur Foundation, 2014. Why buy light bulbs when you can buy light? Signify. Available at: https://www.ellenmacarthurfoundation.org/case-studies/selling-light-as-a-service.
Ellen MacArthur Foundation, 2017. What is a circular economy? Available at: https://ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview. (Accessed 24 August 2021).
European Commission, 2014. Scoping Study to Identify Potential Circular Economy Actions, Priority Sectors, Material Flows and Value Chains: Final Report. Publications Office, Brussels.
European Commission, 2015. Single market for green products initiative. Available at: https://ec.europa.eu/environment/eussd/smgp/. (Accessed 9 August 2021).
Fairphone, 2021. Fairphone roadmap. Available at: https://www.fairphone.com/roadmap/lifecycle/. (Accessed 1 October 2021).
Farooque, M., Zhang, A., Thürer, N., Qu, T., Huisingh, D., 2019. Circular supply chain management: a definition and structured literature review. J. Clean. Prod. 228, 882–900.
Farrell, C.C., Osman, A.I., Doherty, R., Saad, M., Zhang, X., Murphy, A., Harrison, J., Vennard, A.S.M., Kumaravel, V., Al-Muhtaseb, A.H., Rooney, D.W., 2020. Technical challenges and opportunities in realising a circular economy for waste photovoltaic modules. Renew. Sustain. Energy Rev. 128.
Fereday, J., Muir-Cochrane, E., 2006. Demonstrating rigor using thematic analysis: a hybrid approach of inductive and deductive coding and theme development. Int J Qual Methods 5 (1), 80–92.
Franco, M.A., 2019. A system dynamics approach to product design and business model strategies for the circular economy. J. Clean. Prod. 241, 118327.
Freitas, E.S.D.C., Guarieiro, L.L.N., da Silva, M.V.I., Amparo, K.K.D.S., Machado, B.A.S., Guerreiro, E.T.D.A., Torres, E.A., 2022. Emission and performance evaluation of a diesel engine using addition of ethanol to diesel/biodiesel fuel blend. Energies 15 (9), 2988.
Frota Neto, J.Q., Bloemhof-Ruwaard, J.M., van Nunen, J.A.E.E., van Heck, E., 2008. Designing and evaluating sustainable logistics networks. Int. J. Prod. Econ. 111 (2), 195–208.
Geissdoerfer, M., Savaget, P., Bocken, N.M., Hultink, E.J., 2017. "The circular economy–a new sustainability paradigm",? J. Clean. Prod. 143, 757–768.
Geissdoerfer, M., Morioka, S.N., Monteiro de Carvalho, M., Evans, S., 2018. Business models and supply chains for the circular economy. J. Clean. Prod. 190, 712–721.
Gennari, F., 2022. The transition towards a circular economy. A framework for SMEs. J. Manag. Gov. 1–35.
Genovese, A., Acquaye, A.A., Figueroa, A., Koh, S.C.L., 2017. Sustainable supply chain management and the transition towards a circular economy: evidence and some applications. Omega 66, 344–357.
Gerrard, St., 2021. Gerrard St. modular headphones. Available at: www.gerradst.nl. (Accessed 10 September 2021).
Ghosh, T., Avery, G., Bhatt, A., Uekert, T., Walzberg, J., Carpenter, A., 2023. Towards a circular economy for PET bottle resin using a system dynamics inspired material flow model. J. Clean. Prod. 383, 135208.
Glover, J.L., Champion, D., Daniels, K.J., Dainty, A.J., 2014. An institutional theory perspective on sustainable practices across the dairy supply chain. Int. J. Prod. Econ. 152, 102–111.
Goltsos, T.E., Ponte, B., Wang, S., Liu, Y., Naim, M.M., Syntetos, A.A., 2019. The boomerang returns? Accounting for the impact of uncertainties on the dynamics of remanufacturing systems. Int. J. Prod. Res. 57 (23), 7361–7394.

González-Sánchez, R., Settembre-Blundo, D., Ferrari, A.M., García-Muiña, F.E., 2020. Main dimensions in the building of the circular supply chain: a literature review. Sustainability 12 (6), 24–59.
Government of the People's Republic of China, 2008. Circular economy promotion law of the People's Republic of China. Order of the president of the People's Republic of China No. 4. Available at: https://www.greengrowthknowledge.org/sites/default/files/downloads/policy-database/CHINA%29%20Circular%20Economy%20Promotion%20Law%20%282008%29.pdf.
Government of United Arab Emirates, 2021. UAE circular economy policy 2021–2031. Available at: https://www.moccae.gov.ae/assets/download/73d7daa1/UAE%20Circular%20Economy%20Policy%202021-2031.pdf.aspx. (Accessed 3 April 2021).
Greenwood, R., Hinings, C.R., 1996. Understanding radical organizational change: bringing together the old and the new institutionalism. Acad. Manag. Rev. 21 (4), 1022–1054.
Gupta, S., Modgil, S., Gunasekaran, A., Bag, S., 2020. Dynamic capabilities and institutional theories for industry 4.0 and digital supply chain. Supply Chain Forum Int. J. 21 (3), 139–157.
Guzzo, D., Pigosso, D.C.A., Videira, N., Mascarenhas, J., 2022. A system dynamics-based framework for examining circular economy transitions. J. Clean. Prod. 333, 129933.
Hartley, J.L., Sawaya, W., Dobrzykowski, D., 2021. Exploring blockchain adoption intentions in the supply chain: perspectives from innovation diffusion and institutional theory. Int. J. Phys. Distrib. Logist. Manag. 52 (2), 190–211.
Hawley, A.H., 1968. Human Ecology. Macmillan, New York, NY.
Henn, M., Weinstein, M., Foard, N., 2009. A Critical Introduction to Social Research. Sage, Thousand Oaks, CA.
Henrysson, M., Nuur, C., 2021. The role of institutions in creating circular economy pathways for regional development. J. Environ. Dev. 30 (2), 149–171.
Hoffman, A., 1997. From Heresy to Dogma: An Institutional History of Corporate Environmentalism. New Lexington Press, Lanham, MD.
Hussain, M., Malik, M., 2020. Organizational enablers for circular economy in the context of sustainable supply chain management. J. Clean. Prod. 256, e120375.
Hussain, M., Khan, M., Ajmal, M., Khan, B.A., 2019. Supply chain quality management and organizational performance: empirical evidence from telecom industry in the UAE. Benchmark. Int. J. 27 (1), 232–249.
Ibn-Mohammed, T., Mustapha, K.B., Godsell, J., Adamu, Z., Babatunde, K.A., Akintade, D.D., Koh, S.C.L., 2021. A critical analysis of the impacts of COVID-19 on the global economy and ecosystems and opportunities for circular economy strategies. Resour. Conserv. Recycl. 164, 105–169.
Jacobs, B.W., Swink, M., Linderman, K., 2015. Performance effects of early and late six sigma adoptions. J. Oper. Manag. 36 (1), 244–257.
Kalverkamp, M., Young, S.B., 2019. In support of open-loop supply chains: expanding the scope of environmental sustainability in reverse supply chains. J. Clean. Prod. 214, 573–582.
Kazancoglu, Y., Ekinci, E., Mangla, S.K., Sezer, M.D., Kayikci, Y., 2021. Performance evaluation of reverse logistics in food supply chains in a circular economy using system dynamics. Bus. Strateg. Environ. 30 (1), 71–91.
Kravchenko, M., McAloone, T.C., Pigosso, D.C.A., 2019. Implications of developing a tool for sustainability screening of circular economy initiatives. Procedia CIRP 80, 625–630.
Liu, J., Feng, Y., Zhu, Q., Sarkis, J., 2018. Green supply chain management and the circular economy: reviewing theory for advancement of both fields. Int. J. Phys. Distrib. Logist. Manag. 48 (8), 794–817.
Ma, Y.J., Littrell, M.A., Niehm, L., 2012. Young female consumers' intentions toward fair trade consumption. Int. J. Retail Distrib. Manag.
Mahmoum Gonbadi, A., Genovese, A., Sgalambro, A., 2020. Network Design Models for Closed-loop Supply Chains: A Literature Review and a Research Agenda.
MahmoumGonbadi, A., Genovese, A., Sgalambro, A., 2021. Closed-loop supply chain design for the transition towards a circular economy: a systematic literature review of methods, applications and current gaps. J. Clean. Prod. 323, e129101.
Mishra, J.L., Hopkinson, P.G., Tidridge, G., 2018. Value creation from circular economy-led closed-loop supply chains: a case study of fast-moving consumer goods. Prod. Plan. Control 29 (6), 509–521.
Moreau, V., Sahakian, M., van Griethuysen, P., Vuille, F., 2017. Coming full circle: why social and institutional dimensions matter for the circular economy. J. Ind. Ecol. 21 (3), 497–506.
Montiel, I., Husted, B.W., 2009. The adoption of voluntary environmental management programs in Mexico: first movers as institutional entrepreneurs. J. Bus. Ethics 88, 349–363.
Moula, M.E., Sorvari, J., Oinas, P., 2017. Constructing a Green Circular Society.
Murray, A., Skene, K., Haynes, K., 2017. The circular economy: an interdisciplinary exploration of the concept and application in a global context. J. Bus. Ethics 140 (3), 369–380.
Nagasawa, T., 2017. The Effect of Farmers Field School on Inputs Investment Through Electronic Voucher (e-Voucher) Scheme. A Case Study in 4 Provinces of Central Mozambique. Doctoral dissertation. Wangenigen University.
Naveh, E., Marcus, A., Moon, H.K., 2004. Implementing ISO 9000: performance improvement by first or second movers. Int. J. Prod. Res. 42 (9), 1843–1863.
Nikolopoulos, K., Punia, S., Schäfers, A., Tsinopoulos, C., Vasilakis, C., 2021. Forecasting and planning during a pandemic: COVID-19 growth rates, supply chain disruptions, and governmental decisions. Eur. J. Oper. Res. 290 (1), 99–115.
Nowak, R., Haynes, J., 2018. Friendships with benefits? Examining the role of friendship in semi-structured interviews within music research. Int. J. Soc. Res. Methodol. 21 (4), 425–438.
Pigosso, D.C., McAloone, T.C., 2021. Making the transition to a circular economy within manufacturing companies: the development and implementation of a self-assessment readiness tool. Sustain. Prod. Consum. 28, 346–358.
Qazi, A.A., Appolloni, A., 2022. A systematic review on barriers and enablers toward circular procurement management. Sustain. Prod. Consum. 33, 343–359.
Ramkumar, S., 2019. Making sense of the circular economy: The 7 key elements. Available at: https://www.circle-economy.com/circular-economy/7-key-elements.
Rezali, N., Ali, M.H., Idris, F., Yunus, Y.M., Yunan, Y.S.M., 2021. Exploration of institutional theory in green supply chain initiatives for healthcare industries in Malaysia. Int. J. Bus. Contin. Risk Manag. 1 (2–3), 126–141.
Rossi, E., Bertassini, A.C., dos Santos Ferreira, C., do Amaral, W.A.N., Ometto, A.R., 2020. Circular economy indicators for organizations considering sustainability and business models: plastic, textile and electro-electronic cases. J. Clean. Prod. 247, e119137.
Sarkis, J., Kouhizadeh, M., Zhu, Q.S., 2021. Digitalization and the greening of supply chains. Ind. Manag. Data Syst. 121 (1), 65–85.
Saunders, M., Lewis, P., Thornhill, A., 2009. Research Methods for Business Students. Pearson education.
Schoenherr, T., Talluri, S., 2013. Environmental sustainability initiatives: a comparative analysis of plant efficiencies in Europe and the US. IEEE Trans. Eng. Manag. 60 (2), 353–365.
Schütz, A., 1962. Collected Papers 1: The Problem of Social Reality. Martinus Nijhoff, The Hague.
Scott, W.R., 1995. Institutions and Organizations, 1st ed. Sage, Thousand Oaks, CA.
Scott, W.R., 2001. Institutions and Organizations, 2nd ed. Sage, Thousand Oaks, CA.
Singh, M.P., Arpita, C., Roy, M., 2018. Developing an extended theory of planned behavior model to explore circular economy readiness in manufacturing MSMEs, India. Resour. Conserv. Recycl. 135, 313–322.
Spears, B.M., Brownlie, W.J., Cordell, D., Hermann, L., Mogollón, J.M., 2022. Concerns about global phosphorus demand for lithium-iron-phosphate batteries in the light electric vehicle sector. Commun. Mater. 3 (1), 1–2.
Stahel, W.R., 2013. Policy for material efficiency – sustainable taxation as a departure from the throwaway society. Philos. Trans. R. Soc. A Math. Phys. Eng. Sci. 371.
Stindt, D., Sahamie, R., 2014. Review of research on closed loop supply chain management in the process industry. Flex. Serv. Manuf. J. 26 (1), 268–293.
Su, B., Heshmati, A., Geng, Y., Yu, X., 2013. A review of the circular economy in China: moving from rhetoric to implementation. J. Clean. Prod. 42, 215–227.
Su, H.C., Dhanorkar, S., Linderman, K., 2015. A competitive advantage from the implementation timing of ISO management standards. J. Oper. Manag. 37 (1), 31–44.
Suchman, M.C., 1995. Managing legitimacy: strategic and institutional approaches. Acad. Manag. Rev. 20 (3), 571–610.
Sudusinghe, J.I., Seuring, S., 2022. Supply chain collaboration and sustainability performance in circular economy: a systematic literature review. Int. J. Prod. Econ. 245, 108402.
Sylvestre, P., Wright, T., Sherren, K., 2013. Exploring faculty conceptualizations of sustainability in higher education: cultural barriers to organizational change and potential resolutions. J. Educ. Sustain. Dev. 7 (2), 223–244.
Taddei, E., Sassanelli, C., Rosa, P., Terzi, S., 2022. Circular supply chains in the era of industry 4.0: a systematic literature review. Comput. Ind. Eng. 170, 108268.
Tapia, C., Bianchi, M., Pallaske, G., Bassi, A.M., 2021. Towards a territorial definition of a circular economy: exploring the role of territorial factors in closed-loop systems. Eur. Plan. Stud. 29 (8), 1438–1457.
Thompson, J., 2022. A guide to abductive thematic analysis. Qual. Rep. 27 (5), 1410–1421.
Tolbert, P.S., Zucker, L.G., 1996. The institutionalization of institutional theory. In: Clegg, S.R., Hardy, C. (Eds.), Studying Organization: Theory & Method. Sage, Thousand Oaks, CA, pp. 175–190.
United Nations, 1998. Kyoto Protocol to the United Nations Framework Convention on Climate Change. United Nations, New York, NY.
United Nations, 2015. Paris Agreement. United Nations, New York, NY.
Van Engeland, J., Beliën, J., De Boeck, L., De Jaeger, S., 2020. Literature review: strategic network optimization models in waste reverse supply chains. Omega 91, 102012.
van Loon, P., Van Wassenhove, L.N., 2020. Transition to the circular economy: the story of four case companies. Int. J. Prod. Res. 58 (11), 3415–3422.
Vitharana, S.P.H., Kandegama, W.W.W., 2020. Does public concern affect the greenhouse gas emissions of oil and gas production, through logistics? Int. J. Supply Chain Manag. 9 (5), 290.
Wang, C.H., 2014. A longitudinal study of innovation competence and quality management on firm performance. Innov. Manag. Policy Pract. 116 (3), 392–403.
Weetman, C., 2016. A Circular Economy Handbook for Business and Supply Chains: Repair, Remake, Redesign, Rethink. Kogan Page, London.
Wijkman, A., Skånberg, K., 2017. The Circular Economy and Benefits for Society. Club of Rome, Zurich.
Zhang, A., Wang, J.X., Farooque, M., Wang, Y., Choi, T.M., 2021. Multi-dimensional circular supply chain management: a comparative review of the state-of-the-art practices and research. Transp. Res. E Logist. Transp. Rev. 155, 102509.
Zhu, Q., Geng, Y., Sarkis, J., 2016. Shifting Chinese organizational responses to evolving greening pressures. Ecol. Econ. 121, 65–74.