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The role of entrepreneurship in successfully achieving circular supply chain management

Abstract

The concept of circular supply chain management (CSCM) is increasingly attracting the attention of academia, practitioners and other stakeholders. It involves the implementation of circular economy policy throughout the supply chain and supporting ecosystem. The paper responds to the call for further research and evidence on the connection between industrial symbiosis practices (ISP) and CSCM. Specifically, it empirically examined the role of entrepreneurship in facilitating CSCM to achieve its sustainability goals (SG). Furthermore, we analyze the mechanism by which circular economy entrepreneurship (CEE) promotes ISP thereby supporting CSCM. The sector focus is on agri-food small and medium enterprises (SMEs) competing in an emerging economy. This study adopted a quantitative research approach using primary data collected from a questionnaire-based survey and uses Structural Equation Modeling (SEM) approach using the Smart PLS version 3.3.7 to examine the relationships between CEE, ISP, CSCM, and SG. There were 486 valid responses from supply chain managers who manage at either senior or middle levels in the firm. The results provide insight into the optimization mechanisms for CSCM. These promote regenerative value and no-waste processes from a unique perspective. In this regard, this study undertakes an empirical examination and proves how circular entrepreneurship and industrial symbiosis practices drive CSCM to achieving its sustainability goals.

Keywords: Circular supply chain management, Industrial symbiosis, Triple bottom line, Sustainability goals, Circular entrepreneurship.

The role of entrepreneurship in successfully achieving circular supply chain management

1. Introduction

According to Kaza *et al.* (2018), if the world continues to remain on its traditional economic model path, by 2050, the world will need the resource capacity of the Earth to triple. If it is provide enough resources to meet the growth in consumption. The circular economy (CE) model therefore emerged recently as an alternative paradigm to the linear economic model. The proponents of this economic model believe that it is a viable option to achieve high levels of sustainability without diminishing the profitability of the business or reducing the number of available products and services. It is focused on maintaining the value of resources in the economy towards their longest possible "value in use" rather than "market exchange" (Groll, 1980) value associated with the linear economic model.

A circular system model is designed towards achieving "zero waste". The CE concept inspired by "zero waste" aims at proposing more efficient patterns of production and resource consumption as a response to scarcity and the limitation of natural resources. The transition to a CE has been approached at multiple levels: first, at the government level, according to Kalmykova *et al*. (2017); Reike *et al*. (2018), second, at the business level, according to Murray *et al*. (2017), and third, a non-governmental or civic organizational level to raise stakeholder attention on the CE. Whilst promoting strict compliance with CE-related government policies (Wachholz, 2020).

Growing awareness of the role of the CE in addressing economic, social, and environmental problems has led to an acceleration of supply chain research (Khitous *et al*. (2020); Merli *et al*. (2018)). Current literature in this area mainly focuses on terms and definition of the circular economy. Such as eco-parks, industrial-symbiosis, supply-chains, closed-loop materials and business models (Homrich *et al*. 2018). Furthermore, work on the integration of CE principles in the SC is only modestly covered by the SCM literature (Govindan and Hasanagic (2018) and Batista *et al*. (2018a)).

Lahane and Kant (2021) stressed the need for further work on the adoption of CE principles in the supply chain. According to Harland (2021); Govindan and Hasanagic (2018), there are many challenging areas preventing successful CE implementation. These include problems in scaling up materials to multiple stakeholders, cultural-related factors, governance, poor capabilities and technologies.

Industrial symbiosis is a subset of industrial ecology. It describes how a network of diverse organizations can foster eco-innovation and long-term culture change together (Isenmann and Chernykh, 2009). Industrial symbiosis practices (ISP) are characterized by the management of shared resources among many enterprises within an established geographical area. There is a particular focus on the reuse of secondary materials (by-products, wastes from one entity (Ashton et al., 2022).

ISP has received little attention by the operations and SCM community (Herczeg et al., 2018). Indeed, research on ISP is scarce at the operational and process levels (Turken and Geda, 2020). Luthra et al. (2022) suggests that cross-industry collaboration (that is industrial symbiosis based) is characterized by shared relationships, critical functions, resources, informative data and capabilities. This is crucial for the successful implementation of CSCM. However, the existing literature mainly assesses the CSCM concept solely or independently from the perspective of one firm. It rarely explores the role of cross collaboration to achieving joint CSCM.

In addition, a recent comparative review of the field by Zhang *et al*. (2021), suggests that this area of scientific knowledge needs further empirical research to bridge the gap that exists between theory and practice. Furthermore, according to Turken and Geda (2020), the industrial symbiosis approach to SCM should be further explored. Whilst research on CSCM should be further focused on specific sectors such as food supply chain (Lahane and Kant, 2021; Luo et al., 2022).

The CE approach involves businesses making the most efficient use of resources in their activities to move towards a sustainable world (Colin David, 2020). From our perspective, the entrepreneur and entrepreneurship are central to the process of realizing CE. With personal motivation very important for them to participate (Colin David, 2020; Kazancoglu et al., 2021).

The current literature shows a lack of connection between corporate sustainable practices and policy level sustainable development goals (SDGs) (Khaled *et al*., 2021). Therefore, it is difficult for businesses to imagine how their sustainable practices can contribute to realizing the SDGs of a country or the world. Furthermore, most current research is modelling-based that deals with abstract problems rather than being empirical grounded and dealing with real-life practical contexts (Zhang *et al*., 2021). Therefore, this research focuses on developing a specific context-based empirical research study for small- and medium-sized enterprises (SMEs) in the agri-food sector in Vietnam, an emerging economy in Southeast Asia.

In this study, agri-food is prioritized for analysis because of the urgency to deal with rapid population growth. According to Nattassha *et al*. (2020), the most challenging issue with agri-food and its supply chain is the existence of by-products. These are treated as waste and are immediately discarded as waste disposal (Khan et al., 2022; McDougall et al., 2019). This is because agri-food firms have largely entrepreneurial thinking and still follow a traditional economic model, which is leading to unsustainable practices.

Our research sought to undertake an empirical examination of how circular entrepreneurship (CEE) and industrial symbiosis practices (ISP) drive CSCM. Furthermore, we explore the mechanisms by which CEE impacts on ISP, fosters CSCM and facilitates SG. Theoretically, the relationship between CEE, ISP, CSCM, and SG can be explained by institutional theory and stakeholder theory.

Specifically, institutional theory explains how entrepreneurial behavior is conformed, repeated, and socially determined. Moreover why, in an industry sector, entrepreneurs exhibit patterns of behavior and similar responses to external stimuli. With respect to the radical change required for transforming the linear economy to CE, institutional entrepreneurs are deemed critical to enabling this process to occur (Alonso-Almeida *et al*., 2020; Cantarelli, 2022).

In this regard, CEE is seen as a compliance by the entrepreneur to transform the traditional economic paradigm to that of the circular economy. From the perspective of institutional theory, the entrepreneurial individual integrates circular economic principles into their entrepreneurial mindset, which governs their subsequent business activities and practices. This results in the promotion and realization of industrial symbiosis practices.

From a stakeholder theory point of view, businesses must think of the interests of all their various stakeholders. This explains that businesses engage in sustainable practices because they realize that their responsibility is not solely to do business and maximize profit. They also need to address the issues that are important to their stakeholders such as sustainability. Based on this discussion, this research aims at addressing the following questions:

RQ1. How does circular economy entrepreneurship successfully associate with industrial symbiosis practices for achieving circular supply chain management and sustainability performance goals?
RQ2. How will industrial symbiosis practices and circular supply chain management mediate the link between circular economy entrepreneurship thereby achieving sustainability performance goals?
RQ3. What is the entrepreneurial logic in fostering the achievement of sustainability performance in accordance with the triple bottom line?

This study contributes in the following ways. First, it contributes to emerging research on CE by providing a holistic empirical examination on the connection between CEE, ISP, CSCM, and SG for SMEs in the agri-food sector. Second, our work provides empirical evidence on the association of CEE with ISP thereby promoting CSCM for SG for SMEs in the agri-food sector. Third, this study provides well established measures of CEE, ISP, CSCM, and SG for SMEs in the agri-food sector located in an emerging economy.

In general, the findings of this research aim to suggest a path for SMEs to follow as they develop from entrepreneurial mindset, to implementing practices for achieving sustainability performance, in the CE. Importantly, we help enterprises understand their corporate-level sustainable practices and activities that contribute to the realization of SDGs both for nation and the globe.

The remainder of this paper includes the following sections. Section 2 presents the results of a systematic review of the literature and the underpinning theory. Section 3 discusses the key relationships, develops our hypotheses and proposes a model for testing. Section 4 presents the study design and methodology. Section 5 interprets the results. Section 6 discusses the findings of the study and proposes several theoretical and managerial implications. Section 7 concludes the study and outlines the limitations, thereby suggesting future research areas.

2. Literature review

This study adopted a systematic review approach of relevant literature in this study domain. Table 1 summarizes the key points that can be drawn from the mainstream journals in the field. These show the crucial role of CSCM to business performance and the importance of industrial symbiosis for CSCM implementation. Thereby generating transcendent values for the business and for the community at large. They outline the enablers or barriers for CSCM implementation and suggest the critical role of CEE to the value chain and corporate strategy.

In this regard, CEE and ISP are assumed to be crucial for CSCM implementation and SG achievement. However, the mechanism for the association between these constructs has not yet been explored comprehensively in the current literature. In particular, empirical research on the role of CEE in CSCM is very rare.

Furthermore, based on the limitations of the reviewed literature, some proposals for new research have been formulated. We suggest that further research is necessary to explore industrial symbiosis in the field of SCM (Turken and Geda, 2020). Whilst there is also a need for applied CSCM work which focuses on specific areas such as food supply chain (Lahane and Kant, 2021).

Table 1. Summary of the literature review

Authors	Year	Major findings / implications	Limitations
Farooque et al.	2022	CSCM positively and significantly affects business performance metrics (i.e., revenues, costs) if it is undertaken as a consistent strategy.	Business performance only considers financial-related indicators and does not include environmental and social dimensions. Sample population: Chinese manufacturing enterprises across different industries. They recommend future research work should be industry or group specific-based.
Luthra et al.	2022	Cross-sector collaboration, conceptualized on the industrial symbiosis concept, has a critical role in CSCM implementation. In practice, governance and contextual factors (such as government regulation and enforcement, collaboration and mutual support between actors and sectors) can become key barriers to CSCM implementation.	The organization's internal capabilities-related factors that may affect the implementation of CSCM has not been considered.
Rovanto and Finne	2022	Sociocultural factors and entrepreneurial attitudes have a great influence on the entrepreneur's motivation and the ways in which they approach circular economy practices. In this regard, it emphasizes a significant difference in practices between the individualist and collectivist cultural approaches.	Limited to the context of the textile and clothing industry.
Chen et al.	2022	Industrial symbiosis has a positive effect on multi-dimensional benefits such as increasing the productivity of direct inputs, water and energy, saving economic investment, reducing environmental adverse impact, increasing the sustainability index.	This study does not specify its limitations.
Schultz et al.	2021	The governance mechanisms can challenge the ability to implement CSCM because its implementation requires a close collaboration of enterprises with other actors inside and outside the industry and sector. In particular, circular business model innovation, developing a circular economy-enabling environment and	Limited value in terms of applicability in some areas such as solving problems related to partnerships, or limited applicability due to resource constraints of the enterprises.

		strategic alliances with partners are of paramount.	
Saroha et al.	2021	Circular economy entrepreneurship characterized by exploring and exploiting entrepreneurial opportunities in the circular economy leading to value proposition, value creation, value capture and value delivery through innovative circle business models.	Based on a single case, therefore, may affect the ability of this study to generalize the findings into different settings.
Lahane and Kant	2021	Among the identified barriers to CSCM implementation, at the corporate level, entrepreneur's attribute-related factors in terms of support and commitment in adopting circular economy practices hinder it most.	Based on subjective opinion of experts, therefore it may induce bias in the findings. The research context is limited to a developing economy, India. This study focuses on CSCM at large, therefore, it suggests a need for future research to extend to another specific supply chain such as the food supply chain.
Farooque et al.	2019	The main barriers to the integration of circular economy philosophies into the supply chain in the food industry are categorized into three main groups such as: the government (institutional regulation, enforcement), market (preference, pressure) and partners (collaboration, cooperation).	The list of barriers may not be exhaustive. Important actors in the supply chain may not sufficiently be covered, for example, farmers.
Zhu et al.	2019	A circular approach is critical to achieving goals together in terms of ecology, economy and society. In addition, entrepreneurship is very important to building a circular business.	Limited ability to generalize research findings to other socio-economical contexts due to this study's focus on a single farm.
Herczeg et al.	2018	Industrial symbiosis is very important in SCM in the sense of improving resource efficiency. In such a way that the waste of one entity is utilized as an input to another.	This study does not specify its limitations.

2.1. *Underpinning institutional and stakeholder theories*

Institutional and stakeholder theory were identified to be most appropriate theories to analyze the relationships between the constructs identified from the literature. According to Aldrich and Fiol (2007) and Meyer and Rowan (1977), institutional theory explains how entrepreneurial behavior is conformed, repeated and socially determined. Also why, in an industry sector entrepreneurs exhibit patterns of behavior and similar response to external stimulation. For Alonso-Almeida *et al*. (2020), transitioning from a traditional economic model to CE requires many changes and institutional entrepreneurs promote this process. Circular economy entrepreneurship (CEE) can be conceptualized as the process of exploration and exploitation of opportunities in the circular economy domain.

Institutional theory focuses on coercive, mimetic and/or normative pressures. From the external policy environment, entrepreneurs and enterprises are socially pressured to make changes and innovations in response to CE policy demands (Gasbarro *et al*., 2018). Although it can be perceived as a threat, they will also see opportunities from CE government policy. It is important that these opportunities help them to not only grow sustainably, but also to encourage other actors to do likewise along the supply chain.

In the context of moving towards a zero-waste economy, supply chain management (SCM) practices consider a combination of closed loop and open loop actions simultaneously. Thereby maximizing the value creation of resources in the economy. With this study, institutional theory is applied to understand how the entrepreneurial individual can integrate circular economic principles into their mindset, to govern business activities and practices.

The theory can be applied to understand the development of industrial symbiosis practices. Theoretically each enterprise can optimize their closed loop and open loop control actions in their own network. Combining these networks together results in maximizing the value creation of resources in the economy. The result is an ever-expanding economic cycle of many actors from different networks combining to create a system of circularity (Pereira et al., 2022).

Meanwhile, stakeholder theory (Freeman, 1984) explains that businesses must always think of the interests of their various stakeholders. In this regard, businesses engage in sustainable practices because they realize that their responsibility is not only to do business, but also to address the sustainability issues that are of interest to their stakeholders. Businesses must engage in sustainable practices and economic activities simultaneously, to ensure they keep their reputation for being sustainably responsible with their stakeholders. They are directly responsible to their stakeholders and will feel pressure from them. This subsequently leads to compliance with various policy directives, campaigns and state recommendations. In such a dynamic environment, stakeholders directly influence organizational strategy and its operational implementation. As the firm seeks to meet its sustainability performance targets (Heras-Saizarbitoria et al., 2021; Baah et al., 2021).

2.2. *Circular economy entrepreneurship (CEE)*

We now postulate that through institutional and stakeholder pressure a direct strategic response is the firm implementing circular economy entrepreneurship. Entrepreneurship directed to transform the policy measures and stakeholder directives into value added activities by the organization. Given the

ever-increasing importance of the CE, the concept of circular economy entrepreneurship (CEE) is described as a process of exploring and exploiting novel business opportunities in the CE domain (Cullen and De Angelis, 2021).

CEE is therefore largely considered as: *"... a subset of sustainable entrepreneurship*" (Colin David, 2020). Considering the difference with conventional entrepreneurship, CEE, besides the desire to do business and capture market and transactional measures of value, also has the desire to protect the ecosystem and the environment and achieve social and value in use[1] or (green) environmental value (Colin David, 2020). For this study, CEE refers to business practitioners who participate in the agri-food value chain with an aim to achieve targets for both sets of value – market and environmental.

2.3. *Industrial symbiosis practices (ISP)*

Industrial symbiosis is a subset of industrial ecology and it focuses on material and energy exchange. It provides a business-focused collaborative approach towards resource efficiency whilst minimizing the negative effects on the environment (Salomone *et al*., 2020). Therefore, the concept of industrial symbiosis refers to a situation in which different businesses actively collaborate. They do this in a systematic manner in resource sharing or complementing each other with the aim of enhancing resource consumption efficiency for sustainability (Zhao, 2021). Examples of industrial symbiosis are quite wide ranging and they include such activities as the use of waste heat from one industry to warm greenhouses for food production, the recovery of car tyres for use in construction materials and the use of sludge generated from fish farms for use as agricultural fertilizer.

In this regard, industrial symbiosis can foster synergies between several industries, in continuous joint efforts in system development and networks, so that they can facilitate circularity and enhance the overall efficiency of resource use. In the context of CE, industrial symbiosis can promote sustainability by maximizing resource efficiency. Through recovering residues from one entity for use by another. According to Saavedra *et al*. (2018), industrial symbiosis is a very important element of CE and its understanding and manifestation vary considerably in different contexts, according to D'Amato *et al*. (2017). For instance, the use of food waste from the catering sector to feed farm animals, is very different from the use of non-toxic industrial waste to produce energy through incineration. Of the earliest examples of industrial symbiosis on a large scale in Europe is the Kalundborg industrial park in Denmark. This brought together an increasing number of partners that

[1] Value in use is a long run measure that looks at the total value accrued from an investment or strategic decision at a policy or organizational level such as the pedestrianization of town centres, building a cycle lane, installing charging infrastructure, introducing solar or wind-power energy, dealing with eco-efficient suppliers etc.

are currently exchanging 20 resources between each other, as diverse as biomass, gypsum, and steam[2].

According to Baldassarre *et al*. (2019); Merli *et al.* (2018), industrial symbiosis has a very important role in shaping and implementing CE initiatives (Korhonen *et al*., 2018a). From this approach, industrial symbiosis practices (ISP) refers to the situation in which business practitioners create symbiotic networks for waste treatment by sharing facilities, water, energy and resources in general (Trokanas *et al*., 2014). According to Dou *et al*. (2021), ISP concretizes the flow of materials, energy, resources in general, across industries in a systematic way from thinking through to practice (Oughton *et al*., 2022). In the context of SCM, if every actor commits to such practice along the supply chain the result is an ever-expanding industrial symbiosis network. Which in turn provides a very important catalyst for promoting effective CSCM.

2.4. Circular supply chain management (CSCM)

CSCM is a novel conceptualization that is being adopted widely across many global industries (Khan and Ali, 2022). CSCM is the direct application of the philosophies of the CE into supply chain management and indirectly into the supporting industrial- and natural- ecosystems. The supply chain draws on the wider eco-system which indirectly provisions it with resources, assets, and capabilities. For instance, Tesla was largely built and established in the Palo Alto high technological nexus, before recently relocating to Austin, Texas. The eco-system provisioned it with skilled engineers, R and D capital and land development grants.

We suggest that CSCM can only be achieved through system-wide innovations aiming at achieving zero waste and maximum sustainability (Farooque *et al*. (2019)). Therefore, CSCM systematically and purposefully integrates different business ecosystems together. The objective is to maximize the environmental value generated from the combined resources whilst sustaining a life cycle that functions with zero-waste (Batista *et al*., 2018a).

In addition, integrating CE philosophy into SCM leads to advantages, from a sustainability perspective. CSCM should drive sustainability by fostering the application of CEE at each stage of the supply chain (Nasir *et al*., 2017). The mechanism by which CSCM leads to sustainability primarily lays at the source whereas waste is minimized as best as possible. If there is any waste, it can be converted into input resources for other entities (Farooque *et al*., 2019).

[2] A good example of Industrial Symbiosis – the Symbiotic Networks of Bio-Waste Sustainable Management (please refer to: www.symbiosisproject.eu).

As previously mentioned, the CSCM approach includes both the open and closed loop actions to maximize resource efficiency and achieve zero waste. System wide innovation efforts are used to restore value from what is traditionally referred to as "waste" (Farooque *et al.,* 2019). In the agri-food supply chain, CSCM is challenging to achieve because of its complexity and dynamic nature. It involves many actors both large and small, whose membership is often changing and evolving from farm to primary processing, logistics, production, distribution, and consumption.

According to Nattassha *et al.* (2020), the most challenging issue in the agri-food section and its supply chain is the existence of by-products. These are often treated as waste and are immediately discarded. Therefore, for CSCM to be effective in a way that targets resource efficiency, optimizing both closed loop and open loop control actions is crucial and necessary.

2.5. Sustainability goals of firm performance (SG)

In this study, corporate sustainability performance-oriented goals are seen as the scaling down and interpreting national and global SGDs at the firm and supply chain levels. According to Van der Waal and Thijssens (2019), the common SDGs of the globe and nations emphasize the necessity of participation from the business world. Arayssi *et al.* (2019) notes that corporate sustainable practices reflect a voluntary commitment to non-financial benefits and SDGs, which in turn generate value for the various stakeholder groups such as investor, society, and others.

3. Model and hypothesis development

Based on our analysis of the literature we have developed an initial model that is presented in Figure 1. The model has four interrelated variables which include: circular economy entrepreneurship (CEE) is an independent variable; industrial symbiosis practices (ISP) and circular supply chain management (CSCM) are mediating variables, whilst the sustainability goals of firm performance (SG) is a dependent variable. The model itself is underpinned by the logic of institutional and stakeholder theory.

To further test and advance this categorization model we developed a series of hypotheses for testing using a Structural Equation Modeling (SEM) approach that uses the Smart PLS version 3.3.7.

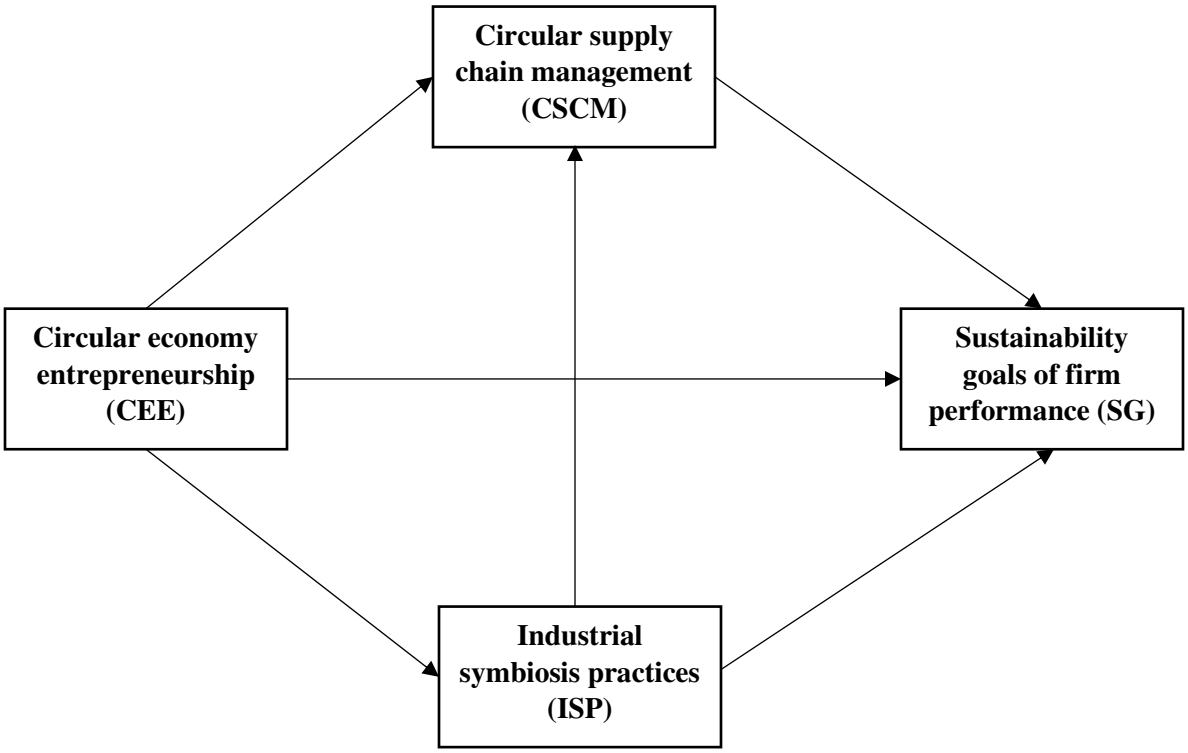

Figure 1. Proposed Literature Categorization Model

3.1 Hypothesis development

Based on our model we suggest that integrating CE principles into entrepreneurial thinking is useful for exploring and exploiting new business opportunities in the CE domain. Furthermore, it helps to promote ISP as an entrepreneurs' vision. According to Saavedra *et al*. (2018), ISP is very important for realizing CE. Theoretically, the relationship between CEE and ISP and CSCM can be debated based on the perspective of institutional theory. Therefore, the institutional entrepreneur has the advantage of power and the ability to engage different stakeholders and inspire them to collaborate in a certain positive direction with respect to the CE.

As a result, this prompts the implementation of the required changes and innovation in response to the requirements for the transition process from a traditional market economy to that of the circular economy (Alonso-Almeida *et al*., 2020; Gasbarro *et al*., 2018). This notion is affirmed by Zhu *et al*.

(2019) who asserted that entrepreneurship is a very important factor in promoting the CE agenda in emerging economies.

According to Gasbarro et al. (2018), the institutional entrepreneur has the advantage of power and the ability to introduce innovative business models. This is in collaboration with end customers and strategic partners, which is crucial to facilitate the transitioning process to a circular economy. Given the above discussion, the hypotheses regarding relationships associated with the mediation of ISP in the link between CEE and CSCM can be assumed as follows:

i. *Hypothesis 1 (H1) ISP successfully mediates the link between CEE and CSCM.*
ii. *Hypothesis 1a (H1a) CEE positively affects ISP.*
iii. *Hypothesis 1b (H1b) ISP positively affects CSCM.*
iv. *Hypothesis 1c (H1c) CEE positively affects CSCM.*

3.1.1 Relationships associated with the mediation of CSCM in the link between ISP and SG

According to D'Amato *et al*. (2019), ISP is seen as the strategic actions involved in promoting the transformation from a traditional market economic model to that of the circular economy (Diaz Lopez *et al.*, 2019). In addition, ISP is seen as a key tool that helps to enhance the environmental performance of enterprises by reducing their emissions (Liu *et al*., 2017; Sun *et al*., 2017).

Trokanas *et al*. (2014) suggests that symbiotic synergies are established with the main purpose of improving resource use efficiency. Whilst reducing the negative impacts on the environment by optimizing circulation throughout the industrial ecosystem. In turn, this creates sustainable practices and economic, social, and environmental benefits for all actors involved in the symbiotic synergies, exchanges and the local communities as well.

Businesses adopting ISP help reduce production costs by improving resource efficiency, which in turn improves their economic, social, and environmental performance (Taddeo *et al*., 2017). Domenech *et al.* (2019) asserts that systematic collaboration between different actors is crucial to realize CE. In other words, it is difficult to implement CE without synergistic collaboration between different actors operating in the business ecosystem. Given the above discussion, the hypotheses regarding relationships associated with the mediation of CSCM in the link between ISP and SG can be assumed as follows:

v. *Hypothesis 2 (H2) CSCM successfully mediates the link between ISP and SG.*
vi. *Hypothesis 2a (H2a) ISP positively affects SG.*
vii. *Hypothesis 2b (H2b) CSCM positively affects SG.*

3.1.2 Relationships associated with the mediation of ISP and CSCM in the link between CEE and SG

As discussed above, ISP is closely related to CSCM (Saavedra *et al*., 2018). Their association is invaluable in improving the efficiency of resource use, ultimately delivering sustainable benefits in terms of economy, society and the environment (Taddeo *et al*., 2017). According to Salomone *et al.* (2020), ISP aims at converting residuals and by-products into input resources for other entities. Whilst CE primarily targets an improvement of material efficiency, waste minimization and recycling. It aims at protecting the ecosystem through responsible-driven and profitable business models (Kirchherr *et al*., 2017).

According to Fitch-Roy *et al*. (2020), CE aims to reverse unsustainable economic and business patterns and create lasting prosperity. The role of CEE is very vital to the CE process. In a supply chain management context, sustainability throughout the entire supply chain from end user to source is highly dependent on compliant management practices. Current literature shows that the correct implementation of CE practices is considered vital in achieving resource circularity, efficiency, and optimization (Sehnem et al., 2019). Farooque *et al*. (2019) notes that CSCM ultimately leads to achieving sustainability goals. As it strives for zero waste via innovation.

ISP and CSCM can jointly address the challenges that exist in the agri-food industry, namely dealing with "waste". By optimizing the value creation of resources in the economy through using the waste of one production activity to become the input into another. Thereby addressing issues of stakeholder concern. Furthermore, by reducing the burden on the environment this contributes to achieving the sustainability goals of firm performance. Namely the triple bottom lines of economy, society, and the environment.

Given the above discussion, the hypotheses regarding relationships associated with the mediation of ISP and CSCM in the link between CEE and SG can be assumed as follows:

viii. Hypothesis 3 (H3) CEE positively affects SG
vix. Hypothesis 4 (H4) ISP mediates the link between CEE and SG
x. Hypothesis 5 (H5) ISP and CSCM mediate the link between CEE and SG

Based on the above discussion and proposed research hypotheses, our model annotated with the hypothesized relationships is shown below in Figure 2.

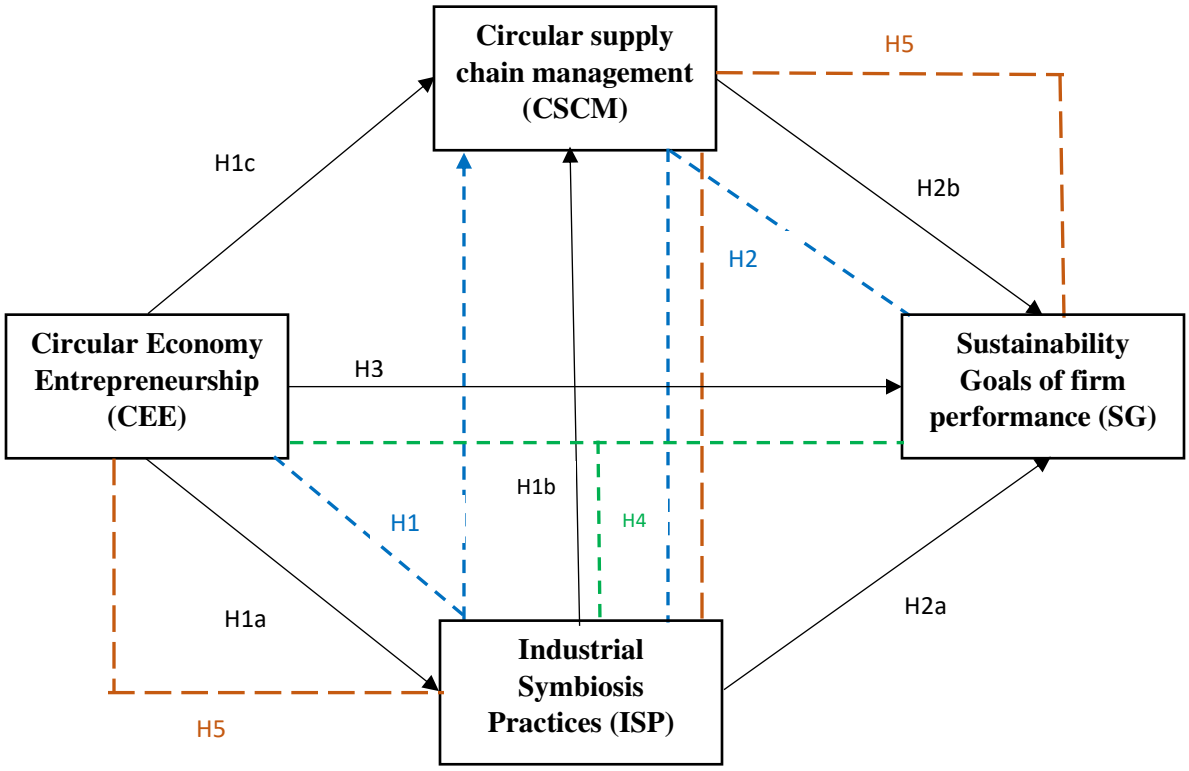

Figure 2. Model with hypothesized relationships.

1. Research design and methodology

a. Target population and sampling

The focus of our study is on SMEs in the agri-food sector in emerging economies. Therefore, the sample population is SMEs those are operating in the field. In this respect, the analysis unit is the enterprise and the survey respondents are the enterprise's representatives who currently hold senior positions in the company. The sample population was recruited through associations of small and medium businesses. In this study, firm size was determined according to the criteria of number of employees in accordance with the OECD definition (2021). Accordingly, enterprises with the number of employees from 10 to 49 people were identified as small enterprises. Whilst enterprises with 50 to 249 employees were categorized as medium enterprises. The total number of sampled respondents that were recruited and eligible to participate in the survey was high at 600.

b. Survey instrument

A questionnaire was developed and pilot tested using the procedure advocated by Cobanoglu et al. (2001). This ensured that the most accurate data possible could be obtained. The questionnaire was

subsequently reviewed by a panel of experts who were asked to review it and then who were interviewed. Then we further tested it with potential survey participants through a pilot survey. Those who participated in the pilot survey had a background similarly to the target sample population (Cobanoglu et al., 2001).

c. Variables and scales

The scales were developed based on a systematic literature review. Table 2 shows the items corresponding to each variable and their sources. These scales were used to develop the questionnaire. The scales applied a range of 5-points from one to five in increasing values. Whereby one represents "totally disagree" / "totally unlikely" and five represents "totally agree" / "totally likely".

Table 2. Variables and items

Variable	Items	Description	Sources
Circular economy entrepreneurship (CEE)	CEE1	We keep in mind that our primary mission is to explore and exploit new opportunities in the domain of the circular economy.	Cullen and De Angelis (2021); Lynde (2020)
	CEE2	We keep in mind that our key responsibility is to improve resource efficiency.	
	CEE3	We keep in mind that our primary responsibility is to enhance sustainable economic, social and environmental values.	
	CEE4	We keep in mind that our primary responsibility is to improve the overall performance of the agri-food value chain in a sustainable way.	
	CEE5	We keep in mind that our primary responsibility is to contribute to the realization of national and global sustainable development goals.	
Industrial symbiosis practices (ISP)	ISP1	We proactively expand our symbiotic network across companies, industries to seek better resource efficiency.	Trokanas *et al.* (2014); Dou *et al.* (2021)
	ISP2	We promote sharing facilities in our symbiotic network to optimize resource use efficiency.	
	ISP3	We promote system integration to maximize resource value creation.	
	ISP4	We always improve the flow of the materials to ensure its value creation is as high as possible.	
	ISP5	We promote sharing a waste treatment system in our symbiotic network to optimize efficiency.	
	ISP6	We promote visualization of the flow of resources in our symbiotic network to optimize management efficiency.	
	CSCM1	We have a change management process to improve resource efficiency.	Farooque *et al.* (2019);
	CSCM2	We have systems and processes in place to manage the primary resource flow along the supply chain.	
	CSCM3	We have systems and processes in place to manage a circular resource flow throughout the supply chain.	

Circular supply chain management (CSCM)	CSCM4	We have systems and processes in place to promote resource recycling in the value chain.	Calzolari *et al*. (2022)
	CSCM5	We have systems and processes in place to promote resource circularity in open networks across industries.	
	CSCM6	We have a management system in place to minimize system leakage to control waste and emissions.	
	CSCM7	We have systems and processes in place to link all actors and stakeholders along the ecosystem.	
	CSCM8	We have system and process in place for knowledge sharing about the circular economy field in the ecosystem.	
Sustainability goals of firm performance (SG)	SG1	Consumption of primary resources decreases over time.	Khaled *et al*. (2021); Calzolari *et al*. (2022)
	SG2	The extent of conversion to using recycled materials increases over time.	
	SG3	The extent of waste decreases over time.	
	SG4	Greenhouse gas emissions reduce over time.	
	SG5	Provide stable employment for society and community over time.	
	SG6	Contribution to improve social welfare increases over time.	
	SG7	Our operating costs decrease over time.	
	SG8	Financial performance increases over time.	

d. Data collection and analysis

The survey was conducted from October 2021 to February 2022 using the internet platform. The questionnaire was sent to 600 target respondents in the sample population. At the end of the survey period, 517 questionnaires were obtained (accounted for a high 86.17% the response rate). After screening to remove invalid answer sheets (lack of information, incomplete answers), 486 valid completed questionnaires were obtained (81%). This high rate was due to the persistence of the researchers who repeatedly sent follow up communication and calls to encourage participation. We successfully marketed the importance of our study. Also, our respondents were interested in having access to the findings as they felt the topic was relevant now to them.

The collected data was then used for analysis using the partial least square structural equation model technique (PLS-SEM). This technique was chosen to be used in this study because it is suitable for complex models. In this research, the model involved analyzing both direct and indirect relationships of a complex nature (Hair *et al.*, 2017).

2. Results

5.1 Representativeness of samples

The representativeness of the collected samples is summarized in Table 3 below which includes criteria such as: gender, the age ranges of respondents, components of their job status/positions, age ranges of their businesses, components of company size. To the best of the authors' knowledge, our sample characteristics were fully representative of the target population. We also had agreement from our interviewees who had done pilot testing of the questionnaire that later checked these samples for their accuracy.

Table 3. Representative characteristics of collected samples

Characteristics	N = 486	Percentage (%)
Gender		
Male	236	48.56
Female	250	51.44
Age ranges of respondents (years)		
34 - < 40	95	19.55
40 - < 45	117	24.07
45 - < 50	145	29.84
> 50	129	26.54
Components of positions		
Non-ownership executive	366	75.31
Ownership executive	120	24.69
Age ranges of businesses (years)		
6 - < 10	79	16.26
10 - < 15	124	25.51
15 - < 20	156	32.10
> 20	127	26.13
Components of company size		
Small-sized	327	67.28
Medium-sized	159	32.72

a. Assessment of measurement model

The assessment process was carried out through the following steps. First, the scale reliability was analyzed by assessing Cronbach's Alpha, composite reliability (C.R) and their total correlation. The results show that the Cronbach's Alpha and C.R are both greater 0.7 and the total correlation coefficients are both greater 0.3. According to Hair *et al*. (2019), these values ensure that the scale is reliable. Next, the convergent validity was evaluated using additional factor loading and AVE (average variance extract) values. The results show that the factor loading values are greater than 0.7 and AVE are greater 0.5, thus, convergent validity is confirmed (Hair et al. 2014). The following Table 4 illustrates the above analysis.

Table 4. Cronbach's Alpha, factor loading, C.R, AVE

Variables	Items	Factor loading	Cronbach's Alpha	C.R	AVE
Circular economy entrepreneurship (CEE)	CEE1	0.782	0.843	0.888	0.614
	CEE2	0.783			
	CEE3	0.789			
	CEE4	0.772			
	CEE5	0.791			
Industrial symbiosis practices (ISP)	ISP1	0.781	0.875	0.905	0.615
	ISP2	0.790			
	ISP3	0.784			
	ISP4	0.783			
	ISP5	0.771			
	ISP6	0.795			
Circular supply chain management (CSCM)	CSCM1	0.703	0.888	0.911	0.562
	CSCM2	0.785			
	CSCM3	0.754			
	CSCM4	0.708			
	CSCM5	0.738			
	CSCM6	0.778			
	CSCM7	0.757			
	CSCM8	0.767			
Sustainability goals (SG)	SG1	0.877	0.955	0.962	0.762
	SG2	0.876			
	SG3	0.879			
	SG4	0.872			
	SG5	0.864			
	SG6	0.870			
	SG7	0.878			
	SG8	0.869			

Next, the Fornell & Larcker criterion and Heterotrait-monotrait ratio of correlations (HTMT) were used to analyze discriminant validity. If the square root of AVE is greater than its correlation value, then discriminant validity is determined (Fornell & Larcker, 1981). The results in Table 5 show the square root of AVE on the top of each column is larger than the correlation values shown below. Thus, discriminant validity is satisfied.

Table 5. Fornell and Larcker criterion

	CEE	CSCM	ISP	SG
CEE	0.783			
CSCM	0.666	0.749		
ISP	0.671	0.713	0.784	
SG	0.686	0.775	0.725	0.873

Furthermore, the results of HTMT analysis as shown in the following Table 6 highlights that all the output values are less than 0.85. This result reinforces discriminant validity.

Table 6. Heterotrait-monotrait ratio of correlations (HTMT)

	CEE	CSCM	ISP	SG
CEE				
CSCM	0.767			
ISP	0.780	0.808		
SG	0.764	0.804	0.792	

b. Goodness of fit analysis

The analysis of goodness of fit (GoF) was carried out through evaluating the following values: SRMR (Henseler *et al*., 2016), NFI (Hair *et al*., 2019) and R^2 (Falk and Miller, 1992). When the GoF value is above 0.36, it means that the model has a strong fit (Wetzels *et al.*, 2009). In this research, we obtained a value for GoF of 0.72. The results also show that the NFI value is 0.917, which is greater than 0.9. Whilst for SRMR the value is 0.041, which is smaller than the proposed upper threshold value of 0.08 (Henseler *et al*., 2016). This result again shows that this model has a good fit. Finally examining the value of R^2, the results show that ISP has R^2 of 0.450, CSCM has R^2 of 0.571, and SG has R^2 of 0.681 those are greater than 0.1 (Falk and Miller, 1992). We are therefore confident that our model is robust and the goodness of fit analysis is highly favorable.

c. Assessment of structural model

This process was undertaken by assessing the results from conducting bootstrapping analysis, which is shown in Table 7 below. Prior to this step, common method bias and multicollinearity problems were evaluated using VIF (the variance inflation factor). The results show that the VIF values are less than 3.3 (from 1.000 to 2.371). This result establishes that multicollinearity and common method bias are not problematic in this research (Hair, Black, Babin and Anderson, 2014; Kock, 2015).

For intermediate relationships, the intermediate level was further assessed using VAF (variance accounting for), in accordance with the procedure outlined by Hair, Sarstedt, Hopkins and Kuppelwieser (2014). The diagrams of SEM analysis using bootstrapping technique and without using bootstrapping technique are illustrated in Figures 3 and Figure 4 below.

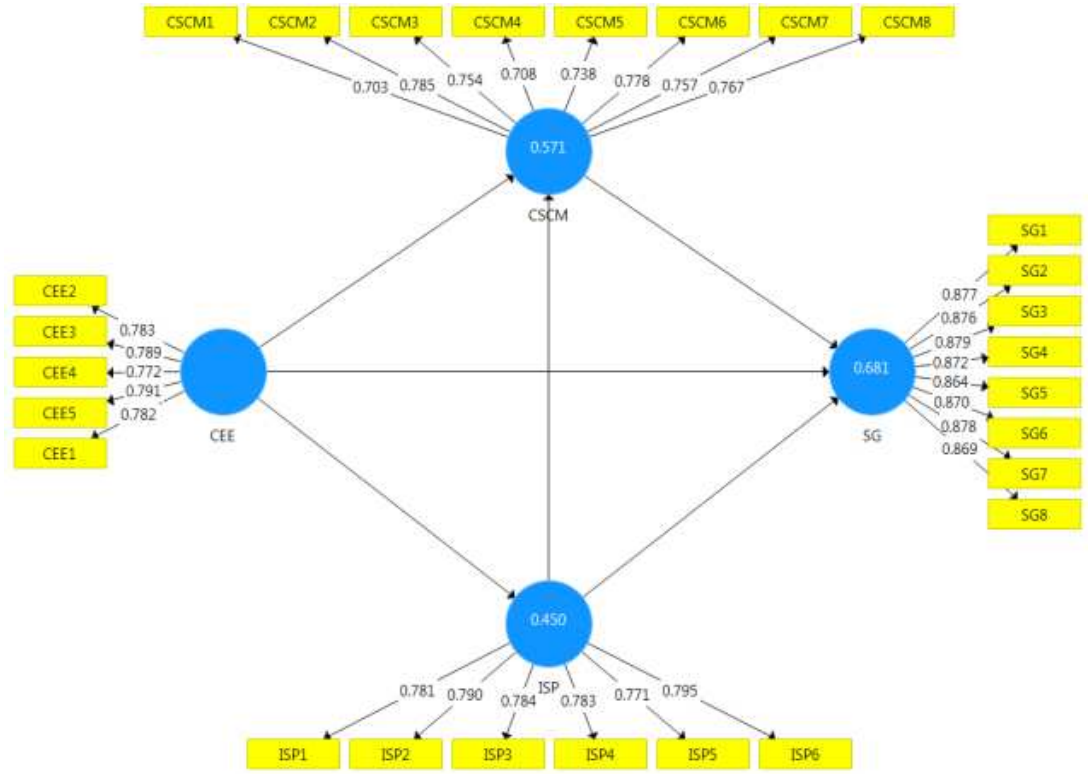

Figure 3. Diagram of SEM analysis without using bootstrapping technique

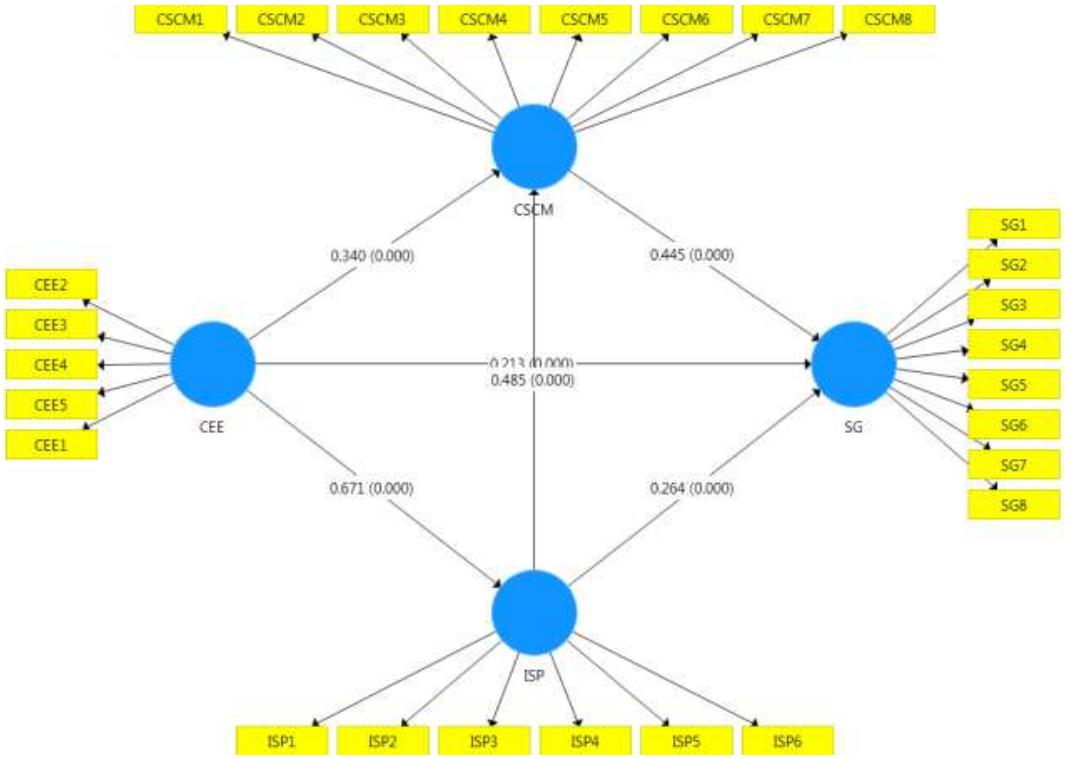

Figure 4. Diagram of SEM analysis using bootstrapping technique

The bootstrapping analysis results are shown in Table 7 below. This show that the research hypotheses are accepted. Specifically, this result supports the statement that CEE positively and

significantly affects ISP (β = 0.671, t = 23.841, p < 0.001). Thus, H1a is accepted. Likewise, ISP positively and significantly affect CSCM (β = 0. 485, t = 11.967, p < 0.001), therefore, H1b is supported. Besides, CEE was found to have a positive and significant relationship with CSCM (β = 0.340, t = 8.018, p < 0.001). Therefore, H1c is confirmed. In addition, H1 is supported (β = 0.326, t = 10.570, p < 0.001, 20% ≤ VAF = 49% ≤ 80%, p < 0.001) asserting that ISP partially mediates the link between CEE and CSCM.

Table 7. Bootstrapping results

Hypothesis	**Paths**	**Coefficient**	**t-statistics**	**p-value**	**CI 2.5%**	**CI 97.5%**	**VAF %**	**Conclusion**
H1a	CEE -> ISP	0.671	23.841	0.000	0.619	0.726	n/a	Supported
H1b	ISP -> CSCM	0.485	11.967	0.000	0.399	0.564	n/a	Supported
H1c	CEE -> CSCM	0.340	0.018	0.000	0.256	0.428	n/a	Supported
H1	CEE -> ISP -> CSCM	0.326	10.570	0.000	0.266	0.385	49	Supported
H2a	ISP -> SG	0.264	5.353	0.000	0.157	0.346	n/a	Supported
H2b	CSCM -> SG	0.445	7.327	0.000	0.335	0.577	n/a	Supported
H2	CEE -> CSCM -> SG	0.151	5.053	0.000	0.101	0.222	42	Supported
H3	CEE -> SG	0.213	4.600	0.000	0.122	0.300	n/a	Supported
H4	CEE -> ISP -> SG	0.177	5.175	0.000	0.103	0.237	37	Supported
H5	CEE -> ISP -> CSCM -> SG	0.145	5.817	0.000	0.102	0.196	41	Supported

Furthermore, H2a is confirmed (β = 0.264, t = 5.353, p < 0.001) supporting the statement that ISP positively and significantly affects SG. Similarly, the results confirm that CSCM has a positive and significant impact on SG (β = 0.445, t = 7.327, p < 0.001). We observed that CSCM partially mediates the link between ISP and SG (β = 0.151, t = 5.053, p < 0.001, 20% ≤ VAF = 42% ≤ 80%, p < 0.001), thus H2 is supported.

Besides, it's also confirmed that CEE has a positive and significant relationship with SG (β = 0.213, t = 4.600, p < 0.001), therefore, H3 is confirmed. The results also show that ISP mediates partially the relationship between CEE and SG (β = 0.177, t = 5.175, p < 0.001, 20% ≤ VAF = 37% ≤ 80%, p < 0.001). Additionally, ISP and CSCM simultaneously play a partial mediation in the relationship between CEE and SG (β = 0.145, t = 5.817, p < 0.001, 20% ≤ VAF = 41% ≤ 80%, p < 0.001). Therefore, H4 and H5 are supported. For intermediate relationships, further assessment was performed using the lower and upper confident intervals. The results show that the values of the confidence interval reinforce our confidence in the significance of the mediating role of ISP and CSCM in the given relationships.

3. Discussion and implications

The main finding of this research is the positive direct and indirect connections we have established between circular economy entrepreneurship, industrial symbiosis practices and circular supply chain management. Their positive interaction positively supports the sustainability performance goals for SMEs in the agri-food sector of an emerging economy. Accordingly, the integration of circular economic principles and entrepreneurial thinking promotes the practice of industrial symbiosis. This is in the form of creating symbiotic networks for waste treatment by firms jointly sharing facilities, water, energy, and resources in general.

In turn, this facilitates the realization of SCM in accordance with CE principles, ultimately leading to the realization of sustainability goals. To the best of our knowledge, empirical studies with respect to this direct association are scarce in the existing literature. Therefore, the findings of this study indirectly support previous studies such as Zhu *et al.* (2019). Through our key finding that entrepreneurship, especially circular economy entrepreneurship plays an important role in promoting the circular economy in emerging economies.

Salomone *et al.* (2020) also notes that ISP is helpful in promoting resource efficiency and minimizing the adverse impact on the environment thereby promoting CE initiatives (Merli *et al*. 2018; Baldassarre *et al*. 2019); Genovese *et al*. (2017); Nasir *et al*. (2017). We confirm that CSCM can lead to positive sustainability performance. Thereby confirming the works of Liu *et al*. (2017); Sun *et al*. (2017) that ISP can help firms improve environmental performance by reducing emissions.

In addition, this study provides support to previous studies of Cullen and De Angelis (2021); Colin David (2020). As we have proven that CEE is about finding and exploiting new opportunities in the circular economy. With a mindset that is not only about doing business and being driven by profit, but also caring and protecting the natural ecosystems and the environment, whilst contributing to building the business ecosystem. The agri-food supply chain, with its unique characteristics make it different from other industries such as its full reliance on natural resources, with the downstream risks being outweighed by the upstream one's and the heavy influence of seasonality on productivity. Besides the factors of weather and pests (Nattassha *et al*., 2020), habitual farming and harvesting practices, knowledge and skills gap are also significantly challenging for supply chain managers.

Especially in emerging economies like Vietnam, where many actors have limited knowledge of the circular economy. This could be due to a lack of interest and reluctance for innovation as they do not have the motivation, or they just have short-term vision. The most challenging issues in the agri-food sector and its supply chain is the existence of by-products which are treated as waste and are immediately discarded as waste disposal (Nattassha *et al*., 2020).

This study contributes to the expansion of previous studies, specifically, Farooque et al. (2022), in the sense that CSCM can help enterprises achieve SG as well as financially related performance metrics. In addition, it advocates the statements of Luthra et al. (2022); Herczeg et al. (2018) that affirms industrial symbiosis and collaboration between partners across sectors are crucial for CSCM implementation (Batista et al., 2018; Mangla et al., 2018).

These factors besides governance, can either promote or hinder CSCM implementation, depending on which circumstances it can trigger. To this extent, it supports the statement of Lahane and Kant (2021) who assert that an entrepreneur's attitude can be a barrier to CSCM implementation. For instance, strategic orientation, support and commitment may hinder the adoption of circular economic practices.

Further, this study confirms the work of Rovanto and Finne (2022) about the potential influence of entrepreneur's attitude on the way in which enterprises approach their circular economy practices. CEE is considered a strategic tool to help businesses explore and exploit entrepreneurial opportunities in the circular economy domain. Adopting circular economy practices through industrial symbiosis accelerates CSCM implementation, which ultimately leads to the achievement of the sustainability goals.

Our work confirms the findings of Chen et al. (2022) about the crucial role of industrial symbiosis in delivering multi-dimensional benefits to increasing the sustainability index of industrial firms. Likewise, this study contributes to Schultz et al. (2021) who asserts that governance mechanisms have a decisive influence on CSCM implementation. In the sense that it entails an entrepreneur's dynamics in promoting collaboration and cooperation inside and outside the firm through strategic alliances.

CEE is characterized by incorporating circular economy philosophies and principles into the entrepreneurial mindset. Hence business activities and practices are made socially, ecologically and

economically responsible. In this sense, it creates a governance mechanism that enables ISP to be the foundation for facilitating CSCM, ultimately leading to SG achievement(De Angelis et al., 2018; Kusi-Sarpong et al., 2021).

Additionally, it supports the statement of Saroha et al. (2021) who asserts that CEE plays a very important role in delivering values through innovative models that integrate circular economy philosophies and practices. We also support the notion of Zhu et al. (2019) by confirming that a circular economy approach is a strategic approach that addresses all the economic, social and ecological benefits towards sustainability. In this respect, entrepreneurship is crucial in building circular businesses. We concur with Farooque et al. (2019) that the incorporation of circular economy practices into SCM depends on the extent to which partners collaborate and cooperate, ultimately, it's down to trust.

a. Theoretical implications

The theoretical implications proposed by this research are as follows. First, this study expands the literature on circular supply chain management. It does this by providing a comprehensive empirical evaluation model on the factors driving the realization of CSCM from the perspective of entrepreneurship. Specifically, circular economy entrepreneurship promotes industrial symbiotic practices that promote circular supply chain management and the achievement of sustainability goals.

In addition, this research contributes to the body of knowledge in the areas of circular entrepreneurship and industrial symbiosis by providing empirical evidence of the association between CEE with ISP. Thereby enabling CSCM to achieve its sustainability goals and targets. We reinforce the novelty of our study, as Turken and Geda (2020) highlighted the need for further research exploring industrial symbiosis in the field of supply chain management. Whilst Lahane and Kant (2021) emphasized that further research is needed on CSCM, especially with respect to the agri-food supply chain.

From the theoretical perspective, this research also contributes by shedding light on the driving forces pushing supply chains towards achieving their sustainability goals. The present research contributes to extending the theory, through providing an empirically proven connection between corporate sustainable practices and sustainability goals in the circular economy domain. This contribution is particularly meaningful as we provide scientific knowledge from small and medium enterprises that is not known in this field.

Finally, this study provides an extension of institutional and stakeholder theory by proving its applicability and validity. The current literature on institutional theory explains why entrepreneurs and enterprises are determined to make changes and innovations (Bhattacharya, 2021). This is in response to the demands for a transition towards a circular economy. As they perceive opportunities from the circular economy, it is important that these opportunities help them not only to grow sustainably for themselves, but they also support all their actors in the supply chain and surrounding eco-system. In addition, stakeholder theory suggests that when business activities and behaviors are performed responsibly and ethically, businesses will receive incentives and (financial and non-financial) support from their stakeholders. This keeps their business operations competitive and will help them to achieve their sustainability goals.

b. Managerial implications

This study provides several managerial implications that business practitioners may be interested in. First, this study suggests that a circular approach based on entrepreneurial thinking to practicing and managing helps them to achieve their sustainability performance goals. Enterprises we suggest should proactively explore and exploit new business opportunities in the circular economy. Further they need to expand and strengthen their industrial symbiotic ecosystem and maintain sustainable entrepreneurship for sustainable development. It is worth emphasizing that enterprises should search for and develop innovative business models to match their circular economic model in the new era. With entrepreneurship playing a central role in these business models

The second managerial implication of this study is the assertion that integrating the circular economy into supply chain management is attainable in the agri-food sector. It is also worth emphasizing that the circular approach from thought to action and management can offer compelling and sustainable benefits. However to achieve this, entrepreneurs are required to put a lot of concerted effort and resources into developing the necessary innovation through their thinking, behaviors, models, systems, processes, technologies, practices and networks.

For SMEs based in emerging economies, especially in the agri-food sector, with limitations in terms of their knowledge of the circular economy and resources, such change requirements must be said at least, to be very challenging. Therefore, it is suggested that enterprises should consider the necessary innovations needed as a prerequisite for making them fit in with their difficult transitions to a circular economy. Accordingly, such necessary innovations should be seen as investments rather than costs. Enterprises then need to be innovating and growing whilst following their sustainability path.

The third managerial implication of this study is the favorable expansion of industrial symbiotic ecosystems in both similar and dissimilar industries. This is, beyond the scope of the supply chain in which they are participating. Enterprises in the network should visualize the flow of materials, flow of resources between businesses in the network to maximize the value creation of resources and reduce the waste of resources in the economy. In a way that radically restores the residual and waste of one productive entity into the inputs of another. Importantly, entities in the symbiosis network can jointly integrate waste treatment systems to optimize their efficiency.

It is also noteworthy that in the agri-food sector in emerging economies, the traditional way of production and distribution presents many challenges in the transition towards a circular economy. The current industrial practice that exists in the supply chain is that by-products are considered waste and are therefore disposed of as waste immediately (Nattassha et al., 2020). Therefore, we recommend that businesses exploit both their closed loop and open loop control systems. Hence the waste from one agri-food entity can be converted into input resources for other agri-entities. For instance, they can become organic fertilizer (Farooque et al., 2019).

4. Conclusion and future scope of research

The findings of this study have addressed the research objective posed and three research questions as outlined in the introduction section. Accordingly, it responds to the first research question. Through outlining the path by which CEE drives ISP to facilitate CSCM for SG. CEE stimulates adopting circular economic philosophies and principles into the culture, strategy and governance mechanisms. To govern business activities and practices in a responsible and ethical manner towards sustainability. This in turn, drives ISP to facilitate CSCM implementation that ultimately results in the achievement of sustainability goals.

In response to the second question. From an organizational perspective, ISP enables companies to understand each other's capabilities and to form strategic alliances based on economic drivers, simultaneously enabling social and environmental responsibility through an emphasis on transparency, shared sociocultural norms, networks, and beliefs. Whilst from an operational perspective, ISP enables the engagement of enterprises in collecting, processing, storage of by-products and distribution of them to other manufacturers. In turn, this facilitates CSCM implementation, leading to improved resource efficiency as well as environmental and social efficiency that ultimately results in achieving SG.

The third research question we address by proposing a novel logic that entrepreneurs should integrate their circular economic philosophies and principles with entrepreneurial thinking. Hence their business operations and practices are made more socially, ecologically and economically responsible. Importantly, their entrepreneurship should align well with surrounding industrial symbiosis patterns and appropriate practices. Thereby facilitating CSCM implementation and faster achievement of SG.

Above all, the main finding of this research can be considered as making a novel contribution to the field of CE and SCM, especially in the agri-food section. Furthermore, this study contributes to narrowing the gap between research and practice in the current literature. It responds to the need for more practical and context-specific research as highlighted by Zhang et al. (2021). Specifically, this research provides a holistic approach for exploring the association of circular entrepreneurship and industrial symbiosis. Our research is designed to applicable to practice and the results should help assist SMEs working in the field of agri-food.

Limitation for future scope of research

This study has some limitations which must be considered in guiding future research investigations. First, this study solely focuses on SMEs. Therefore, future research should consider other organizational forms and provide more results diversity, enabling comparisons to be made. Second, this study approach is purely based on quantitative methods. Future studies may consider mixed-method combinations to triangulate and cross-reference macro and micro-findings together. Also, this would potentially facilitate more robust and time-based data investigations that explores phenomena as it evolves and changes over time. Thereby overcoming the problem of cross-sectional bias that often besets quantitative work. However, access for such a kind of investigation is often too problematic. Third, this study focuses on the context of an emerging economy in Southeast Asia. Each different regional context has its own idiosyncrasies and unique characteristics and, therefore, it is likely to provide differences in the results however minor these may be.

Future investigations therefore may consider researching other developing economies in other regions to enrich the validity of our results. This would also enable detailed international comparisons to be made and stronger, more robust theoretical models to be developed that cross-cut different cultures and international contexts.

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