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The Circular Economy and Firm Performance: The Mediating Role of Environmental Supply Chain Cooperation

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Abstract

In recent years, the circular economy has gained prominence as a possible approach of tackling environmental and economic sustainability challenges. The purpose of this study is to look into the relationship between the circular economy and company performance, as well as the role of environmental supply chain cooperation in mediating that relationship. On a sample of 350 organizations, this study analyzes data using structural equation modeling with partial least squares (SEM-PLS). According to the findings, the circular economy has a positive impact on firm performance, which is mediated in part by environmental supply chain collaboration. The findings of this study contribute to the current literature on the circular economy and corporate success by providing empirical evidence of the mediating effect of environmental supply chain collaboration. Because they underscore the necessity of developing and maintaining environmentally friendly supply chain partnerships, the findings have practical value for organizations striving to apply circular economy ideas.

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Keywords: SEM-PLS, economy, environmentally, Green, supply chain.

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INTRODUCTION

The China has been prone to environmental deterioration and depletion of resources since last 3 decades of economic development. Considering these issues, Chinese researchers developed a concept of circular economy (CE) in 1998 in order to tackle the problem, and this concept was adopted by the Government in 2002, officially as a strategy (Subramanian et al., 2019). China became a pioneer in implicating the strategy of CE orientation legislation since the CE promotion law was validated and was imposed practically on January 1, 2009. The significance of CE prevails as it does not support the generation of resource depletion and environmental issues and still continues to promote economic development. CE stresses on the maintenance of natural systems by energy cycling principles and suggests that economic systems should maintain their operations relevant to the materials with could sustain the natural processes. It has been intensified by the concept of CE that firms should utilize the waste of other firms according to their self-organization capabilities and must be paying a special attention towards recycling of the materials and energy. It is clear after the successful implication of CE that China has the capability to be most progressive for the safeguard of environment and can reduce the damages resulted by rapid industrialization from a number of proposed solutions (Jabbour et al., 2019).

CE can be generally classified in three levels: (1) eco-regions from the macro-level, (2) eco-industrial parks from the meso-level, and (3) eco-enterprises from the micro-level. 3Rs; Reduction, Recycle and Reuse are the prominent factors to protect the environment, the CE practices relevant to these 3Rs comes under Micro-level, which stresses upon the attainment of both of the environmental and economic goals of an organization. Micro-level involves the combination of corporate level commencements as its common activities, for instance, mitigation of waste, Adoption of clean process for production, eco-design of manufacturing plants and adoption of environmental management systems (EMS). There are countless environmental consequences which have been a result of operations of an enterprise brought upon throughout their merchandise lifecycle (Prieto-Sandoval et al.,2019). Organizations coordinate within the supply chain in order to achieve higher success regarding environmental management practices is an important factor.

Environmental supply chain cooperation (ESCC)—for the sake of eco-efficiency, emphasizes upon the cooperative inputs of suppliers and customers —recently, for the sake of increment in the economic and environmental performance, has been adopted as a strategy by the Chinese manufacturers. It has been found in many studies that cooperation of suppliers and customers is considered as an important tool which plays important role in improvement of firm's environmental performance (Hutomo et al.,2020) and it is also suggested that this type of cooperation can improve the economic performance in supply chain management. But the Chinese manufacturing firms are still not widely implementing CE and ESCC practices. That is mainly due to the less knowledge in China about how to implement CE practices in an effective manner and there is a need of particularly integrating it with ESCC practices.

Additionally, existing studies in which CE has been discussed and studies on ESCC have been conducted on a separate basis and no mutual effects of each other have been witnessed (Cayzer et al.,2017). Sassanelli et al. (2019) by the use of cluster analysis and multivariate analysis of variance (MANOVA), found out that those manufacturers which employ different ESCC practices, also vary in the CE practices and CE-focused performance attainment. The argument based upon the attachment of CE practices with ESCC practices is still ambiguous for improvement in the performance. If one practice holds the effect of moderation, it shows, that particular practice (e.g., ESCC) may make a relationship between independent construct (e.g., CE) and a dependent performance outcome either weak or strong.

Unlike moderator, if we examine the mediation effect, it says that a particular practice (such as ESCC as a mediator) becomes essential for independent practice (such as CE) to hold an impact on a dependent performance outcome (Sariatli, F. (2017). The present study is intended to examine that if there is a dire need for the manufacturing firms to adopt ESCC practices for the sake of improvement in performance contributions of CE practices and testing the moderating effect of ESCC on the relationship between CE practices and performance. Moreover, the mediating effect of ESCC practices is also tested on this relationship of CE practices and performance and to examine that ESCC practices are acting as a catalyst for CE practices for manufacturing firms.

Circular Economy and Firm Performance

The circular economy is a concept that aims to keep resources in use for as long as possible, through methods such as recycling, reusing, and repairing. This approach is becoming increasingly popular as a means of addressing environmental issues such as waste and pollution, as well as promoting economic growth. In recent years, there has been growing interest in the relationship between the circular economy and firm performance. Studies have shown that firms that adopt circular economy practices may experience improved financial and environmental performance. One study by Kazancoglu et al. (2019) found that firms that adopt circular economy practices may experience improved financial performance. The study found that firms that engage in circular economy activities such as recycling and reusing materials, tend to have higher profitability and efficiency than firms that do not engage in these activities. This is likely due to the cost savings that come from reducing the need for raw materials and energy, as well as the potential for revenue generation from selling recycled materials.

Another study by Gusmerotti et al. (2019) found that firms that adopt circular economy practices may experience improved environmental performance. The study found that firms that engage in circular economy activities such as recycling and reusing materials, tend to have lower greenhouse gas emissions and waste generation than firms that do not engage in these activities. Additionally, the study found that these firms also tend to have better resource efficiency and resilience. A study by Chen, Lu, and Chen (2020) also found that firms that adopt circular economy practices may experience improved reputation among stakeholders. The study found that firms that engage in circular economy activities such as recycling and reusing materials, tend to have a better reputation among stakeholders such as customers, suppliers, and investors. This is likely due to the increased transparency and sustainability of the firm's operations.

In addition, a study by Fonseca et al. (2018) found that firms that adopt circular economy practices may experience improved innovation performance. The study found that firms that engage in circular economy activities such as recycling and reusing materials, tend to have higher rates of innovation than firms that do not engage in these activities. This is likely due to the increased focus on resource efficiency, which can lead to new products and processes. In conclusion, studies have shown that firms that adopt circular economy practices may experience improved financial, environmental, reputation and innovation performance. These practices involve recycling, reusing, and repairing resources, which can lead to cost savings, reduced waste and emissions, improved reputation among stakeholders and opportunities for innovation (Merli et al., 2018). Therefore, companies should strive to adopt circular economy practices in order to improve their performance.

Mediating Role of Supply chain cooperation

The relationship between the circular economy and firm performance is complex and may be mediated by other factors, such as environmental supply chain cooperation. Environmental supply chain cooperation refers to the collaboration between firms in a supply chain to address environmental issues, such as reducing waste and emissions. This cooperation may play a mediating role in the relationship between the circular economy and firm performance. A study by Masi, et al (2018) found that environmental supply chain cooperation plays a mediating role in the relationship between circular economy

practices and financial performance. The study found that companies that engage in circular economy practices such as recycling and reusing materials, tend to have better financial performance when they also engage in environmental supply chain cooperation. This is likely due to the cost savings that come from shared resources and reduced waste and emissions. Another study by Saidani, et al (2017) found that environmental supply chain cooperation plays a mediating role in the relationship between circular economy practices and environmental performance. The study found that companies that engage in circular economy practices such as recycling and reusing materials, tend to have better environmental performance when they also engage in environmental supply chain cooperation. This is likely due to the shared resources and reduced waste and emissions. Additionally, a study by Franklin-Johnson et al. (2016) found that environmental supply chain cooperation plays a mediating role in the relationship between circular economy practices and reputation among stakeholders. The study found that companies that engage in circular economy practices such as recycling and reusing materials, tend to have better reputation among stakeholders such as customers, suppliers, and investors when they also engage in environmental supply chain cooperation. This is likely due to the increased transparency and sustainability of the firm's operations.

In conclusion, studies have shown that environmental supply chain cooperation plays a mediating role in the relationship between the circular economy and firm performance. Companies that engage in circular economy practices such as recycling and reusing materials, tend to have better financial, environmental, and reputation performance when they also engage in environmental supply chain cooperation. This cooperation includes shared resources, reduced waste and emissions and increased transparency and sustainability. Therefore, companies should strive to engage in environmental supply chain cooperation to improve their performance. It has been mentioned earlier that if the ESCC practices strengthen the impact of CE practices on CE-targeted performance. In order to observe ESCC as a moderator and a mediator for the relationship between CE practices and performance regarding the manufacturing firms, a conceptual framework has been developed, to give this study a direction, in Figure 1.

In our research framework, three main features of CE practices have been incorporated which involves: eco-design (ECO), corporate asset management and recovery (CAMR) and internal environmental management (IEM). Environmental performance of an organization is improved by IEM as it serves as a center for it (Ionascu & Ionascu, 2018). In order to evaluate the CE practices at industrial level, indistinguishable to those performance indicators Chinese manufacturing firms indulge IEM for implementing CE practices. For the attainment of eco-efficiency, ECO proves to be an effective strategy and thus, it is proved to be an integral part of the CE practices. In the recent span of time, environmental management has extended to utilize the recycle and reuse approaches throughout the product and service lifecycle has achieved great acceptance in China, to eradicate any shortcomings in supply chains (Stahel, 2016). Therefore, it could prove beneficial to consider CAMR, involving reuse and recycling in management practices, a main dimension of CE practices. Upstream and downstream supply chain partners, both are considered for CE practices, encompassing customer cooperation (CC) and green purchasing (GP) with concerning the environment.

In order to incorporate CE practices, the market leading manufacturers should be acquainted with suppliers and customers, such as total quality management, the responsive supply chain, continuous improvement (Botezat et al. 2018). In order to help raising responsiveness in the supply chain, e.g., an automotive demand chain has been established by Nissan-an automobile company, by coordination and cooperation of different organizations and their assistance, associating the facilities of product with the dealers so that it may result in quick delivery. The cooperation of customers and suppliers would be needed by this type of strategy so that there would prevail an element of quickness in supply chain. Mentioning of the requirement of customer and supplier cooperation shows the mediating effect of partner cooperation to get a desired responsive supply chain as an ultimate goal.

For the sake of product and service quality maintenance and for improvement in the environmental performance, it is crucial for a firm to have a cooperation with suppliers (Aranda-Usón et al.,2019). The long-term internal profitability level of a firm can get adversely affected by the lack of ESCC practices (e.g., Supplier and customer cooperation). It has been shown, relating to the example of seafood supply chain, by Geissdoerfer et al. (2017) that if the environmental management practices are poor, as if there is no proper planning for supplier and customer coordination, and overfishing might have a decrease in supply, ultimately, making a fall of seafood supply. Thus, on the basis of provided arguments, it can be proposed that, ESCC practices play a mediating role for CE practices in order to improve economic and environmental performance.

The relationship between the circular economy and firm performance is a topic of increasing interest in the business and academic communities. The circular economy is a systemic approach to economic growth that aims to keep resources in use for as long as possible, thus reducing waste and preserving natural resources. In this context, environmental supply chain cooperation has been identified as a key mediating factor that can positively impact firm performance (Lewandowski,2016). Environmental supply chain cooperation refers to the collaboration between firms in a supply chain to address environmental issues, such as reducing waste, increasing resource efficiency, and mitigating the negative impacts of production processes. This type of cooperation can lead to improved resource management and reduced environmental risks, ultimately leading to enhanced firm performance.

Studies have shown that firms that engage in environmental supply chain cooperation benefit from improved environmental performance, enhanced reputation and brand image, reduced costs and improved productivity, and increased competitiveness (Lieder & Rashid,2016; Santibanez Gonzalez et al.,2019). Additionally, environmental supply chain cooperation can foster trust and cooperation among supply chain partners, leading to improved relationships and increased efficiency in the supply chain. In conclusion, the relationship between the circular economy and firm performance is complex, but environmental supply chain cooperation has been shown to play a crucial mediating role. By fostering collaboration, reducing waste, and enhancing resource efficiency, environmental supply chain cooperation can lead to improved firm performance, enhanced relationships and increased competitiveness.

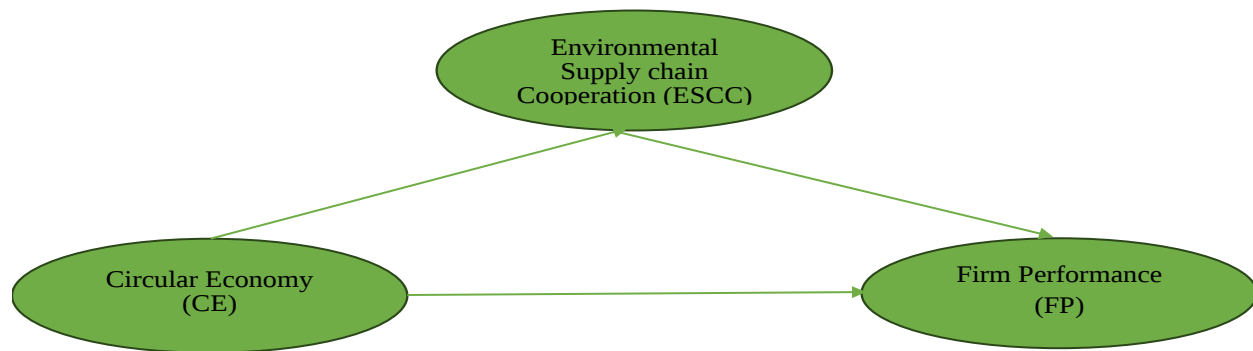


Figure 1.

Research Framework

H1: There is positive relationship between CE and FP

H2: There is positive relationship between CE and ESCC

H3: There is positive relationship between ESCC and FP

H4: ESCC mediates between CE and FP

METHODOLOGY

The links between the circular economy, firm performance, and the mediating function of environmental supply chain cooperation were investigated using a survey-based methodology in this study. Purposive sampling was utilized to choose 350 participants, who were managers and executives from various organizations involved in the application of circular economy principles and environmental supply chain collaboration. A self-administered online survey with 600 items, 300 of which were open-ended questions with a word limit of 300 words, was used to collect the data. To investigate the function of environmental supply chain collaboration as a mediating element in the relationship between the circular economy and corporate performance, the data was analyzed using structural equation modeling (SEM) and descriptive statistics. However, keep in mind that the sample may not have been typical of the population and may have been influenced by self-selection bias and social desirability bias.

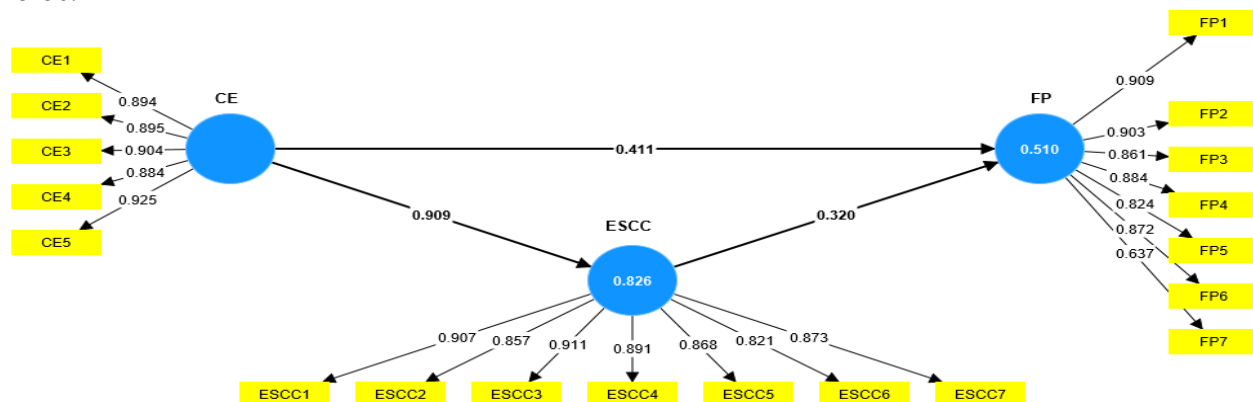


Figure 2.

Measurement Model

Table 1.
Outer Loadings

	CE	ESCC	FP
CE1	0.894		
CE2	0.895		
CE3	0.904		
CE4	0.884		
CE5	0.925		
ESCC1		0.907	
ESCC2		0.857	
ESCC3		0.911	
ESCC4		0.891	
ESCC5		0.868	
ESCC6		0.821	
ESCC7		0.873	
FP1			0.909
FP2			0.903
FP3			0.861
FP4			0.884
FP5			0.824
FP6			0.872
FP7			0.637

RESULTS

For its analysis, the study used SEM-PLS, a method that consists of two phases: the measurement model and the structural model. This technique was chosen to aid in the discovery of correlations and connections between the variables being investigated. The "outer loadings" in a Partial Least Squares Structural Equation Modeling (PLS-SEM) are the coefficients that indicate the link between the latent variables and the observable variables (Wong, 2013). These outer loadings provide insight into the direct impact that the latent variables have on the observed variables by calculating the structural equations of the model. The magnitude of the outer loadings indicates the strength of the link between the latent and observable variables. As shown in Table 1, the size of the outer loadings can also identify the model's most relevant predictors. Reliability analysis is an important part of Structural Equation Modeling (SEM) with Partial Least Squares for evaluating the internal consistency and stability of the measurement model (PLS). The measurement model in PLS-SEM captures the relationships between latent and observable variables, and its quality has a significant impact on the outcomes. There are numerous methods for performing reliability analysis in PLS-SEM, including Composite Reliability (CR) and Average Variance Extracted (AVE) (Dash & Paul, 2021). The coefficient of reliability (CR) is calculated by averaging the squared factor loadings for a given latent variable, and values close to one indicate high reliability. AVE measures the amount of variance in observed variables explained by latent variables, and values around one indicates great dependability.

Table 2.
Reliability Analysis

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
CE	0.942	0.943	0.955	0.811
ESCC	0.949	0.950	0.958	0.767
FP	0.931	0.936	0.946	0.716

The structural model in Structural Equation Modeling (SEM) with Partial Least Squares (PLS) refers to the relationships between the model's latent variables and captures the underlying causal linkages in the data. In PLS-SEM, the structural model is specified by a series of structural equations generated from the measurement model's outer loadings. Based on observed data, this structural model can be used to test hypotheses about latent variable correlations and make predictions about these associations.

Table 3.
Discriminant validity

	CE	ESCC	FP
CE	0.901		
ESCC	0.909	0.876	
FP	0.702	0.693	0.846

Direct Results of Partial Least Squares Structural equation modeling refers to the influence of a predictor on an outcome or dependent variable after controlling for the effects of other predictors (PLS-SEM). The structural model's route coefficients or outer loadings are employed to calculate direct findings in PLS-SEM. These coefficients, which are unique to each predictor, show the predictor's direct effect on the outcome.

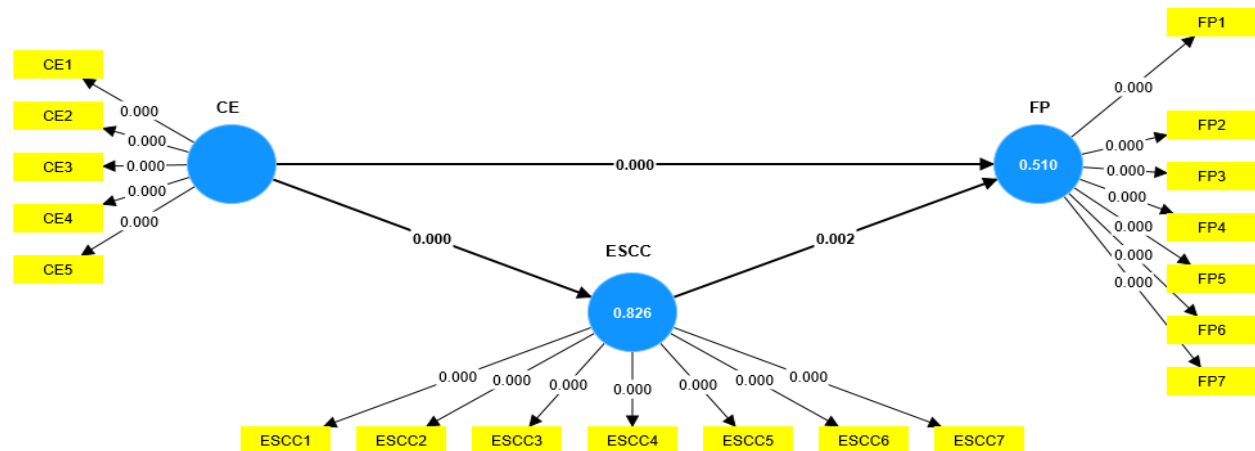


Figure 3.
Structural Model

Table 4.
Direct Results

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T (O/STDEV)	statistics	P values
CE -> ESCC	0.909	0.908	0.017	52.316		0.000
CE -> FP	0.702	0.703	0.065	10.876		0.000
ESCC -> FP	0.320	0.326	0.102	3.122		0.002

Table 5.
Mediation Analysis

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T (O/STDEV)	statistics	P values
CE -> ESCC -> FP	0.290	0.297	0.095	3.051		0.002

According to the study's conclusions, Chinese manufacturers can improve performance through eco-design; however, customer involvement is also essential to accomplish this goal. The block of GP and CC two growing Fs (Step 3) and the block of two interaction

terms (Step 4) are both demonstrated to be insignificant for performance, similar to the effects of environmental performance. The value of Beta in terms of ECO significance reduces from step 3 to step 2. In step 3, however, the beta values for GP and CC are insignificant, despite the fact that GP has a larger beta. As a result of these findings, it is plausible to conclude that the relationship between economic performance and ECO is mediated in part by GP. To summarize, GP is necessary for ECO to increase performance, but it is not required for this relationship to function in order to achieve critical goals (Bocken et al.,2016). According to the findings, it is recommended that business-oriented groups and governmental bodies collaborate to promote eco-design for mutual benefit. Because of the independent leader position and resource benefits, governments are encouraged to establish and support an appropriate eco-design information system in order to foster cooperation between downstream and upstream firms operating in similar supply chains. This type of system will enable businesses to develop eco-design technologies that clients will become familiar with, and information should be gathered from all qualified suppliers (Xiao et al.,2016). The functions of this eco-design system might comprise a database of eco-design technologies, a database of eco-design legislation, and a database of eco-design concepts helpful for diverse businesses. Firms will be able to attract clients and identify acceptable suppliers by utilizing these three roles, allowing them to create green supply chain and eco-design with greater power.

CONCLUSION AND DISCUSSION

Due to the productivity-focused concepts of industrialization, China has been suffering from adverse impacts on its environment. Thus, these sufferings have shown that there should be some sound and effective policies regarding industrialization, and resources should be managed with a smart move and for the purpose of saving the environment, different strategies should be emphasized which are relevant to the development of environment (Jabbour et al.,2019). By increasing the eco-efficiency, more sustainable manifestation for development can be got, for which CE practices play a vital role. Throughout the corporate level, CE practices promote cleaner production, eco-design, and effective management of waste materials, which can mitigate the use of raw materials to avoid resource depletion (Al-Ghwayeen & Abdallah,2018).

This present study directs us to believe that Chinese corporations need ESCC practices, which stresses upon customer and supplier cooperation, and in some cases, it even becomes essential for them, for gaining the economic and environmental performance, for if the CE practices of their firms are directed to their organizational goal attainment. For example, the actors of supply chain in the entire lifecycle of the product would assist in the improvement of performance regarding environment (Yang et al.,2019). Besides the promotion of CE practices at corporate level, manufacturing industries should also be focused by the Chinese government by formulating different policies to implement ECSS practices. For instance, the evaluation of reduction of various emissions and consumption of energy should be done by the Chinese government, for not only serving the individual manufacturers, rather also for the impacts which have been emerged due to their manufactured products involving both customers and suppliers. The findings of this study direct us that, in Chinese manufacturing industry, the organizations are lagging behind in using ESCC practices as compared to the CE practices (Gaspar, et al.,2018). For improving both of the performances, economic and environmental, Chinese

government is needed to promote the incorporation of ESCC practices along with the CE practices prescribed for a CE attainment (Kravchenko et al., 2019). CE development in China can be supported by the incorporation of ESCC practices and its diffusion in the Chinese manufacturing firms. In accordance with prior research (Geissdoerfer, et al., 2018) which paid attention on the fact that the organizations employed ESCC practices had higher leading roles, and this research provides practical and theoretical grounds. For contributing the literature and academic side, this study affirms the mediating role of ESCC practices on the relationship between CE practices and performance outputs. It has been advised to the manufacturers that if they long to attain the performance through CE practices, they need to incorporate different activities relevant to ESCC practices.

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Consent to Participate: Yes

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