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Ambidextrous Leadership Initiative Propelling the Circular Economy: The Moderating Role of SME Entrepreneur Orientation

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Abstract

The current study aimed to investigate how the strategic approach of Small and Medium-sized Enterprises (SME) entrepreneurship innovation moderates the relationship between ambidextrous opening and closing behaviour and the adoption of three different circular practices. This study used a sample of 267 manufacturing SMEs in Nigeria. Through PLS-SEM structural equation modelling, it was discovered that only two of the three categories of circular economy (CE) practices are moderated by SME entrepreneurship innovation, despite opening leadership and closing leadership behaviour being positively connected to all three. This unique perspective adds to the body of CE literature, arguing that SME entrepreneurship innovation promotes the adoption of CE practices. In the context of Nigerian manufacturing SMEs, a differentiated perspective of adopting CE practices is also provided.

***Keywords*:** ambidextrous, circular economy (CE), closing leadership, opening leadership, resource-based, small and medium-sized enterprises (SME) entrepreneur, sustainable development

Introduction

The Resource-based View (RBV) framework lays the theoretical foundation for this study. Barney (2001) asserts that businesses use unique and valuable resources that are also challenging for rivals to imitate, gain, and preserve a competitive edge. According to Perotti et al. (2024), the circular economy (CE) framework recognises that organisational characteristics related to sustainability, such as eco-innovation techniques, leadership adaptability mechanisms, and a corporate sustainability culture, serve as strategic business assets. By turning waste into useful resources, the CE proposes an economic framework to replace traditional linear

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systems (Boakye et al., 2025). Large corporations are the first to implement CE principles, however, small and medium-sized enterprises (SMEs) are essential. This is because they launch numerous companies globally and develop cutting-edge products for the market (Chabowski et al., 2023). Due to their low cash, poor infrastructure, and short-term planning perspective, SMEs face several obstacles while adopting CE including poor financial support (Farrukh et al., 2024). By analysing the leadership trait of ambidextrous behaviour, which entails switching between exploratory and exploitative tactics, the study assessed how Nigerian manufacturing SMES apply CE.

To illustrate how employee attitude and innovation potential affect the efficacy of ambidextrous leadership, SME entrepreneurship innovation was selected as the primary moderating mechanism in the current study. According to Rehman (2025) and Li and Shafait (2025), limited research is available on the internal organisational characteristics that facilitate or impede the adoption of CE in emerging economies, such as Nigeria. To better understand the internal leadership skills and entrepreneurial mindset as crucial success factors for SME businesses' adoption of circular innovation, this study employed the RBV theory.

The transition to a CE is a pressing global issue, particularly as the current linear 'take-make-waste' paradigm is linked to significant environmental damage (Kazancoglu et al., 2021). In this restorative system, resource consumption and waste are reduced by continuously looping materials. Firms, especially SMEs, play a pivotal role in this transition as they need to restructure their operations in order to align with circular principles fundamentally (Koohmishi et al., 2025). Therefore, the current research is significant as it investigated the role of SME entrepreneurship innovation in this crucial transition. CE presents significant difficulties in adapting and evolving business models because it necessitates economic systems' restoration, regeneration, and disruption (Kakar et al., 2025). Achieving a high degree of sustainable development through the CE necessitates practical actions, behaviours, and investments from the public and commercial sectors (Gagnon et al., 2022). SMEs, which comprise most of the companies in the private sector globally, offer the most significant opportunity for the transition to CE and greener production. However, financial and organisational hurdles may constrain SMEs' involvement including size and lack of financial, human, or technological resources

(Cramer, 2022). Although, adopting sustainable practices has beneficial externalities, these benefits are unpredictable and long-term, rendering it more difficult for SMEs to make the necessary expenditures (Sohal & De Vass, 2022). Manufacturing SMEs typically are less engaged in sustainability management even though major multinational businesses have begun implementing it (Ilić et al., 2022). The Carbon Majors Report 2017 indicates that 25 corporate and state-owned producing enterprises are accountable for 51% of the world's industrial Green House Emissions (GHG) (Vela et al., 2022). This information was collected using a database of publicly available emissions' figures. SMEs in the United Kingdom (UK) are reported to generate 44% of non-household GHG, while 90% are financially constrained to embark on an improved greener business environment (Sage, 2022). Worldwide, SMEs are essential economic players since they account for almost 90% of enterprises, 99.8% of non-financial businesses in Europe, and 99% of all companies in Mexico (Pavan et al., 2022). SMEs employ 66.6% of the workforce in Europe and generate 60% of the region's total manufacturing and service revenue (Hailemariam & Erdiaw-Kwasie, 2023). In the UK, SMEs generate 52% of employment and 50% of the value-added Gross Domestic Product (GDP) (Sage, 2022). Similarly, they generate more than half of Mexico's GDP and work close to 89% of the country's economically active population (Herrador et al., 2022). To properly facilitate their move towards sustainability, it is crucial to consider their qualities and circumstances. Exploratory innovation behaviours involve increasing employee behaviour variance through experimentation, autonomy, and trial-and-error learning. In contrast, exploitative innovation behaviours involve reducing employee behaviour variance through routine maintenance, refinement, and standardisation based on the knowledge that the ideal way to think of exploitative and explorative innovation behaviours is as complementary influences on one another (Wongvatana et al., 2025).

The idea of ambidextrous leadership also leaves open questions about how managers should handle moving between Open leadership Behaviour (OLB) and Close Leadership behaviour (CLB). However, no study has specifically addressed the organisational perspective of the corporate transition to a CE. Therefore, this puzzle is still not understood. Ultimately, manufacturing SME owners/managers are displaced due to their emphasis on traditional business methods (Christensen & Karlsson, 2019). The study examined the impact of ambidextrous opening and closing behaviour on

circular economic practice and SME entrepreneur innovation as moderators.

Literature Review

The literature analysis indicates a scarcity of research on the necessary resources and capabilities for SMEs and the significance of ambidextrous opening and closing leadership behaviours for manufacturing SMEs involved in CE initiatives. De Martino et al. (2024) examined the business models of firms driven by CE, whereas Dey et al. (2020) emphasised the resources and competencies that SMEs require to enhance their sustainability performance. Both of these studies did not primarily examine the value provision to customers, nor did they take into account the potential to boost value through ambidextrous opening and closing leadership actions. Stekelorum et al. (2021) analysed circular strategies from a big data perspective, however, did not specifically consider the role of manufacturing SMEs in promoting CE practices.

Resource-based View (RBV)

The RBV describes how resources assist a business to obtain and maintain a competitive edge. When a company gathers resources in a certain way, they are more tightly linked to competitive advantage and are difficult to be replaced or copied (Barney, 2001). Resources are assets unique to a company and are challenging to replicate (Teece et al., 1997). Relational capability may increase the resources of alliance partners to establish, extend, or adjust their resource bases, while knowledge enables dynamic organisational learning in organisations for the natural environment. CE business models need access to reusable and recyclable materials and goods and the ability to acquire trash as resources in order to create circular processes and products (Centobelli et al., 2020; Prieto-Sandoval et al., 2019). Design and creativity are essential to developing innovative, competitive circular products or services (Prieto-Sandoval et al., 2019).

Ambidextrous Leadership and Circular Economy (CE)

Although, CE is a developing strategy, moving in that direction frequently encounters these obstacles due to the stakeholders' lack of perspective, as discovered in Spain (Martínez-Falcó et al., 2024). By separating economic development from resource exhaustion and using the concepts of regeneration, recycling, and reuse, the CE has emerged as a game-changing option for global sustainability (Cai et al., 2024). By

achieving this balance, leadership techniques that demand dual functionality between process improvement (exploitation) and the creation of new systems (exploration) acquire value (ambidexterity) (Rosing et al., 2011). This is because researchers have not properly examined how ambidextrous leadership fosters organisational agility necessary for CE implementation, there is still a dearth of research on the crucial role that leadership plays during the shift to CE. By examining the current research links and evidence gaps for further study, this analysis focused on ambidextrous leadership combined with CE. This is because leaders must connect long-term innovation projects with operational efficiency requirements, ambidextrous leadership is crucial in sustainability contexts. As Trieu et al. (2024) demonstrates, organisational ambidexterity transforms into a competitive advantage in dynamic circumstances by facilitating leadership. Ambidextrous leaders allow teams to do eco-innovations in addition to maintaining operational efficiency (Silva et al., 2022). According to Khan et al. (2023), ambidextrous leadership in manufacturing firms enhances the development of green products by encouraging innovative settings that adhere to rigorous execution procedures. The study only looks at environmental sustainability; it does not determines all of the CE standards, such as supply chain loops and product lifespan growth. Hence:

H1: Opening leadership behaviour is significantly related to internal environmental management in the CE context.

H2: Opening leadership behaviour is significantly related to internal corporate asset management in the CE context.

H3: Opening leadership behaviour is significantly related to internal eco-design in the CE context.

H4: Closing leadership behaviour is significantly related to internal environmental management in the CE context.

H5: Closing leadership behaviour is significantly related to internal corporate asset management in the CE context.

H6: Closing leadership is significantly related to internal eco-design in the CE context.

SME Innovation Capability as a Moderator

The existing literature frequently expresses the moderating effect of SME entrepreneur innovation (Kibisu & Awino, 2017). SMEs adopt the CE to achieve sustainability since this framework promotes efficient resource management and waste reduction by using circular systems (Geissdoerfer et al., 2017). SMEs face multiple barriers when implementing the CE because organisational inertia joins resource limitations (de Jesus et al., 2023). Organisations led by ambidextrous leaders could manage operational efficiency and exploratory innovation (Rosing et al., 2011) which benefits their adoption of CE. Studies remain unclear about the factors that determine SME innovation capabilities to affect this connection. The review combines existing studies to analyse how SME innovation ability affects the relationship between ambidextrous leadership and CE outcomes. Leadership ambidexterity becomes vital for SMEs under CE reforms since they need to establish new business models (such as product-as-a-service) with their existing process optimisation (recycling) programs (Silva et al., 2022). Ambidextrous leadership styles allow employees to try CE practices within work environments that maintain operational stability, according to Khan et al. (2023). García-Muiña et al. (2021) documented that Spanish textile SMEs that used ambidextrous leadership achieved higher resource productivity levels through major digital product passport updates and minimal material recovery advancements. SMEs often lack enough structure to execute multiple strategic approaches; thus, contextual moderators, such as innovation capability should be considered.

Most of the available research fails to address SMEs' distinctive challenges and instead focuses on large businesses. The limitation of SMEs to secure finance and expertise raises the need for leaders who can adjust between exploration and exploitation, according to Adams et al. (2023). The current research on ambidextrous leadership fails to supply empirical evidence in SME-CE contexts while showing exaggerated optimism and neglecting sectoral and geographical inequalities (de Jesus et al., 2023). SMEs gain success in CE through innovation capability, which represents their capacity to develop innovative thoughts and integrate them into their operations (Rosca et al., 2020). Strong innovation capabilities among SMEs enable them to use the resources freed from standard compliance implementation for digital supply chain tracking and product dismantling (Bocken et al., 2022). According to the study of Italian SMEs conducted by

Ghisetti et al. (2023), high research and development companies succeed by implementing ambidextrous leadership to experiment with remanufactured goods. In some situations, innovation capability creates negative moderating influences on businesses. The wrong alignment between innovation strategies puts SMEs at risk of financial troubles when they spend heavily on exploratory CE projects, such as bio-based materials, which diminishes their core operational efficiency (Kirchherr et al., 2023). The conflicting needs of short-term business success and long-term sustainability require matched alignments of ambidextrous leadership and innovation capability. Research shows that innovation capability is a theoretical base for deploying dual strategies, enhancing ambidextrous leadership's impact on CE. Strong innovation systems in SMEs enhance their ability to apply leadership visions into CE practices through processes, such as circular design implementation in product development, according to Lüdeke-Freund et al. (2019). A study of Kenyan SMEs showed that CE goals from leaders failed since stakeholders opposed changes and leaders needed more technical skills, according to Ngugi et al. (2023).

A lack of evidence exists about the interaction dynamics of these variables. Most of the scholarly research analyses innovation capability as an individual determinant rather than a moderating factor for CE (Bocken et al., 2022). Silva and Fontana (2023) analysed 150 European SMEs to show that innovation capability increased the connection between CE performance and ambidextrous leadership, specifically when regulatory pressure is high (for instance, in the plastic industry). Limitations from the cross-sectional study design prevent the determination of cause-and-effect relationships because the analysis also misses emerging economy SME environments that differ from European ones.

On this account, the study proposed the following hypotheses:

H7: SME entrepreneurship innovation would moderate the relationship between open leadership behaviour and CE internal environmental management.

H8: SME entrepreneurship innovation would moderate the relationship between open leadership behaviour and CE practising internal corporate asset management.

H9: SME entrepreneurship innovation would moderate the relationship between open leadership behaviour and CE practice internal eco-design.

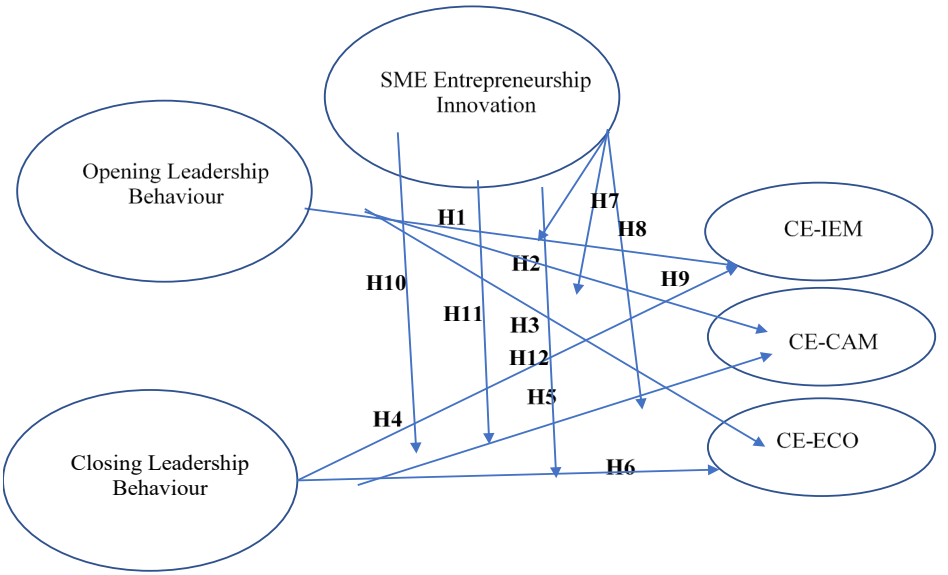
H10: SME entrepreneurship innovation would moderate the relationship between closing leadership behaviour and CE practice internal environmental management.

H11: SME entrepreneurship innovation would moderate the relationship between closing leadership behaviour and CE practice internal corporate asset management.

H12: SME entrepreneurship innovation would moderate the relationship between closing leadership behaviour and CE practice internal eco-design.

Figure 1

Research Study Model



Methodology

Measurement of Variables

A quantitative survey employing a standardised questionnaire with a Likert scale of 1 to 5 was utilised in the current study. The items were adapted and modified from those of other studies to ensure content validity. The dependent variables were assessed using first-order constructs: corporate asset management and recovery, internal environmental management, and eco-design. These constructs were referred to collectively as the CE practices adopted (Zhu et al., 2010). Internal environmental

management was characterised by a Cronbach's alpha coefficient of 0.91, while eco-design was assessed at a Cronbach's alpha coefficient of 0.75. Like that of Zhu et al. (2010), it was requested that participants classify the implementation status of various aspects within their organisation as first-order constructs (1 = *strongly disagree*; 7 = *strongly agree*).

For the opening and closing behaviours measurement, the employees rated their team leaders on a 5-scale rating developed by Zacher et al. (2016) and the variable was measured with an eleven (7)-item scale for opening behaviour and (6) items for closing behaviour. To develop a specific measurement scale for SME entrepreneurship innovation, the study adapted previously validated scales by Hyvönen et al. (2004) and Camisón and Villar López (2010), the variable was measured with an eleven (11)-item scale.

Data Collection and Determination of Sample Size

The current study focused on the population of Nigeria's manufacturing SMEs. The sample comprised 15,538 individuals holding managerial or ownership positions in SMEs that are officially registered and operated in the North-Central region of Nigeria. This region includes the states of Benue, Kogi, Kwara, Nasarawa, Niger, Plateau, and the Federal Capital Territory (FCT), Abuja. These SMEs are engaged in the sectors of manufacturing, pharmaceuticals, and communication. The study gathered information on the demographics of the respondents and their business backgrounds. The survey questionnaire was shared among a randomly selected group of participants (Kelley et al., 2003). Based on data from the Small and Medium Enterprises Development Agency of Nigeria (SMEDAN) and the National Bureau of Statistics (NBS), Table 1 shows that the population for this study consisted of 15,538 registered SMEs within the North-Central region of Nigeria (National Bureau of Statistic & SMEDAN, 2007). A sample size of 384 was determined from a population of 15,538 (Krejcie & Morgan, 1970). A total of 267 questionnaires were returned out of the 384 distributed, resulting in a response rate of 69.5%. To validate the data for the analysis, the researchers performed relevant tests to eliminate any errors or inconsistencies in the data.

Table 1
Population of the Study

S/N	State	No. of Registered SMEs
1	Benue State	1,869
2	Kogi State	1,350
3	Kwara State	562
4	Nasarawa State	1,792
5	Niger State	2,173
6	Plateau State	4,304
7	FCT	2,173
	Total	15,538

Note. Source. National Bureau of Statistics and SMEDAN (2017)

Statistical Tool for Analysis of the Results

The research model was analysed utilising the partial least squares (PLS) structural equation modelling (SEM) method in SmartPLS Version 3.0. The primary rationale for this decision was the exploratory nature of the current work (Hair et al., 2011). Importantly, the current study's data analysis process aligns with the proposal made by Hair et al. (2017), consisting of two distinct stages. The model was quantitatively assessed in the first stage, while in the second stage, the interconnections between the underlying constructs were analysed. Before assessing the structural relationships of the model, this approach was employed to scrutinise the validity and reliability of the constructs. To ensure its model robustness, SmartPLS version 3.3.3 was utilised (Henseler et al., 2015). By initially evaluating the measurement model for item reliability, the model was tested in two steps.

Demographic profiles of the survey respondents were generated by considering their gender, age, educational background, marital status, ethnicity, and current employment. Table 2 displays the demographic details of the respondents. The gender distribution of participants revealed that 206 of them, or 76%, were men, while the remaining 65 participants, or 24%, were women. Similar gender distributions may be found in Nigeria's overall population, where men significantly outnumber women. Regarding the age distribution of the participants, approximately 59 of the sample, or 21.8%, were less than 25 years of age. A further 104 participants,

or 38.4%, were between the ages of 26 and 35. Additionally, 76 (28.0%) of the participants were between the ages of 36-45, and 32 (11.8%) said they were between the ages of 46 and 50. Regarding education level, 60 (22.1%) of the participants had a secondary school certificate, while 68 (or 25.1%) had a national diploma. About 95 of the participants, or 35.1%, stated that they have a bachelor's degree or its equivalent, while the others represented 48, or 17.7% of the participants.

Additionally, 173 of the participants or 63.8% of them represented business owners with 98 or 36.2% being the managers of manufacturing SME businesses. This is because owners and managers are better positioned to contribute critical information about their businesses, the high percentage of owners in the sample supports the accuracy of the data in the filled and returned questionnaires. Furthermore, the data in the table indicated that 161 (or 59.4%) of the enterprises that took part in the study had less than 50 employees. A mere 34 of the participating firms, or 12.5%, reported having between 100 and 249 employees, while approximately 63 (or 63%) reported having between 50 and 99 employees. Thirteen of the participating firms, or 4.8%, had a workforce ranging from 250 to 499 individuals.

In terms of industry, Table 2 indicates that 162 or 59.8% of the participating firms were operating in the food and beverages industry. Relatedly, 61 (22.5%) of the participating firms were operating in the packaging/containers industry and 32 (11.8%) were operating in the metal and metal products industry. Additionally, 14 or 5.2% of the firms were operating in the printing and publishing industry. Only two (about .7%) of the respondents were captured in the building materials section. Regarding business experience, 66 firms (24.4%) had less than 3 years of experience, while those with 3-6 years of experience were 26, constituting 9.6%. Firms with 7-9 years of experience were 51, representing 18.8%. Those with 10-12 years of experience were 49, representing 18.1%. Finally, those with 13 years or more of experience were total 79, representing 29.2%.

Table 2

Respondents' Demographics

Item	Frequency	Percentage (%)
Gender		
Male	206	76.0
Female	65	24.0

Item	Frequency	Percentage (%)
Age		
Less than 25	59	21.8
26-35	104	38.4
36-45	76	28.0
46-55	32	11.8
Qualification		
SSCE	60	22.1
ND/NCE	68	25.1
B.Sc./HND	95	35.1
Others	48	17.7
Position		
Owner	173	63.8
Manager	98	36.2
No of Employees		
Less than 50 employees	161	59.4
50-99 employees	63	23.2
100-249 employees	34	12.5
250-499 employees	13	4.8
Industry		
Food and beverages	162	59.8
Packaging/containers	61	22.5
Metal and metal products	32	11.8
Printing and Publishing	14	5.2
Building materials	2	.7
Business Experience		
Less Than 3 years	66	24.4
3 – 6 years	26	9.6
7 – 9 years	51	18.8
10 – 12 years	49	18.1
13 years or more	79	29.2

Assessment of Hypotheses

SEM in PLS-SEM 3.0 was employed to examine the hypotheses in order to estimate two models. Prior to examining hypotheses 1, 2, 3, 4,5, and 6, an assessment was conducted on the direct impacts of open and closing leadership behaviours on the three CE practices. Subsequently, the

moderation model was assessed for innovation in SME entrepreneurship with respect to hypotheses 6, 7, 8, 9, 10, 11, and 12 (Model 2).

Results

Measurement Model

The evaluation of convergent validity involved the assessment of factor loading, average variance extracted (AVE), and composite reliability (CR) (Hair et al., 2017). A two-stage procedure was utilised in the development of these constructs. Table 3 indicates that all constructs have CRs greater than 0.7, factor loadings larger than 0.4, and AVE values greater than 0.5. To ascertain reliability, it is necessary for both the CR and Cronbach's alpha values to surpass 0.70 (Hair et al., 2011; Nunnally, 1978). Both CR and Cronbach's alpha values surpassed 0.70. These results indicated that convergent validity was deemed adequate (Hair et al., 2017). As suggested by Henseler et al. (2015), the discriminant validity was evaluated using the Heterotrait-Monotrait ratio of correlations (HTMTŠ). The HTMT values in Table 4 are all below 0.9, providing further evidence for the discriminant validity of each construct (Kline, 2015).

Table 3

Results of Convergent Validity

Constructs	Items	Loadings	Cronbach Alpha	Composite Reliability	Average Variance Extracted (AVE)
CE-Corporate Asset Management	CE-CAM1	0.816	0.899	0.938	0.836
	CE-CAM2	0.962			
	CE-CAM3	0.957			
CE-eco Design	CE-ECO2	0.835	0.791	0.864	0.617
	CE-ECO3	0.828			
	CE-ECO4	0.727			
	CE-ECO5	0.833			
CE-internal Environmental Management	CE-IEM1	0.785	0.818	0.830	0.582
	CE-IEM3	0.768			
	CE-IEM4	0.853			
	CE-IEM5	0.752			
	CE-IEM8	0.741			
Closing Behaviour	CLB1	0.805	0.852	0.895	0.633
	CLB2	0.831			
	CLB3	0.801			
	CLB4	0.867			
	CLB5	0.657			

Constructs	Items	Loadings	Cronbach Alpha	Composite Reliability	Average Variance Extracted (AVE)
Entrepreneurship Innovation	INN_O1	0.890	0.833	0.879	0.549
	INN_O2	0.819			
	INN_O3	0.819			
	INN_O4	0.844			
	INN_O5	0.800			
	INN_O6	0.775			
	INN_O7	0.856			
	INN_O8	0.797			
Opening Behaviour	OLB1	0.791	0.850	859	0.545
	OLB2	0.752			
	OLB3	0.733			
	OLB4	0.751			
	OLB5	0.801			
	OLB7	0.796			

Table 4

Discriminant Validity (HTMT)

	CE-CAM	CE-ECO	CE-IEM	CLB	INNO	OLB
CE-CAM						
CE-ECO	0.422					
CE-IEM	0.570	0.834				
CLB	0.805	0.586	0.760			
INNO	0.567	0.471	0.504	0.745		
OLB	0.818	0.646	0.899	0.865	0.726	

Common Method Bias (CMB)

It is a well-known fact that the common method bias (CMB) overstates the significance of correlations between model variables because every response originated from the same source. To detect potential bias, a comprehensive collinearity evaluation (Kock & Lynn, 2012) and Harman's Single Factor (Bagozzi & Phillips, 1991; Podsakoff et al., 2003) were implemented. The test results showed no single factor could account for above 50% of the variance, given that the first component accounted for only 29.22%.

Figure 2

Measurement Model

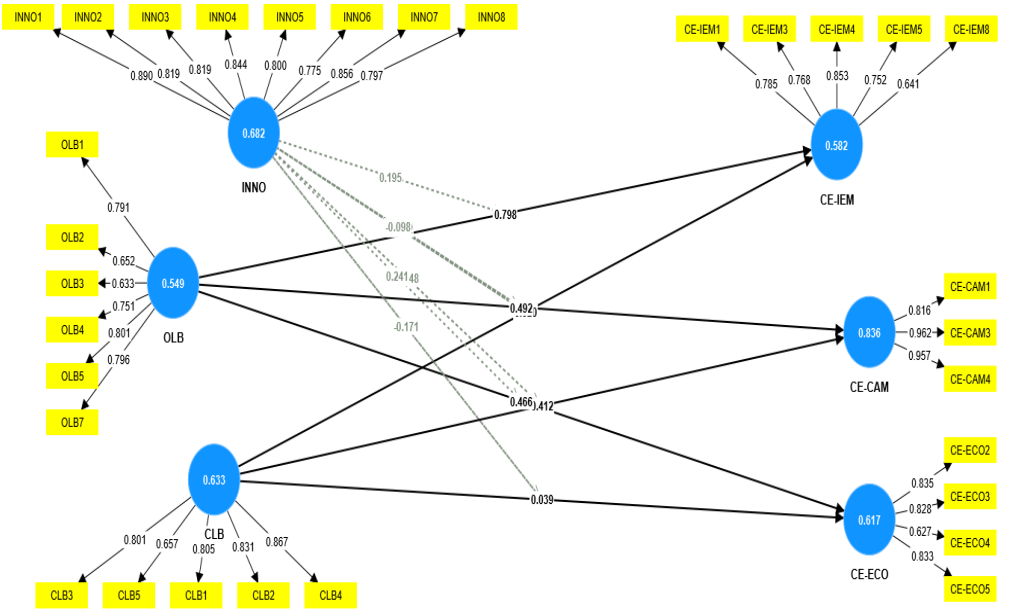


Figure 3

Structural Model

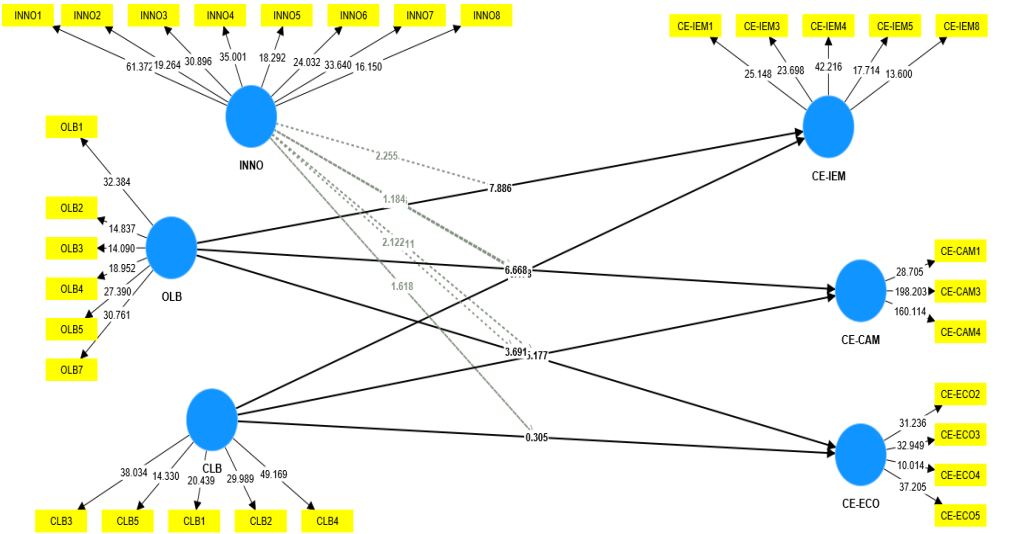


Table 5

Results of the Assessment of Hypotheses

Hypothesis / Relationships	*β*	*SE*	*t*	*p*	*VIF*	R^2	F^2	Q^2	Decision
H1: CLB -> CE-CAM	0.412	0.411	5.177	0.000	1.906	0.701	0.134	0.504	Supported
H2: CLB -> CE-ECO	0.039	0.026	0.305	0.380	1.897	0.311	0.005	0.608	Not Supported
H3: CLB -> CE-IEM	0.020	0.014	0.178	0.430	1.286	0.586	0.200	0.602	Not Supported
H4: OLB -> CE-CAM	0.492	0.496	6.668	0.000	2.259		0.004	0.217	Supported
H5: OLB -> CE-ECO	0.466	0.473	3.691	0.000	1.712		0.078	0.372	Supported
H6: OLB -> CE-IEM	0.798	0.798	7.886	0.000	1.351		0.010	0.392	Supported
H7: INNO x CLB -> CE-CAM	0.048	0.040	0.611	0.271	2.284		0.021	0.372	Not Supported
H8: INNO x CLB -> CE-ECO	-0.171	-0.159	1.618	0.054	2.478		0.000	0.256	Not Supported
H9: INNO x CLB -> CE-IEM	-0.242	-0.215	2.786	0.003	1.807		0.005	0.217	Not Supported
H10: INNO x OLB -> CE-CAM	-0.098	-0.082	1.184	0.120	2.814		0.380	0.504	Not Supported
H11: INNO x OLB -> CE-ECO	0.241	0.232	2.122	0.018	1.293		0.035	0.608	Supported
H12: INNO x OLB -> CE-IEM	0.195	0.169	2.255	0.013	1.906		0.023	0.602	Supported

Interaction Plot

The interaction diagram (Figure 4 & 5) illustrates the significant interaction between variables H11 and H12, as Podsakof suggested. As shown in Figure 4, the positive correlation between open leadership behaviour and the CE eco-design of manufacturing SMEs becomes more pronounced when entrepreneurial SME innovation is high. Additionally, Figure 5 demonstrates that SME innovation is high when entrepreneurship is present. There is increased strength in the positive correlations between transparent leadership behaviour and internal environmental management in manufacturing SMEs that adhere to the CE.

Figure 4

Interaction Plot for INNO x OLB -> CE-ECO

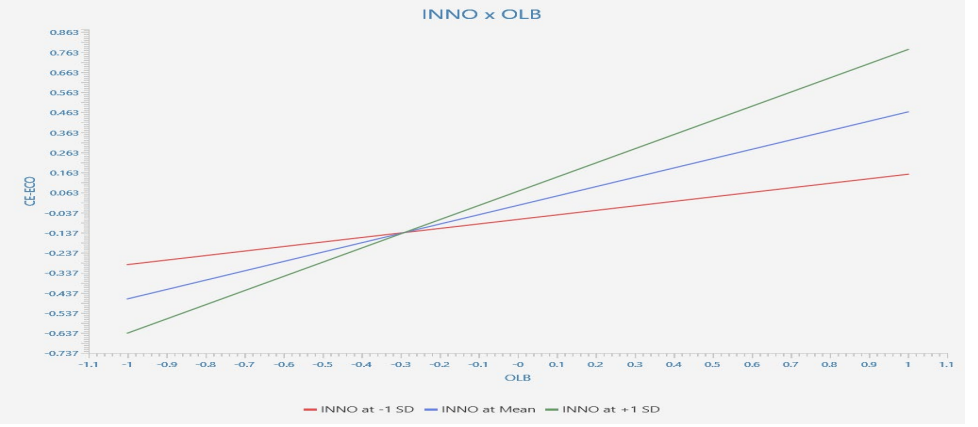
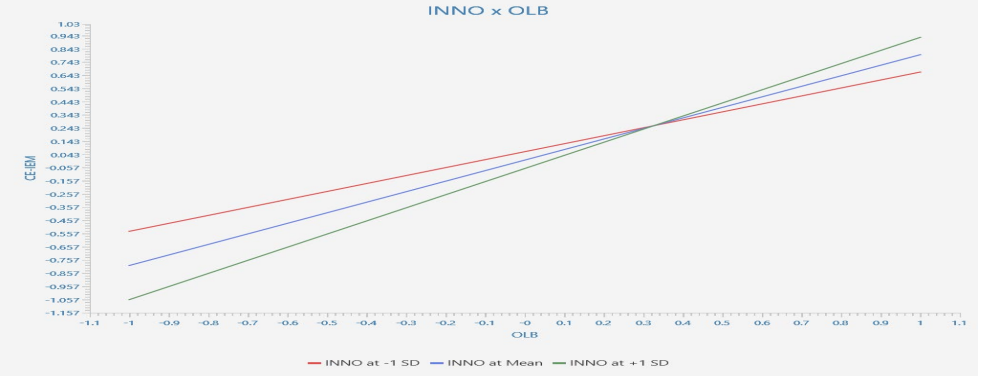


Figure 5

Interaction Plot for INNO x OLB -> CE-IEM



Structural Model

The percentage of the variance that can be explained was used to gauge how well the model predicted the data. The current study's R^2 values for operational performance and innovative capability were 0.605 and 0.415, respectively. A blindfolding method in PLS was also used to obtain the StoneGeisser Q^2 (cross-validated redundancy) value, which measures the predictive relevance. If the value of Q^2 is greater than zero, the model exhibits predictive relevance (Chin, 2010). The findings demonstrated that the Q^2 values for the endogenous variables in this study, CE-CAM (0.504), CE-Eco (0.173), and CE-IEM (0.372), were all more than zero, supporting their predictive importance. Non-parametric bootstrapping was used to evaluate the structural model (Moreno & Huertas, 2017) with 5000 reproductions (Table 3). Table 5 lists the conclusions of the hypotheses in light of the findings. The hypotheses may be tested using the findings of the structural model fit and quality indices, which show how well the structural model fits the data. CLB and CE-CAM have a good working relationship (β 0.412, p <0.000), H1 accepted. The relationship between CLB and CE-ECO design was not supported (β 0.039, p <0.380), and H2 was not supported. The relationship between CLB with CE-IEM (β 0.020, p < 0.178), H3 was not supported. OLB positively correlated with CE-CAM (β 0.492, p <0.000), and H4 was accepted. The relationship between OLB and CE-ECO design was supported (β 0.466, p <0.000), and H5 was supported. OLB positively correlated with CE-IEM (β 0.798, p <0.000), and H6 was supported. SME entrepreneurship innovation did not moderate the relationship between CLB-CE-CAM (β 0.048, p < 0.271), and H7 was not supported. SME entrepreneurship innovation did not moderate the relationship between CLB-CE-ECO (β -0.171, p < 0.054), and H8 was not supported. SME entrepreneurship innovation did not moderate the relationship between CLB-CE-IEM (β -0.242, p < 0.003), and H9 was not supported. SME entrepreneurship innovation did not moderate the relationship between OLB-CE-CAM (β -0.098, p < 0.120), and H10 was not supported. SME entrepreneurship innovation moderated the relationship between OLB-CE-Eco (β 0.241, p < 0.018), and H11 was supported. SME entrepreneurship innovation moderated the relationship between OLB-CE-IEM (β 0.195, p < 0.013), and H12 was supported.

Discussion

Resultantly, three key contributions were made to the literature and theory surrounding CE. Firstly, by defining a mechanism through which entrepreneurship innovation can be transferred into adopting CE practices, the current research contributed to the perspective based on natural resources. The findings imply that the more focused strategic approach used to promote innovation among SME manufacturers in Nigeria should concretise innovation. The failure to transform market orientation into more particular strategic orientations may be inferred to be a potential barrier to applying CE standards. Consequently, inquiries were addressed regarding precursors that may facilitate the elimination of obstacles to the implementation of CE practices (de Oliveira et al., 2019). By synthesising the hitherto disparate findings on innovation as a driver of environmental practice adoption (Cainelli et al., 2020), the results contributed to the corpus of knowledge. Specifically, it was illustrated how ambidextrous opening and closing leadership behaviour may facilitate innovation among SME manufacturing entrepreneurs in the context of CE practices. This, in turn, positively affects the internal environmental management and eco-design.

Concerning the firm's natural resources-based perspective, these results underscore the importance of strategic and cultural transformations within organisations seeking to adopt CE practices. The body of literature was furthered by distinguishing between the three distinct CE practices of internal environmental management, eco-design, corporate asset management, and recovery. Most of the literature only considers these particular practices in aggregate form as a component of the CE practices framework. There are few comprehensive results for the subconstructs used as dependent variables. The analysis distinguishes between these three methods. The association between OLB and CE-ECO and OLB and CE-IEM was both found to be positively moderated by SME entrepreneurial innovation. Still, the relationship between OLB and CE-CAM is not.

In contrast, earlier research indicates a favourable relationship between SME innovation and CE practices (Yousaf et al., 2022). The findings imply that the moderating factor of SME entrepreneurship innovation accounts for this association. The findings refute that SME entrepreneurial innovation moderates the connections between CLB and CE-CAM, CLB and CE-ECO, CLB and CE-IEM, and OLB and CE-CAM. This outcome is unexpected because it would have been thought that businesses with a strong capacity

for invention might find it more straightforward to establish corporate asset management and recovery procedures. Nigerian entrepreneurs' comparatively limited participation in investment recovery initiatives, which is also owing to regulatory limitations, could be one factor, as mentioned by Ebire and Daniels (2022). Corporate asset management may no longer be influenced by SME innovation, given that investment recovery has been a component of Nigeria's SMEs' operations for several decades. Thirdly, although, CE is a topic that academics, policymakers, and practitioners are increasingly interested in, there has not been a complete empirical study of how Nigerian SMEs might adopt CE techniques in the literature. Overall, the findings are helpful in academics. This is because they advance theory and provide evidence that, at least in the case of developing nations, such as Nigeria, grouping the subconstructs of CE practices may be the most appropriate approach. The findings also provide practitioners looking to implement CE practices in their organisations with insightful information.

Managerial Implications

According to the findings, eco-design and internal environmental management strategies have the most significant potential to implement CE principles. Organisations that proactively enhance their internal environmental management and eco-design procedures ought to proactively foster an environment that promotes innovation. The findings suggest that managers should be cognizant that this approach might not encompass all CE-related behaviours. The influence of SME entrepreneurial innovation on CLB and CE-CAM, CLB and CE-ECO, CLB and CE-IEM, and OLB and CE-CAM lacks sufficient support for managers to conclude that the implementation of CE is overly simplistic; instead, they should differentiate between the various aspects associated with it.

Limitations and Further Research

To begin with, the study's methodology necessitated that the primary respondents and sole source of data regarding a company's CE practices and innovation capacity be the owner-managers. Despite the diligent efforts to mitigate the influence of key informant bias and common methods, future research endeavours might employ an alternative study design to surmount this constraint. The results provided an initial indication as the mechanisms underlying the development of CE practices were specifically investigated.

Furthermore, the study revealed that the effects of CE procedures vary in magnitude. Recovery and administration of corporate assets seem to be an exception. Even though, the unexpected results for CLB and CE-CAM, CLB and CE-ECO, CLB and IEM, and OLB and CE-CAM may also be relevant to the context of the current study. It was proposed that the roles of CLB and CE-CAM, CLB and CE-ECO, CLB and CE-IEM, and OLB and CE-CAM concerning CE practices should be investigated further.

Conclusion

The combination of ambidextrous leadership initiatives in the CE context offers a chance for transformation for manufacturing SMEs in Nigeria. Due to infrastructural developments and competitive market aces which these enterprises face, such as inadequate infrastructures combined with restricted market access, the role of leadership is to pursue exploration and exploitation in a harmonised manner. Since the CE presents considerable challenges in Nigeria, and since Nigerian SMEs may still benefit from it, SMEs in the country should develop an entrepreneurial orientation that is receptive to sustainability. Sustainability is a significant factor mainly related to the future survival and development of SMEs in the Nigerian manufacturing sector. This has not only made the CE embrace environmental management, however, also transformed it into a tool for economic growth through employment and innovation. However, it is evident from the challenges identified in the literature that the exemplary implementation of CE principles depends on a thorough understanding of the local environment. Additionally, government policies or frameworks also play vital roles in the power sector in detail. It, therefore, means that the Nigerian government has to direct its efforts to address the formulation of policies that would strengthen and encourage SMEs in embracing a CE. By offering training and education resources that would develop entrepreneurial skills and means, the government could nudge the SMEs towards the desired change and make them adapt to new models of businesses that incorporate circularity. In addition, there is an opportunity for ambidextrous leadership initiatives to spur the CE for Nigerian manufacturing SMEs. With the help of further developing the concepts of EO and CE, these enterprises can not only mitigate the existing problems but also become leaders in sustainable development practices.

Conflict of Interest

The authors of the manuscript have no financial or non-financial conflict of interest in the subject matter or materials discussed in this manuscript.

Data Availability Statement

The article includes all relevant data. However, more information is available upon reasonable request from the corresponding author.

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