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The Influence Of Circular Economy Practices On Green Entrepreneurship Among Agro-Processing SMEs in Ghana With Entrepreneurial Orientation As A Moderator

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Abstract

Purpose

Globally, agro-processing SMEs contribute significantly to economic growth and development, yet face several challenges, including waste generation, financial challenges, and technical challenges, which lead to environmental challenges. SMEs' activities are considered the major activities contributing to environmental challenges, specifically in the agro-processing sector. This study, hinged on the Dynamic Capability Theory, investigates whether the circular economic practices and green entrepreneurship nexus can be enhanced by the presence of entrepreneurial orientation among agro-processing sector SMEs.

Design/methodology/approach

Our study research framework and its associated hypotheses were explored using structural equation modeling (SEM) in AMOS version 23, which was analysed using a sample of 320 usable questionnaires collected from agro-processing sector SMEs in Kumasi, Ghana.

Findings

The findings indicate a positive and significant relationship between circular economy practices and green entrepreneurship. In addition, these relationships exhibit heightened strength with increased levels of green entrepreneurship.

Originality/value

The contributions of this research extend to both theoretical and practical realms, offering valuable insights for agro-processing SME managers, owners, and policymakers, be encouraged to adopt circular initiatives to enhance sustainable business operations and achieve green entrepreneurship.

Keywords: Circular Economy Practices, Green Entrepreneurship, Entrepreneurial Orientation, Agro-processing SMEs, Sustainability.

1. Introduction

Globally, Small and Medium Enterprises (SMEs) are recognized as the backbone of several economies, having substantial input in nations' economic growth through employment creation, poverty reduction, and economic growth. The Ghana Statistical Service published a report in 2023 that SMEs account for about 92% of registered businesses, contribute over 70% to Gross Domestic Product (GDP), and provide approximately 85% of employment opportunities. Despite their economic contributions, SMEs also cause challenges to the environment through excessive resource consumption, inefficient production systems, and waste generation (Fumey et al., 2025; Goyal et al., 2022; Kabbera et al., 2024). Environmental sustainability has therefore become a major concern for governments, businesses, and policymakers seeking business strategies that balance economic growth with environmental protection (Mamash et al., 2025). For SMEs to continue producing and simultaneously protect the natural environment, the circular economy (CE) emerged as an appropriate means of promoting enduring production and consumption while enhancing organizational competitiveness (Al Halbusi et al., 2025). A circular economy is a regenerative economic system that minimizes waste and maximizes resource utilization through reuse, recycling, and remanufacturing of materials considered waste that would have been disposed of (Chowdhury et al., 2022; Mondal et al., 2023). Unlike the established production approach, where resources are tapped, produced, used, and the by-products are thrown away, often considered as a “take-make-dispose” approach. In this study, the circular economy practices focus on extending the life cycle of

resources and maintaining their value within production systems. The efficient resource management and waste minimization using regenerative systems in businesses have improved the performance of SMEs in reducing environmental challenges and supporting sustainable innovation (Maldonado-Guzmán & Garza-Reyes, 2023).

Circular practices are particularly relevant in developing economies such as Ghana, where environmental pollution remains a growing challenge. Agro-processing SMEs play an important role in economic growth through employment creation, food security, and value addition to agricultural products (Wang et al., 2025). However, the sector continues to face challenges as a result of inefficient use of raw materials, excessive energy consumption, poor waste management, and pollution associated with conventional production systems (Derhab & Elkhwesky, 2023). These challenges highlight the need for sustainable production practices that protect the environment and improve business performance.

Circularity promotes entrepreneurship. In simple terms, green entrepreneurship refers to entrepreneurial activities that create economic value while reducing environmental issues using initiatives such as waste minimization, by-product valorization, eco-products, services, technologies, and business models (Baquero, 2024). In the agro-processing sector, green entrepreneurship may include eco-friendly packaging, renewable energy use, waste recycling, and waste-to-energy innovations (Ayofemi et al., 2026). These practices support environmental sustainability while creating market opportunities and enhancing firm competitiveness.

Previous studies have confirmed that circularity improves environmental performance through the reuse and recycling of waste material (Mora Contreras et al., 2025). Similarly, green entrepreneurial activities contribute to innovation and sustainable firm performance (Appiah et al., 2023). Despite these contributions, important gaps remain in the literature. Most previous studies have focused on large firms in advanced countries to the disadvantage of developing economies such as Ghana, particularly in the agro-processing sector. In addition, circular economy practices, entrepreneurial orientation, and green entrepreneurship have largely been examined separately rather than within a combined framework. Few studies have examined how entrepreneurial orientation influences green entrepreneurship through circular economy initiatives (Mouawad, 2025). Extant studies argue that entrepreneurial orientation may strengthen firms' ability to translate circular economy initiatives into green entrepreneurial outcomes (Musfar et al., 2025; Owoseni et al., 2025). Accordingly, this study investigates how circular economy practices influence green entrepreneurship among agro-processing SMEs in Ghana and examines whether entrepreneurial orientation moderates this relationship. Our study seeks to mitigate these empirical gaps, leading to the expansion of sustainability and entrepreneurship literature and providing workable strategies for policymakers, SME owners, and managers seeking to promote sustainable businesses.

2. Theoretical Background

2.1 Dynamic Capabilities Theory

Dynamic Capabilities Theory explains how organizations develop and deploy strategic capabilities to adapt to changing environments and exploit business opportunities. DCT is an extended version of the traditional Resource-Based View, developed by Barney (1991) and later refined by Teece et al. (1997), highlighting how firms integrate, build, and reconfigure internal and external resources to achieve sustainable competitive advantage (Martadha et al., 2025). Many academics have shown interest in DCT for research since its inception. DCT explains how firms integrate, build, and reconfigure internal and external resources to respond effectively to changing environmental and market conditions (Li et al., 2025; Teece, 2018). In this study, DCT clarifies how circular economy practices, entrepreneurial orientation, and green entrepreneurship are operative in the agro-processing sector. Regarding circular economy practices in the agro-processing sector, employing DCT as a foundational theory for this study, the theory explains how agro-processing SMEs can develop strategic capabilities to minimize waste generation and extend product lifecycles across the production process, thereby enhancing environmental sustainability. Firms

found in the agro-processing sector may arrive at this objective with the adoption of strategic circular initiatives such as recycling, reuse, remanufacturing, and waste minimization, which are considered regenerative systems that promote environmental sustainability (Mora Contreras et al., 2025). Due to growing environmental issues, entrepreneurs and SME firms are compelled to rethink their operational methods and adopt sustainable business practices that promote the environment (Odeyemi et al., 2024). DCT supports the argument that firms with strong capabilities respond effectively to environmental challenges and develop innovative solutions that support sustainable growth and environmental protection. DCT is also in line with the entrepreneurial orientation (EO) perspective, enabling firms to be innovative, proactive, and willing to take calculated risks. From the perspective of Dynamic Capability Theory, EO boost firm's ability to sense opportunities and threats in its external environment and to utilize opportunities in a profitable venture. The agro-processing sector remains one of the sectors that serves as an employment avenue for a large number of people in the agricultural sector. Entrepreneurial orientation capability enables firms to sense opportunities in the environment, seize them through strategic decisions, and transform material that would have been thrown away into economically valuable use (Wade et al., 2022). Empirical evidence confirms that when a firm exploits opportunities and possesses entrepreneurial skills, such as innovativeness, proactiveness, and risk-taking capabilities, it helps such firms achieve their business goals (Roh et al., 2025). These capabilities enable firms to respond quickly to environmental changes and market demands.

However, DCT suggests that circular economy practices create sustainability-oriented opportunities, while entrepreneurial orientation strengthens a firm's ability to exploit such opportunities (Raji et al., 2026). Firms that combine circular economy practices with entrepreneurial capabilities often achieve successful green entrepreneurial outcomes (Abhishek Behl et al., 2024). Therefore, EO, a strategic capability enhances green entrepreneurship among agro-processing SMEs. For this study, DCT is considered to provide a strong theoretical foundation to investigate how circular economy practices influence green entrepreneurship moderated by entrepreneurial orientation.

2.2 Green Entrepreneurship

According to Makhloufi et al. (2022), "Green entrepreneurship refers to entrepreneurial activities that create economic value while addressing environmental challenges through innovative products, services, and sustainable business models." Green entrepreneurship not only protects the environment but also contributes significantly to national growth. It enables SMEs in various sectors of the economy, including agro-processing firms, to channel environmental pressures into innovative business opportunities. Through sustainable production practices and eco-friendly innovations, agro-processing firms enhance competitiveness while contributing to environmental sustainability and long-term economic growth (Kabbera et al., 2024).

2.3 Circular Economy Practices

Circularity is a strategy that organizations apply to minimize waste generation, extend resource lifecycles, and improve the efficient usage of physical resources. (Adanma et al., 2024; Ghad Abdewahed, 2026). Unlike the traditional production model, circularity involves producing goods, using them, and recycling the by-products. The main goal of circularity is to minimize waste in the production process. Circularity emphasizes resource regeneration, value addition, and environmental sustainability (Jaswal et al., 2024). Circularity enables firms to improve operational efficiency in achieving ecological gains (Obiuto et al., 2024; Tawo and Mbamalu, 2025). A circularity strategy helps convert waste resources into useful outputs and financial gains.

2.3.1 Waste Minimization

Waste minimization is the process of converting waste materials into a valuable resource. It is an effort by organizations to reduce material losses and prevent waste generation throughout production processes. This approach is critical because it prevents overdependence on natural materials in the production system

and also reduces environmental pollution (Tawo & Mbamalu, 2025). The fundamental goal of profit-oriented businesses is to maximize profit. Therefore, firms seek to eliminate inefficiencies in their business activities. In the production process, particularly in the agro-processing sector, firms that minimize waste help lower production costs, improve resource utilization, and reduce environmental impacts (Kabbera et al., 2024). Waste minimization enables firms to conserve resources and enhance operational efficiency, and also creates opportunities for sustainable innovation and supports the development of green entrepreneurial ventures (Tawo & Mbamalu, 2025).

2.3.2 Resource Efficiency

Resource efficiency involves efficient and effective use of raw materials, energy, and other production inputs to maximize value and minimize waste. SMEs in the agro-processing sector are encouraged to engage in restorative business practices to increase outputs while decreasing ecological pressures as a result of excessive resource use. Resource-efficient practices enhance competitiveness, lower operating costs, and strengthen sustainability performance (Ezekwu 2025). Resource efficiency concerns identifying and exploiting environmentally friendly business opportunities, thereby promoting green entrepreneurship (Asier Baquero, 2024).

2.3.3 Recycling and Reuse

Recycling and reuse as a circularity strategy involve recovering materials considered waste are reused as many times as possible in the product life cycle (Triguero et al., 2023). The ultimate goal of entrepreneurs in doing business is to maximize profit. Entrepreneurs found in the agro-processing sector aim at minimizing waste and environmental degradation. Studies show that firms that reuse their leftover gains financial benefits, reduce environmental pollution and waste disposal costs (Kiran et al., 2025). Such practices encourage innovative resource management approaches and facilitate the development of sustainable products and business models that contribute to green entrepreneurship.

2.3.4 By-product Valorization

By-product valorization is the deliberate process by which firms convert production residues and waste outputs into useful inputs, products, or energy, instead of discarding them as waste (Tawo & Mbamalu, 2025). By-product valorization enables businesses to achieve greater resource efficiency by transforming production waste into useful economic value. This process enables firms to extend the production life cycle of raw materials and obtain more output from the same quantity of raw materials, reducing waste and improving resource utilization. By-product valorization enhances resource productivity, reduces disposal costs, and creates additional revenue streams (Khoiruddin et al., 2024; Tawo & Mbamalu, 2025). Engaging in product valorization practice encourages innovation and enables firms to discover new market opportunities from underutilized resources, thereby strengthening green entrepreneurial activities and sustainable business growth (Jaswal & Kandpal, 2024).

2.3.5 Eco-design

Eco-design is the deliberate design or development of eco-friendly products and processes that promote environmental sustainability. In other words, eco-design is when a firm offers a product or service with a lower environmental impact (Mahmood et al., 2025; Vernier, 2024). Engaging in eco-design minimizes environmental impacts throughout a product's life cycle while maintaining functionality and economic value. Eco-design encourages the use of sustainable materials, improved durability, recyclability, and resource-efficient production methods. In relation to agro-processing firms, adopting eco-design facilitates sustainable innovation and enhances environmental performance, enabling firms to develop greener products and utilize emerging sustainability-driven entrepreneurial opportunities (Favi & Marconi 2025).

2.4 Entrepreneurial Orientation

Entrepreneurial orientation has become a key variable in entrepreneurial research.

Entrepreneurial orientation (EO) refers to a firm's strategic tendency to pursue innovation, proactively identify market opportunities, and undertake calculated risks to achieve superior performance. Entrepreneurial orientation has become a key variable in entrepreneurial literature in recent times. According to Zaato et al. (2020), EO is considered a key and valuable entrepreneurial intention organizational capability that enhances competitiveness and business growth, enabling firms to effectively deploy resources and respond to changing market conditions. In the agro-processing sector, entrepreneurial orientation is a key strategy enabling firms to operate in active surroundings characterized by resource constraints, environmental pressures, and evolving consumer preferences (Xiao et al., 2025). Literature suggests that firms with strong EO are capable of transforming circular economy practices such as waste minimization, resource efficiency, recycling, by-product valorization, and eco-design into profitable business opportunities (Ciannamea et al., 2025). Through continuous innovation and strategic decision-making, these firms can develop value-added products, improve operational efficiency, and create sustainable competitive advantages. According to Anim et al. (2024), entrepreneurially oriented firms can readily identify and exploit business opportunities. This may enable them to outperform their competitors. Recent studies in Ghana further indicate that entrepreneurial orientation influences firm performance by strengthening innovation capabilities, opportunity recognition, and strategic resource utilization, thereby enabling SMEs to achieve both economic and environmental objectives.

2.5 Hypotheses Development

Waste Minimization and Green Entrepreneurship

Waste minimization is a dimension of circular economy practice that reduces the rate of waste generation in the production system and enhances green entrepreneurship. Waste minimization is an approach that firms adopt to minimize material loss during the production process. It is an approach to improve material efficiency and create opportunities for ecological sustainability. (Wijayanti et al., 2025). In the agro-processing sector, a lot of resources are left unused because the firms do not have the capabilities for transforming the waste into useful financial gains. For instance, waste materials such as cassava peels, cocoa pods, palm kernel shells, and many other wastes in the agricultural sector can be transformed into bio-products, thereby stimulating green entrepreneurial ventures and sustainable business model development. Agro-processing firms can not automatically achieve green entrepreneurship during production. Unless the rate of waste generated during production is minimized. We predict that:

H1: There is a positive relationship between waste minimization and green entrepreneurship.

Resource Efficiency and Green Entrepreneurship

Resource efficiency is about how firms use resources effectively and efficiently to increase output and minimize waste generation. For instance, efficient use of energy, water, and raw materials enables firms to reduce costs while generating environmentally sustainable outputs.

Al Halbusi et al. (2025) argued that resource-efficient systems strengthen firms' green innovation capacity and sustainability-oriented entrepreneurship. In this study, we assume that agro-processing firms that adopt modern technologies in their production system can use materials efficiently and effectively to support eco-friendly production systems, thereby encouraging firms to develop green products and services that enhance competitive advantage and environmental sustainability. Therefore, it can be hypothesised that,

H2: There is a positive relationship between resource efficiency and green entrepreneurship.

Recycling and Green Entrepreneurship

Recycling and reuse of waste materials involve transforming them into useful products. Recycling waste materials extends product life and promotes resource efficiency (Almusaed et al., 2024). In the agro-

processing sector, SMEs that can convert by-products or waste materials into useful products improve firm performance and increase revenue streams. In this research, we believe that adopting recycling extends product lifecycles, reduces environmental waste, and creates new business opportunities through the use of secondary materials. Prior empirical studies highlight that recycling is a key driver of circular economy-based entrepreneurship and sustainable firm performance (Tuncer & Korchagina, 2024; Musfar et al., 2025). Therefore, we can say that:

H3: There is a positive relationship between recycling and green entrepreneurship.

By-product Valorization and Green Entrepreneurship

Due to the challenges of climate change and resource depletion, firms are eager to transform residues or materials considered as waste into economically useful products. SMEs that engage in by-product valorization are capable of transforming waste products that would have been discarded into valuable products (Oyedede et al., 2024). Firms that transform waste materials into valuable products enhance both profitability and sustainability. Recent literature emphasizes that by-product valorization strategies significantly drive green innovation and sustainable business models within circular economy systems (Munir & Fausiah, 2025). In the agro-processing sector, waste materials from agricultural goods can be converted into industrial inputs, promoting entrepreneurial opportunities aligned with environmental sustainability goals.

In this study, we therefore hypothesised that:

H4: There is a positive relationship between by-product valorization and green entrepreneurship.

Eco-design and Green Entrepreneurship

Eco-design involves developing and designing products, services or processes that cause fewer challenges in product development to minimize issues across the lifecycle (Favi & Marconi, 2024). It emphasizes how businesses are capable of identifying environmental challenges and turning the challenges into economic benefits. The idea behind this concept is that firms produce goods that do not cause harm to the environment but achieve their business goals. Eco-design practice enables firms to achieve sustainability goals and minimize environmental issues (Watto et al., 2025; Favi & Marconi, 2024). Eco-design reflects a proactive business strategy that generates new entrepreneurial opportunities by introducing products or services that cause less harm to the environment. For SMEs, eco-design signals commitment to sustainability, attracting eco-conscious customers and partners. Recent studies show that eco-design significantly enhances green innovation performance and sustainability-oriented entrepreneurship (Oduro, 2024). Producing environmentally friendly goods helps firms identify new market opportunities and enter new markets that are environmentally oriented; hence, such firms can achieve sustainability goals (Olubusola Odeyemi & Favour Oluwadamilare Usman, 2024; Moawad et al., 2024). However, NRBV and Innovation Diffusion theory support this argument and explain why it is important to develop eco-friendly products.

H5: There is a positive relationship between eco-design and green entrepreneurship.

2.6 Moderating role of Entrepreneurial Orientation

Entrepreneurial orientation has been widely used as a mediating factor in several studies to investigate how entrepreneurial orientation influences green entrepreneurship. In this study, we are interested in examining entrepreneurial orientation as a mediating mechanism and its impact on green entrepreneurship. In this study, we can see that the conceptual framework provides an understanding of how entrepreneurial orientation moderates the relationship between circular economy practices and green entrepreneurship. We are interested in investigating whether, without entrepreneurial orientation, it would be possible to achieve the sustainability goal through circular practices. We assumed that entrepreneurial orientation has an impact on green entrepreneurship because studies show entrepreneurial-oriented SMEs perform better than SMEs with low entrepreneurial capabilities (Aftab et al., 2024).

Entrepreneurial Orientation (EO) represents the strategic posture of proactiveness, innovativeness, and risk-taking. RBV suggests EO is an intangible capability that strengthens how firms organize other resources. SMEs with high EO capabilities are more alert to environmental opportunities and more willing to take calculated risks to utilize the opportunity ahead of competitors by introducing new products or services (Castro- Lopez et al., 2024). Thus, EO strengthens the translation of CE practices into Green Entrepreneurship by enhancing opportunity recognition and implementation speed. Without EO, CE practices may remain operational routines rather than entrepreneurial initiatives. SMEs adopt EO to proactively control waste minimization, improve resource utilization, and introduce eco-design products to control environmental challenges. Extant literature shows EO amplifies sustainability strategy outcomes. Therefore, H6-H10 have a positive moderating effect on Green Entrepreneurship as in Fig. 1.

H6: Entrepreneurial Orientation Moderates Waste Minimization and Green Entrepreneurship
H7: Entrepreneurial Orientation Moderates Resource Efficiency and Green Entrepreneurship
H8: Entrepreneurial Orientation Moderates Recycling/Reuse and Green Entrepreneurship
H9: Entrepreneurial Orientation Moderates the By-product Valorization and Green Entrepreneurship
H10: Entrepreneurial Orientation Moderates Eco-design and Green Entrepreneurship

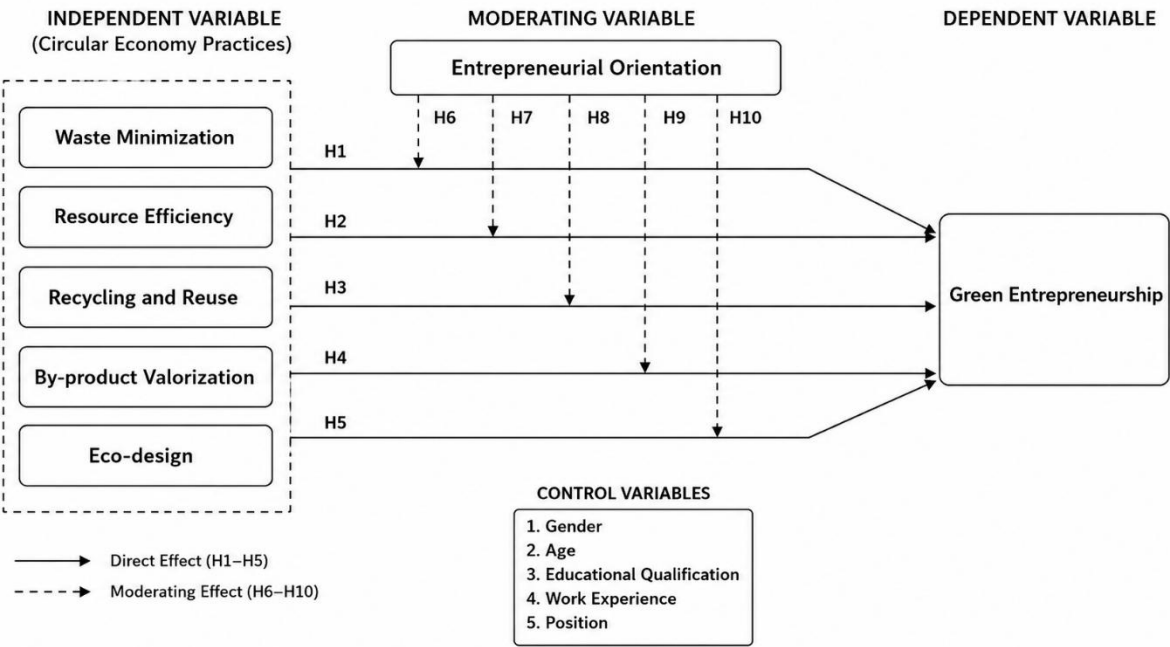


Figure 1: Conceptual framework

Methodology

We used a positivist research paradigm to investigate this study. The purpose of the study is to understand whether entrepreneurial orientation has an impact on green entrepreneurship through circular principles or not. We use the positivist research approach for this study because we believe knowledge can be obtained through objectivity. The positivist philosophy enables us to understand the relevance of the theories supporting our research.

In this study, we use a quantitative research approach to collect data from agro-processing SME managers, owners, and other key staff in the agro-processing sector to test the proposed hypotheses. The agro-processing sector contributes significantly to economic growth and development. As a result, it is considered the appropriate sector of the economy for the study. We can identify the challenges and opportunities in the sector. This helps us to capture the experience of the managers, assistant managers, and owners for the research. A quantitative approach was used to conduct statistical analysis and quantitative measurement to conclude this study.

Population, sampling, and data collection

A total of 320 SME managers, owners, and key staff members constitute top management, middle, and lower management in the agro-processing sector in Ghana, and were used for this study. The population was selected from different regions engaged in various agro-processing activities in Ghana. The selected population comprises managers and owners of palm oil processing, cassava processing, fruit processing firms, rice processing firms, and many other firms in the agro-processing sector. The population was selected for the study by focusing on the skills, knowledge, and experience in the agro-processing sector. We believe that the selected population can provide us with valuable information to assist us in the study process. Additionally, the selected regions include the Central Region and the Ashanti region were chosen as the study area for the study. Because the regions are notable for agricultural activities, including food production, forestry, and fishing.

The sample for our research was accessed through a field visit to obtain their contact information and administer the questionnaire through a WhatsApp link. Only a few were accessed through email addresses. A total of 105 SMEs were visited to administer the questionnaire. In each firm, four or three participants were asked to respond to the questionnaires for data collection. Out of 105 agro-processing SMEs for this study, 320 participants responded to the questions.

The research instrument delivered to the participants was divided into four sections. Section A comprised the demographics of the participant, Section B emphasized circular economy practices items; Section C emphasized entrepreneurial orientation; and Section D was on green entrepreneurship. The sample size chosen for the study was appropriate because it was determined by power analysis. The analysis showed that 157 samples were enough for the study, but because of the complexity of the study, we collected data from 320 participants for the study.

The study instrument

Actually, three constructs were used for this study. Circular economy practice was an independent variable, entrepreneurial orientation was a moderating and green entrepreneurship was a dependent variable. Circular economy practice was adapted from Abhishek Behl et al. (2024), with 5 measurement items. Circular economy practices consist of five dimensions: waste minimization, resource efficiency, recycling or reuse, by-product valorization, and eco-design. Green entrepreneurship was the dependent variable, which measures the degree to which respondents engage in environmental sustainability. Five measurement items of green entrepreneurship were adopted from Karikari et al. (2025) to understand the degree to which participants were eager for environmental sustainability. The measurement items were measured on a seven-point "Strongly Disagree" to "Strongly Agree" to measure the extent to which participants understood issues relating to environmental protection. Moreover, entrepreneurial orientation is used as a mediating factor in this study. Entrepreneurial orientation measurement items were adopted from Anaba et al. (2021). The measurement items capitalized on how firms identify business opportunities and how they turn opportunities into reality. EO was measured on seven-point Likert scales ranging from "strongly disagree" to "strongly agree" to rate their agreement level with each question on opportunity recognition and exploitation.

Study Results

Background information

The table 4.1 below represents the demographic information of the respondents.

The gender statistics show that females were the majority of respondents in this study, constituting 50.9% (163), and males represented 49.1% (157). Having identified the gender distribution of the respondents, the study further asked about the age distribution, educational qualification, and work experience of the respondents. Regarding the age distribution, the age group between 20-30 years formed the largest with 27.2% (87), followed by those aged 50 years and above with 25.6% (82). Respondents aged 30–39 years accounted for 24.7% (79), while those aged 40–49 years represented 22.5% (72), indicating that the study captured respondents from diverse age groups. Regarding the educational qualification of the respondents, the statistics indicated that respondents who had Secondary educational qualifications recorded the highest

percentage of 28.1% (90), followed by Master's degree holders, who constituted 26.3% (84), and Diploma holders, who constituted 25.6% (82), and finally bachelor's degree holders, who formed the smallest group with 20.0% (64). In terms of work experience, respondents who worked between 1 and 3 years formed the highest group with 27.2% (87), those who worked above 7 years formed the second largest group, representing 25.6% (82), followed by group with experience under 1 year representing 23.8% (76) and finally those who worked between 4 and 6 years constituted the least group with 23.4% (75). Concerning the positions held by the respondents in this study, the statistics showed that the owners, who constituted senior management, recorded the highest number with 36.9% (118), the other key staff members, who constituted the junior management, recorded 32.8% (105), and finally assistant managers formed the lowest percentage of the respondents with 30.3% (97) suggesting that the study benefited from experienced managerial perspectives.

Table 4.1: Demographic Characteristics

Variable	Category	Frequency	Percent
Gender	Male	157	49.1
	Female	163	50.9
Age	20 -30 years	87	27.2
	30–39 years	79	24.7
	40–49 years	72	22.5
	50 years and above	82	25.6
Educational Level	Secondary certificate	90	28.1
	Diploma	82	25.6
	Bachelor's Degree	64	20.0
	Master's Degree	84	26.3
Work Experience	Below 1 year	76	23.8
	1–3 years	87	27.2
	4–6 years	75	23.4
	Above 7 years	82	25.6
Position	Junior Management	105	32.8
	Middle/Assistant Managers	97	30.3
	Senior Management/Owners	118	36.9

Source: Researcher's Field Survey (2026).

Confirmatory Factor Analysis (CFA)

Table 4.2 below presents the Confirmatory Factor Analysis (CFA) performed to understand how the measurement items fit our study. The model fit indices demonstrated that the measurement model achieved an acceptable fit with the data. The model produced a chi-square value (CMIN) of 620.305 with 539 degrees of freedom, resulting in a CMIN/DF ratio of 1.151, which is below the recommended threshold of 3.0. Additionally, the goodness-of-fit indices indicated satisfactory model adequacy, including GFI = .902, AGFI = .886, TLI = .987, CFI = .989, NFI = .920, RMSEA = .022, and RMR = .012. These values confirm that the model adequately represents the observed data. The standardized factor loadings for all measurement items exceeded the acceptable threshold of 0.50. The factor loadings ranged from 0.682 to 0.878, thereby confirming indicator reliability. Furthermore, Cronbach's Alpha (CA) and Composite Reliability (CR) values exceeded the acceptable threshold. The Average Variance Extracted (AVE) values ranged from 0.494 to 0.730, suggesting adequate convergent validity for the constructs used in the study.

Table 4.2: Confirmatory Factor Analysis (CFA)

Model-fit Summary: CMIN = **620.305**; DF = **539**; CMIN/DF = **1.151**; GFI = **.902**; AGFI = **.886**; TLI = **.987**; CFI = **.989**; RMSEA = **.022**; RMR = **.012**; NFI = **.920**

Construct	Item	Factor Loading	R ²	CA	CR	AVE
Waste Minimization (WM)	WM1	0.860	0.740	0.937	0.931	0.730
	WM2	0.870	0.756			
	WM3	0.878	0.771			
	WM4	0.868	0.753			
	WM5	0.855	0.731			
Resource Efficiency (RE)	RE1	0.724	0.524	0.849	0.847	0.527
	RE2	0.682	0.465			
	RE3	0.762	0.580			
	RE4	0.750	0.562			
	RE5	0.721	0.520			
Recycling and Reuse (RR)	RR1	0.778	0.605	0.843	0.844	0.521
	RR2	0.695	0.483			
	RR3	0.737	0.543			
	RR4	0.706	0.499			
	RR5	0.689	0.475			
By-product Valorization (BV)	BV1	0.686	0.471	0.829	0.830	0.494
	BV2	0.689	0.475			
	BV3	0.729	0.531			
	BV4	0.717	0.514			
	BV5	0.690	0.476			
Eco-design (ED)	ED1	0.725	0.525	0.851	0.852	0.536
	ED2	0.738	0.545			
	ED3	0.744	0.554			
	ED4	0.738	0.544			
	ED5	0.710	0.505			

Construct	Item	Factor Loading	R ²	CA	CR	AVE
Entrepreneurial Orientation (EO)	EO1	0.855	0.731	0.925	0.925	0.711
	EO2	0.843	0.711			
	EO3	0.830	0.689			
	EO4	0.846	0.716			
	EO5	0.842	0.709			
Green Entrepreneurship (GE)	GE1	0.715	0.511	0.850	0.851	0.534
	GE2	0.738	0.545			
	GE3	0.707	0.500			
	GE4	0.744	0.554			
	GE5	0.741	0.549			

Notes: CFI = Comparative Fit Index; CMIN/DF = Chi-square/Degree of Freedom; RMR = Root Mean Square Residual; RMSEA = Root Mean Square Error of Approximation; TLI = Tucker–Lewis Index; GFI = Goodness-of-Fit Index; AGFI = Adjusted Goodness-of-Fit Index; NFI = Normed Fit Index; CA = Cronbach's Alpha; CR = Composite Reliability; AVE = Average Variance Extracted.

Discriminant validity

We performed discriminant validity analysis to understand the extent to which each construct distinct itself from one another. According to Fornell and Larcker (1981), discriminant validity is established when the square root of the Average Variance Extracted (AVE) for each construct is greater than the relationships among that construct and other constructs within the model. Table 4.3 presents the outcomes of the discriminant validity. The (AVE) values are arranged and bolded in a diagonal style. According to Suleyman Demir (2022). The recommended threshold of ± 2 skewness and kurtosis is between -7 and +7. Therefore, we can emphasize that all the constructs used were within the recommended threshold; this means that the data satisfied the assumption of normality. The skewness values ranged from -0.164 to -0.047, while kurtosis values ranged from -1.097 to -0.146. The correlation analysis further revealed significant positive relationships among the dimensions of CEP. Waste Minimization (WM) showed encouraging association with Resource Efficiency ($r = 0.795$, $p < 0.01$), Recycling and Reuse ($r = 0.776$, $p < 0.01$), By-product Valorization ($r = 0.776$, $p < 0.01$), Eco-design ($r = 0.798$, $p < 0.01$), and Green Entrepreneurship ($r = 0.764$, $p < 0.01$). Additionally, Green Entrepreneurship (GE) being the independent variable, had a positive relation with Entrepreneurial Orientation (EO) ($r = 0.359$, $p < 0.01$). The findings, therefore, indicate satisfactory relationships among the constructs, further illustrated by Figure 2.

Table 4.3 Discriminant validity analysis

Variables	Mean	SD	Skew	Kurt	Gender	Age	Educational Level	Work Experience	Position	WM	RE	RR	BV	ED	EO	GE
Gender	1.510	0.501	—	—	1.000											
Age	2.470	1.144	—	—	0.001	1.000										
Educational Level	2.440	1.157	—	—	-0.045	0.097	1.000									
Work Experience	2.510	1.114	—	—	-0.028	-0.061	0.026	1.000								
Position	2.040	0.835	—	—	-0.027	0.016	0.088	0.099	1.000							
Waste Minimization (WM)	3.384	0.707	-0.164	-1.097	0.108	-0.169**	-0.051	0.056	0.114*	0.854	0.795	0.776	0.776	0.798	0.027	0.764
Resource Efficiency (RE)	2.866	0.461	-0.095	-0.458	0.044	-0.156**	-0.029	0.072	0.101	0.795**	0.726	0.658	0.695	0.677	0.136	0.704
Recycling and Reuse (RR)	2.771	0.432	-0.121	-0.489	0.055	-0.156**	-0.038	0.036	0.095	0.776**	0.658**	0.722	0.624	0.660	0.048	0.652
By-product Valorization (BV)	2.803	0.423	-0.047	-0.146	0.071	-0.172**	-0.034	0.080	0.117*	0.776**	0.695**	0.624**	0.703	0.675	0.116	0.670
Eco-design (ED)	2.789	0.449	-0.147	-0.640	0.065	-0.131*	-0.068	0.008	0.085	0.798**	0.677**	0.660**	0.675**	0.732	0.077	0.701
Entrepreneurial Orientation (EO)	3.439	0.664	-0.115	-0.987	0.031	0.022	0.095	0.025	0.032	0.027	0.136*	0.048	0.116*	0.077	0.843	0.359
Green Entrepreneurship (GE)	3.029	0.468	-0.055	-0.221	0.090	-0.094	-0.032	0.064	0.055	0.764**	0.704**	0.652**	0.670**	0.701**	0.359**	0.731

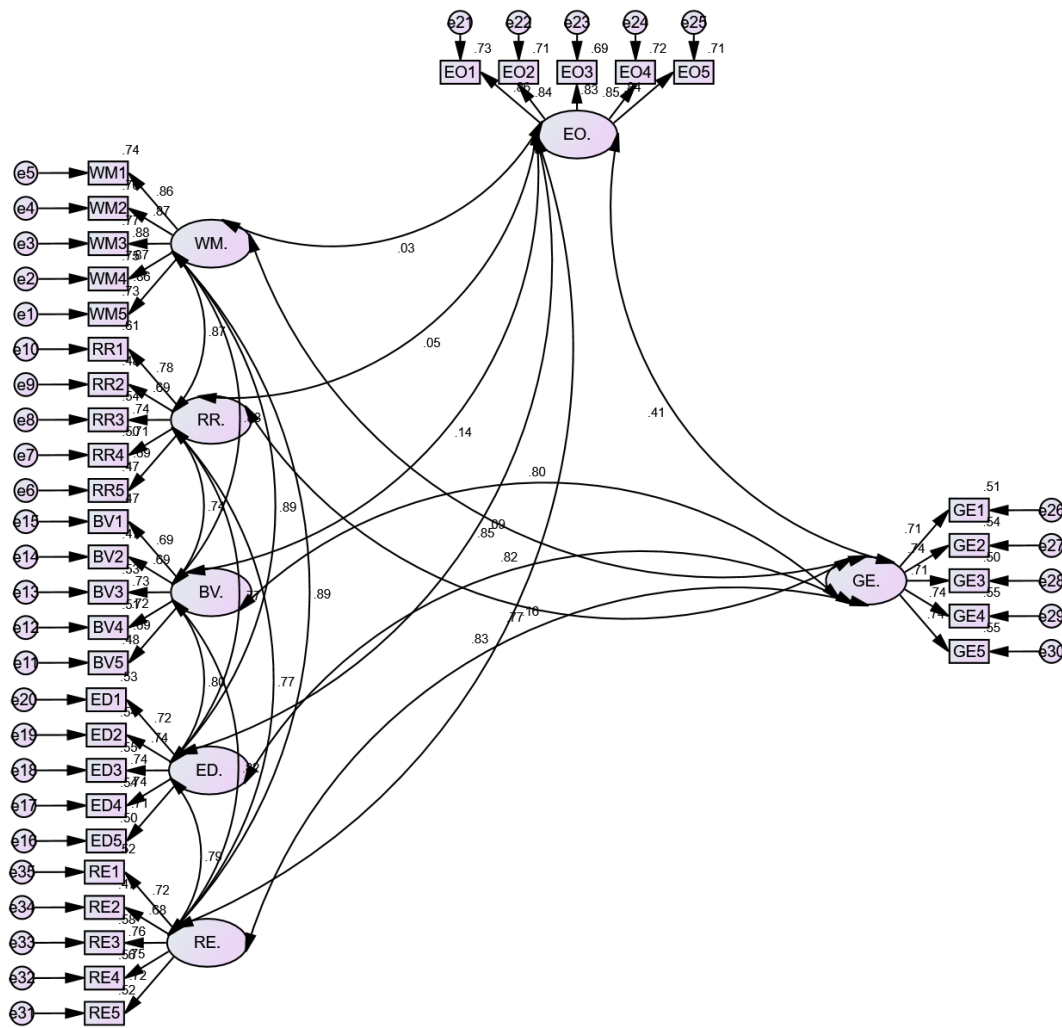


Figure 2: Measurement Model

Exploratory Factor Analysis (EFA)

Exploratory Factor Analysis (EFA) was performed to examine the measurement items. Before factor extraction, the Kaiser–Meyer–Olkin (KMO) was used to measure the sampling adequacy, assessed, and produced a value of 0.965, which exceeds the minimum threshold of 0.60, indicating that the sample was adequate for factor analysis. In addition, Bartlett’s Test of Sphericity was significant ($\chi^2 = 7415.558$, $df = 595$, $p < 0.001$), confirming that the correlation matrix was appropriate for factor extraction.

Using Principal Component Analysis with Varimax rotation, five components with eigenvalues greater than 1.0 were extracted. The five components accumulated to 63.8% of the total variance, exceeding the minimum acceptable threshold of 50%. The first factor accounted for 42.74% of the variance, followed by 11.65%, 3.505%, 3.089%, and 2.863%, respectively. The rotated factor solution further revealed that the extracted constructs were adequately represented and conceptually distinct. The result for the exploratory factor analysis is provided in Table 4.4 below.

Table 4.4: Exploratory Factor Analysis (EFA)

Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy = 0.965 Bartlett's Test of Sphericity: $\chi^2 = 7415.558$, df = 595, $p < 0.001$									
Component	Initial Eigenvalues Total	% of Variance	Cumulative %	Extraction Sums of Squared Loadings Total	% of Variance	Cumulative %	Rotation Sums of Squared Loadings Total	% of Variance	Cumulative %
1	14.960	42.742	42.742	14.960	42.742	42.742	5.239	14.970	14.970
2	4.079	11.655	54.397	4.079	11.655	54.397	4.377	12.507	27.476
3	1.227	3.505	57.902	1.227	3.505	57.902	4.270	12.199	39.676
4	1.081	3.089	60.991	1.081	3.089	60.991	4.242	12.121	51.796
5	1.002	2.863	63.854	1.002	2.863	63.854	4.220	12.057	63.854
6	0.834	2.382	66.236						
7	0.701	2.003	68.239						
8	0.681	1.946	70.185						
9	0.638	1.821	72.007						
10	0.625	1.786	73.793						
11	0.594	1.697	75.490						
12	0.585	1.671	77.162						
13	0.563	1.609	78.771						
14	0.527	1.507	80.278						
15	0.499	1.426	81.703						
16	0.478	1.366	83.070						
17	0.468	1.338	84.408						
18	0.448	1.281	85.688						
19	0.436	1.245	86.934						
20	0.404	1.153	88.087						
21	0.387	1.107	89.194						
22	0.372	1.064	90.258						
23	0.348	0.995	91.253						
24	0.346	0.988	92.241						
25	0.340	0.970	93.211						
26	0.315	0.901	94.112						
27	0.306	0.875	94.987						
28	0.277	0.792	95.778						
29	0.264	0.754	96.532						
30	0.248	0.709	97.241						
31	0.229	0.654	97.896						
32	0.208	0.593	98.489						
33	0.191	0.545	99.034						
34	0.185	0.529	99.562						
35	0.153	0.438	100.000						

Extraction Method: Principal Component Analysis
 Rotation Method: Varimax with Kaiser Normalization

Common Method

Bias

Podsakoff et al. (2003) clarified common method bias as a situation where the researcher intentionally manipulates the research findings, which affects a fair result for the study. Since data was collected from a single sector of the economy through a structured questionnaire, there is a possibility that the researcher can manipulate the results.

To assess whether there was bias during the data collection, Harman's Single-Factor Test shown in Table 4.5 was conducted using Principal Axis Factoring. The test examined whether a single dominant factor accounted for the majority of the covariance among the measurement items. The result shows that the first unrotated factor explained 42.742%, below the recommended threshold of 50%. The cumulative variance explained was 63.854%, suggesting that the measurement items captured multiple underlying constructs rather than reflecting a single common source of variance. Since the analysis recorded that no single factor emerged as the majority of the variance, the result indicated that common method bias was not problematic in the study. This means that the data collection was free from bias. This confirmed the dataset is valid and reliable for subsequent multivariate analyses and hypothesis testing. The table below presents the result of Harman's single-Factor test for common method bias.

Table 4.5 Harman's Single-Factor Test for Common Method Bias

Factor	Initial Eigenvalues	% of Variance	Cumulative %	Extraction Sums of Squared Loadings Total	% of Variance	Cumulative %
1	14.960	42.742	42.742	14.457	41.306	41.306
2	4.079	11.655	54.397			
3	1.227	3.505	57.902			
4	1.081	3.089	60.991			
5	1.002	2.863	63.854			
6	0.834	2.382	66.236			
7	0.701	2.003	68.239			
8	0.681	1.946	70.185			
9	0.638	1.821	72.007			
10	0.625	1.786	73.793			
11	0.594	1.697	75.490			
12	0.585	1.671	77.162			
13	0.563	1.609	78.771			
14	0.527	1.507	80.278			
15	0.499	1.426	81.703			
16	0.478	1.366	83.070			

17	0.468	1.338	84.408
18	0.448	1.281	85.688
19	0.436	1.245	86.934
20	0.404	1.153	88.087
21	0.387	1.107	89.194
22	0.372	1.064	90.258
23	0.348	0.995	91.253
24	0.346	0.988	92.241
25	0.340	0.970	93.211
26	0.315	0.901	94.112
27	0.306	0.875	94.987
28	0.277	0.792	95.778
29	0.264	0.754	96.532
30	0.248	0.709	97.241
31	0.229	0.654	97.896
32	0.208	0.593	98.489
33	0.191	0.545	99.034
34	0.185	0.529	99.562
35	0.153	0.438	100.00

Extraction Method: Principal Axis Factoring

Note: Harman's Single-Factor Test showed **42.742%** of the total variance, which is below the recommended threshold of **50%** (Podsakoff et al., 2003). This indicates that the study was free from bias.

Structural Equation Model Analysis

After analysing confirmatory and exploratory factor analyses, the study continues to examine the moderating factor to determine how entrepreneurial orientation serves as a moderating factor among the study variables. The result proved that all five dimensions of circular economy practices have a significant and positive influence on GE. Confirming H1-H5, the study found a direct, significant relationship between circular economy practices and green entrepreneurship. The study is consistent with the findings of Triguero et al. 2023) and Mora-Contreras et al. (2025), who mentioned that circular economy practices have a favourable impact on green entrepreneurship and environmental performance. These results suggest that adopting a sustainable production system and resource management practices enhances green entrepreneurship among SMEs. Regarding the moderation impact of Entrepreneurial Orientation on green entrepreneurship, the results show that entrepreneurial orientation strengthened the relationship between Eco-design, a dimension of CEP, and GE. ($\beta = 0.163$, $p < 0.001$), though it had a negative moderation effect between Resource Efficiency and GE. According to Al-Halbusi et al. (2025), firm circular economy practices are widely recognized as a critical approach to advancing environmental sustainability. This confirms that EO strengthens CEP and GE, but statistical insignificant in the relationship Anaba, (2021) as in Table 4.6.

Table 4.6: Structural Equation Modeling (SEM) Results

Hypothesis Path				Estimate (β)	S.E.	C.R.	P- value	Decision
H1	GE	←	Waste Minimization (WM)	0.306	0.030	10.070	***	Supported
H2	GE	←	Resource Efficiency (RE)	0.191	0.033	5.790	***	Supported

Hypothesis Path		Estimate (β)	S.E.	C.R.	P- value	Decision	
H3	GE $\leftarrow$ Recycling and Reuse (RR)	0.151	0.036	4.237	***	Supported	
H4	GE $\leftarrow$ By-product Valorization (BV)	0.085	0.036	2.362	0.018	Supported	
H5	GE $\leftarrow$ Eco-design (ED)	0.090	0.032	2.840	0.005	Supported	
	GE $\leftarrow$ Entrepreneurial Orientation (EO)	0.256	0.027	9.387	***	Significant	
H6	GE $\leftarrow$ WM $\times$ EO	-0.029	0.017	-1.661	0.097	Not Supported	
H7	GE $\leftarrow$ RE $\times$ EO	-0.072	0.033	-2.180	0.029	Supported Moderation	(Negative)
H8	GE $\leftarrow$ RR $\times$ EO	-0.040	0.031	-1.306	0.192	Not Supported	
H9	GE $\leftarrow$ BV $\times$ EO	-0.015	0.032	-0.481	0.631	Not Supported	
H10	GE $\leftarrow$ ED $\times$ EO	0.163	0.031	5.232	***	Supported Moderation	(Positive)

Note: *** = $p < 0.001$.

Theoretical and Managerial Implications

This study makes a significant contribution to the literature on circular economy practices, green entrepreneurship, and entrepreneurial orientation by extending the application of Dynamic Capabilities Theory in Ghana's agro-processing sector. Our findings show that all the dimensions of the circular economy, such as waste minimization, resource efficiency, recycling and reuse, by-product valorization, and eco-design, have a positive influence on green entrepreneurship. Our findings support the previous argument, which states that sustainability-oriented capabilities can serve as strategic resources for achieving environmental and entrepreneurial outcomes. In addition, the result of the SEM analysis showed that entrepreneurial orientation initiatives strengthen green entrepreneurship. The positive moderation linking eco-design and green entrepreneurship suggests that firms with innovative, proactive, and risk-taking capabilities are capable of transforming sustainable initiatives into entrepreneurial opportunities in the agro-processing sector.

From a managerial perspective, our research provides a practical understanding for SME owners, managers, policymakers, entrepreneurs, and individuals to understand the importance of circular practices in enhancing business performance and environmental sustainability. Specifically, Managers in the agro-processing sector should take advantage of these findings to prioritize circular economy initiatives in their production systems to improve operational efficiency, minimize waste generation, and address environmental challenges. Since the SEM analysis showed that entrepreneurial orientation strengthens green entrepreneurship through innovation, proactive market strategies, and calculated risk-taking will help them to be more strategic in their business operations. Because our study provides practical evidence for policymakers, government agencies, and SME owners that adopting circularity can translate into green entrepreneurship, it should support agro-processing SMEs through sustainability training, financial incentives, and environmentally focused policies that encourage green entrepreneurial activities and sustainable industrial development in Ghana.

Limitations and Future Research Directions

Despite the valuable contributions of our research to the already existing literature, some limitations still occur. First, we used a cross-sectional research design to gather information from the participants for the research. Future studies may employ longitudinal designs to scrutinize how circular economy practices and entrepreneurial orientation influence green entrepreneurship over time. Second, our study focused only on agro-processing SMEs in selected regions of Ghana, specifically the Ashanti and Central regions. Therefore, the findings may not be generalized to other sectors when a similar study is conducted within Ghana and beyond. Further research should expand the geographical scope to developed economies and include other sectors, such as the manufacturing sector, and compare circularity initiatives in less developed economies to provide a broader theoretical and practical understanding of green entrepreneurship. Additionally, we used a structured questionnaire for our data collection from a single sector of the economy, which may be biased in the data collection process. We recommend that future researchers combine quantitative and qualitative approaches to obtain deeper insights into sustainability practices among SMEs. We examined entrepreneurial orientation as a moderating mechanism in the association between circular economy practice and green entrepreneurship. We recommend future investigators explore other variables such as innovation capability, environmental regulation, digital transformation, or organizational culture as mediators or moderators.

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All the authors have approved the final manuscript.

Data availability

The datasets generated and/or analysed during the current study are not publicly available due to confidentiality and ethical restrictions but are available from the corresponding author on reasonable request.

Ethics approval: The study protocol was approved by the Institutional Ethical Review Committee (IERC) of the University of Skills Training and Entrepreneurial Development (USTED), Kumasi, Ghana, under approval number USTED/IERC/2026/186.

Accordance statement: The study was conducted in accordance with the ethical requirements and guidelines of the USTED Institutional Ethical Review Committee (IERC), including requirements for informed consent, voluntary participation, confidentiality, and protection of participants' rights.

Consent to participate: Informed consent was obtained from all participants involved in the study. Participation was voluntary, and participants were informed of the purpose of the study; participants had the right to withdraw at any time, and their privacy was assured; their views would be treated confidentially, with no personal information required, and the data would be used solely for academic purposes.

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Credit to: **Solomon Gbene Zaato- PhD:** conceptualization, data curation, Formal analysis, Methodology, Writing original draft, resources, software, writing review & editing;

Gordon Ati: Conceptualization, Formal analysis, investigation, Methodology, validation, writing original draft, writing review & editing; resources, software, writing review & editing.

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