Examining the Impact of Circular Economy on the Corporate Profitability of Voltic Ghana Company Ltd: The Mediation Effect of Process Innovation

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ABSTRACT

This study investigates the impact of circular economy practices on the profitability of Voltic Ghana Company Ltd, exploring the interplay between sustainability and financial performance within the dialog of industry-specific and geographic factors in Ghana. Amid growing environmental pressures on firms, this research emphasizes the importance of aligning economic efficiency with environmental stewardship to meet societal needs. Using purposive sampling, data from 100 respondents directly involved in circular economy practices were targeted, coded, and analyzed through SPSS (version 27) and validated using AMOS for dimensional reduction. The study reveals a positive and significant relationship between circular economy practices and corporate profitability, demonstrating that process innovation enhances these benefits by providing a competitive advantage. Additionally, the mediation analysis confirms that process innovation is a crucial intermediary, amplifying the profitability gains from circular economy initiatives. These findings underscore the economic viability of sustainable business models, offering empirical support for corporate decision-makers, investors, and policymakers to integrate circular economy principles with strategic innovation. This research provides a framework for companies in similar industries, bridging the gap between sustainability and profitability while guiding efforts to align environmental goals with business objectives.

Keywords: Circular Economy, Process Innovation, Corporate Profitability, Performance, Resources

INTRODUCTION

The development and wealth of societies heavily depend on natural resources, the environmental impact of manufacturing, and production economics. With population growth, economic expansion, and increasing standards of living, the demand for more and better goods rises, which in turn requires more natural resources and manufacturing activities. Without careful planning, these developments can result in resource depletion, increased landfill waste, higher pollution levels, and greater environmental impacts, such as climate change. Rising environmental awareness, stricter environmental laws, and the necessity for social responsibility are driving manufacturing companies to seek innovative, sustainable business practices. Although circular economy is considered one of the new economic development concepts, its roots date back to the 1960s. The circular economy has increasingly become a central framework for guiding public and private actions related to sustainable production and consumption. Governments and public bodies have widely adopted it as a new approach to addressing traditional policy challenges like waste management and recycling (OECD 2020; Völker, Kovacic, and Strand 2020). Additionally, the circular economy has emerged as a key business principle, driving incremental changes towards more sustainable production and consumption through techno-economic interventions to enhance efficiency and economic growth (Ghisellini, Cialani, and Ulgiati 2016). Given its rising prominence, social scientists are keen to explore the social and normative dimensions of circular economy (Corvellec et al. 2020; Gregson et al. 2015; Kovacic, Strand, and Völker 2020; Valenzuela and Böhm 2017). Their research examined how circular economy principles are implemented in policy and regulatory frameworks (Völker, Kovacic, and Strand 2020), the various moral economies supporting circular economy policies (Gregson et al. 2015), and how circular economy fosters different types of ecomodernist

socio-technical visions (Hobson 2016). The concept of the circular economy plays a significant role in the discussion about how firms can fully embrace corporate social responsibility in their operations and core strategies to address the growing scarcity and depletion of non-renewable resources (Stewart & Niero, 2018). Circular economy, grounded in the principles of recycling, reducing, and reusing, offers an alternative to the traditional linear economy model of production-consumption-disposal, enabling the reduction of resource use and waste production (Geissdoerfer et al., 2018; Gupta et al., 2019; Pagoropoulos et al., 2017; Teixeira et al., 2016; Tseng et al., 2018). Consequently, circular economy has garnered significant interest from both academics and practitioners and has begun to be incorporated into the corporate social responsibility agendas of firms worldwide (Heyes et al., 2018; Mendoza et al., 2017; Urbinati et al., 2017; Yang et al., 2019). In recent years, many large firms have adopted the circular economy approach, viewing it as a new perspective on sustainability and corporate social responsibility that can enhance their image, reputation, and financial performance (Fortunati et al., 2020). At the firm level, this new perspective primarily involves implementing waste management, reduction, and recycling practices to meet environmental requirements and customer expectations (Agan et al., 2013; Ghisellini et al., 2016; Yang et al., 2019). The United Nations' Sustainable Development Goals (UN, 2015) aim to engage supply chain stakeholders in environmentally friendly practices. However, firms face challenges transitioning to a circular economy due to resource limitations (Rodríguez-Espíndola et al., 2022). To succeed in a circular economy, companies need to innovate their business models (van Renswoude et al., 2015). Finding solutions for the negative impacts of economic activities has become a global priority, leading to a shift towards sustainable development (Johnson & Wilson, 1999) to prevent resource depletion (UN, 2015). The UN's Sustainable Development Goals encourage supply chain stakeholders to adopt environmentally friendly practices. However, the transition to a circular economy is challenging for firms due to limited resources (Rodríguez-Espíndola et al., 2022). Companies need to base their activities on innovative business models to operate in a circular economy (Van Renswoude et al., 2015). Despite the highlighted benefits of circular economy, empirical evidence linking its practices to firm performance remains mixed and scarce (Moric et al., 2020). Moreover, the majority of studies rely on corporate sustainability reports instead of primary data, with few examining circular economy practices at the firm level (Stewart & Niero, 2018). Their research aimed at filling these gaps by analyzing the causal relationships between CE practices (waste treatment, reduction, and recycling), brand reputation, and financial performance using structural equation modeling (SEM) on data from 404 large manufacturing firms in Italy. The findings indicate that waste treatment and recycling enhance financial performance through improved brand reputation, while reduction practices directly boost financial performance by cutting costs. The role of process innovation in improving circular economy practices and corporate profitability remains underexplored, particularly across different political and economic sectors. Process innovation has consistently attracted attention from the business sector due to increasing environmental concerns (Abdullah, Zailani, Iranmanesh, & Jayaraman, 2016). Manufacturing firms, particularly those in highly polluting industries, have a crucial role in environmental protection. Beyond the environmental benefits, firms should also address customer needs and uphold corporate social responsibility (Woo, Chung, Chun, Han, & Lee, 2014). Process innovation involves the creation of new ideas, products, services, processes, or management systems aimed at addressing environmental issues (Rennings, 2000). It can significantly reduce environmental pollution and the adverse effects of resource and energy consumption, thereby promoting sustainable development (Kemp & Pearson, 2007). Process innovation is crucial in enabling circular economy practices by developing technologies and systems that support resource recovery and recycling (Geissdoerfer et al., 2017). Since these papers were published, numerous studies have supported the notion that challenges to competitive advantages can diminish the impact of being a first mover. The issue lies not just in creating value-added products, which unexpectedly reduce a firm's profitability, as argued by Teece (1986, 2006), Suarez and Lanzolla (2005), Pisano and Teece (2007), Bamberger (2008), McCarthy et al. (2010), Kim and Lee (2011), Lieberman and Montgomery (2013), Vidal and Mitchell (2013), Gomez et al. (2016), and Mackelprang et al. (2018). Consequently, while there has been an abundant stream of innovation research, it has also been prone to bias, particularly when applied in the dynamic context of current times. Process innovation can mediate the relationship between circular economy practices and corporate performance, leading to enhanced outcomes (Chen et al., 2010). Companies adopting circular economy principles often achieve enhanced financial performance, including cost savings and improved market access due to sustainability advantages Geissdoerfer et al., 2017). Process innovation aims to achieve a dual benefit: reducing environmental impact and advancing technological progress in the economy (Rennings, Ziegler, Ankele, & Hoffmann, 2006). Ziegler and Nogareda (2009) note that for green technology innovation to

succeed, it must be based on new technological knowledge and already be implemented, meaning either new products have been launched or new processes adopted within the firm. Limited research has been conducted on this subject matter hence, highlighting the need for this study to explore how circular economy practices influence corporate profitability, particularly through the mediating role of process innovation. To achieve the main objective of the study, the research sought to answer the following:

Q1: What is the effect of the circular economy practices on the corporate profitability of the firm?

Q2: How do circular economy practices influence process innovation?

Q3: What is the impact of process innovation on the corporate profitability of the firm?

Q4: Is there a mediating effect of process innovation on the relationship between circular economy practices and corporate profitability?

LITERATURE REVIEW

Circular Economy

A circular economy prioritizes greater resource usage and offers a circular movement of materials and energy. It does this by using the 3R (reduce-reuse-recycle) principles to establish a plan of action for businesses. The circular economy promises a brighter future for businesses, industries, and society by implementing it first at the corporate level and then at the industrial park and regional levels. Potential prospects brought about by the circular economy are covered in the next section. The circular economy has emerged in recent years as a framework for industrial and environmental policies in China (Winans et al., 2017; Zhu et al., 2019), Africa (World Economic Forum, 2020), the European Union (Völker et al., 2020), and the United States (ReMade Institute, 2021). It is also a popular choice for many businesses and local governments, including those connected to the Ellen MacArthur Foundation (2017). According to proponents, the circular economy is a regenerative strategy that extends product life cycles via design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling to reduce resource input, waste, emissions, and energy loss (Geissdoerfer et al., 2017). To encourage a shift from consumption to use and decouple economic development from environmental deterioration, this model imagines "closed loops" where material flows are halted (Lazarevic & Valve, 2017). Circular business models are thought to be ways to lower expenses, boost income, control risks, and make it possible for the financial industry to take part in sustainability shifts (Ellen MacArthur Foundation, 2020). Critiques of the circular economy come from a variety of disciplines, including human geography, ecological economics, and management, despite its widespread adoption. From a theoretical, economic, ideological, social, and environmental standpoint, these criticisms cast doubt on the viability and effects of the circular economy. In particular, detractors contend that policy support for circularity is frequently uncritical and overly optimistic, offering a "vague yet agreeable" concept that eludes examination and promises a win-win situation without agreement on the concrete advantages (Gregson et al., 2015; Lazarevic & Valve, 2017; Kovacic et al., 2020; Aguilar-Hernandez et al., 2021). In addition to possibly restricting critical debate and realistic evaluation (Lazarevic & Valve, 2017), this consensus-based approach may ignore alternative solutions that address the complex trade-offs and problems involved with shifting away from a linear economy (Völker et al., 2020). By compiling criticisms of circularity, this work makes a useful contribution by providing a realistic viewpoint on the shortcomings and restrictions of the circular economy. By doing this, it gives businesses a better grasp of what the general public expects, allowing them to produce goods that satisfy consumer demands and increase customer happiness.

Process Innovation

Innovation creates the groundwork for a company to achieve an economic-social-environmentally harmonious growth model, which has been widely supported by scholars and practitioners, while also striking a balance between environmental responsibility and profitability. For businesses looking to boost competitiveness and advance sustainable development, process innovation is essential (Terjesen & Patel, 2017; Von Krogh et al., 2018). By increasing production volumes, reducing lifecycle costs, reducing environmental impacts, and

improving efficiency, process innovation is defined as the adoption of new or significantly enhanced production or delivery methods involving notable changes in techniques, equipment, or software (OECD, 2005)—can give an organization a competitive edge (Pisano, 1996; Milewski et al., 2015; Schuman & Brent, 2005). However, since projects are often large and costly, putting process innovations into practice may also be financially risky. These risks might include cost overruns, delays, quality problems, and production interruptions like plant outages (Filippou & King, 2011; Lager, 2012; Rönnberg Sjödin et al., 2016). Advances in digital technologies, such as the Internet of Things, artificial intelligence, and automation, are driving process innovation in today's dynamic environment, posing both possibilities and problems (Iansiti & Lakhani, 2014; Porter & Heppelmann, 2014; Sjödin et al., 2018). For example, manufacturers and their networks face considerable unpredictability and complexity when integrating autonomous manufacturing systems into the current production infrastructure (Parida et al., 2018; Sjödin et al., 2018). Businesses must effectively manage the application of knowledge and skills for continuous manufacturing process innovations if they want to stay competitive (Terjesen & Patel, 2017). Businesses may lessen the adverse effects of their operations on the environment by using process innovation. The industry's transition to sustainable production and the development of sustainable manufacturing initiatives are greatly aided by process innovation. Furthermore, as the knowledge required to build and deploy specialized process equipment sometimes falls outside of their key competencies, businesses usually work with equipment suppliers to co-create new process solutions (Lager, 2012; Bruch & Bellgran, 2012). Internal operations and process innovation are closely intertwined, thus equipment vendors must use customer expertise to tailor solutions to specific design requirements (Robertson et al., 2012; Rönnberg Sjödin, 2013). To successfully co-create ecosystems, collaborative innovation ventures must overcome significant obstacles in the areas of knowledge collection, processing, and recombining. There is a need for more understanding of managing value co-creation in open process innovation because, despite these complexities, little is known about how firms design knowledge-processing activities for process innovation development (Keupp et al., 2012; Von Krogh et al., 2018; Robertson et al., 2012; Rönnberg Sjödin, 2013). Therefore, this study presents process innovation as an inter-organizational, knowledge-intensive activity focused on cooperative problem-solving and the creation and sharing of technological knowledge among ecosystem participants (Terjesen & Patel, 2017; Milewski et al., 2015; Eriksson et al., 2016). In this sense, process innovation will become a fundamental prerequisite for gaining legitimacy in addition to being a significant means for businesses to get a competitive edge in the future.

Corporate Profitability

One kind of firm performance metric is financial performance. By computing and understanding financial ratios, ratio analysis may be used to assess and track financial performance. One of the financial ratio categories that gauges the rate of return is profitability. Corporate profitability may be measured using a variety of metrics. Various metrics have been used in many studies to evaluate the profitability of businesses. For example, scholars like Al-Omar and Al-Mutairi (2015), Darayseh and Chazi (2018), Menicucci and Paolucci (2016), Mokni and Rachdi (2014), Zheng, Sarker, and Nahar (2018), Al-Homaidi et al. (2018), Almaqtari et al. (2018), and Al-Homaidi et al. (2019) have frequently used ROA (Return on Assets). However, Waleed, Pasha, and Akhtar (2016) chose to use EPS (Earnings per Share) to measure profitability in different countries. Although it is still unclear how corporate governance affects operational performance, Haque and Arun (2016) found a favorable correlation between business value and corporate governance quality. While audit committee size, institutional ownership, and management ownership had no effect on profitability, Herdjiono and Sari (2017) discovered that a bigger board of directors was positively correlated with profitability. ROE (Return on Equity) and board size showed a modest negative link, whereas ROE and board independence showed a moderate positive correlation, according to Dzingai and Fakoya (2017). Additionally, they found a tiny negative link between equity returns and company size and a moderate positive correlation between equity returns and sales growth. However, since prosperous companies are less likely to manipulate profits, Kapoor and Goel (2017) found that profitability has a substantial impact on the relationship between audit committee independence and earnings management. According to Ahmad and Al-Homaidi (2018), among tourist enterprises, public ownership had the least visibility, while board size and audit committee size were the most significant indicators revealed. Last but not least, Jackling and Johl (2009) proposed that bigger boards have a beneficial effect on profitability because they provide access to a wider range of resources and enhance external participation. The foundation of value creation for stakeholders is the return on equity, a profitability

metric that can be used to gauge the rate of return on investments made by shareholders (Gitman & Zutter, 2015). As a result, identifying the elements that influence it becomes crucial (Pantea, Gligor, & Anis, 2014). Corporate profitability may be influenced by several variables, with capital structure being one of the most important. The amount of debt and equity that businesses utilize to fund their operations is referred to as their capital structure. This is because economies of scale will result in a cheaper cost per unit for the business. As a result, business size and profitability are positively correlated. Macroeconomic elements are external to the business and outside management's control, in contrast to financial indicators. These elements do, nevertheless, have an impact on business profitability. Another macroeconomic element that may have an impact on business success is the interest rate. Profitability is impacted by low interest rates and interest rate volatility (Bikker & Vervliet, 2018). Profit is a measure of how effectively and efficiently organizational units use the company's resources. Profitability is often used to describe a company's capacity to make money and its prospects for the future; a high profitability number denotes a high degree of efficiency and profit (Andreas et al., 2015).

Theoretical Review

According to Kivunja (2018) in Kerlinger and Lee (2000, p. 11), a theory is a collection of connected ideas, definitions, and propositions that provide a methodical perspective on a phenomenon by defining the relationships between variables to explain and forecast the phenomenon. Three fundamental hypotheses have been used to structure this investigation. The ideas of the resource-based approach are expanded upon by the dynamic capabilities view. The dynamic capabilities perspective goes beyond the resource-based approach, which concentrates on a company's existing resources, including its organizational, human, and physical assets, to comprehend how businesses may construct strategies that generate value and achieve long-term competitive advantages (Maghzi, 2018). According to Barney (1986) and Eisenhardt and Martin (2000), dynamic capability highlights a company's capacity to adjust, integrate, and reorganize its resources over time to react to changing market circumstances and take advantage of new possibilities. Over the last three decades, technical progress has accelerated, product lifespans have decreased, globalization has expanded, and many sectors have merged. These elements have helped to increase the dynamic nature of corporate settings. Therefore, to successfully traverse and adjust to these shifting settings, leaders in businesses need dynamic competencies (Zhou et al. 2019). According to Gupta et al. (2020), companies are enhancing their capacity to adjust to erratic situations by using or investigating resources and technology. If companies want to effectively adjust to issues regularly, they need to have dynamic skills (Opuni, 2022). The dynamic capability approach emphasizes how a business can adapt and use its resources to accomplish a particular objective (Amit and Schoemaker, 1993; Helfat and Peteraf, 2003). Teece and Pisano (1994) assert that by replacing existing resources, dynamic capabilities may provide extraordinary outcomes by creating a more efficient alignment between an organization's resource configuration and external environmental conditions. Companies were first forced to react to the COVID-19 supply chain disruption, and then they had to develop new resources, solutions, and resilience-enhancing skills (Kähkönen et al. 2023). For enterprises to succeed in the modern environment, they need to possess dynamic skills. Businesses that are unable to adjust and respond to changing customer tastes and volatile market circumstances would find it difficult to thrive (Opuni, 2022). Therefore, businesses need to have dynamic capacities in order to embrace process innovation, corporate profitability, and the circular economy. This will improve supply chain coordination, enable them to adapt to unanticipated organizational changes and boost overall business performance. Additionally, stakeholder theory has origins in four major academic fields: politics, economics, history, and ethics. These fields are especially relevant to framework theory, corporate social responsibility, corporate planning literature, and organizational philosophy. Generally considered the actual implementation of stakeholder theory, Freeman (1984) describes in his book "Strategic Management" how stakeholders with common interests and rights impact and mold a community. Freeman's concept emphasizes the company's connection with its stakeholders and focuses on the relationship between an organization and its external environment. According to this concept, stakeholder and company connections are interconnected and dyadic (Frooman, 1999). The fundamental idea of Stakeholder Theory, as expounded by Savage et al. (2004), is forming alliances with different parties that both influence and are impacted by the company, referred to as "stakeholders." The approach focuses on managing and establishing fruitful relationships between the business and its stakeholders while acknowledging the importance of each stakeholder's concern without giving preference to any one dominating group of interests. Stakeholder theory

explores managerial decision-making and clarifies how stakeholders try to sway organizational structures to suit their goals and preferences. Diverse stakeholders' requirements should be taken into account and accommodated by organizations. Stakeholder management, according to Baldwin (2002), is a framework for identifying, assessing, and researching the traits of partners impacted by business conduct. This makes it easier to manage at three important levels: identifying stakeholders, putting in place systems to comprehend and respond to their needs and wants, and cultivating alliances while keeping the organization's objectives front and center. Once again, institutional theory states that organizations' decision-making processes are impacted by institutional and technological factors (Sharma et al., 2023). Additionally, it implies that adaptive mechanisms shape organizational processes, hence reducing the impact of individual members (Colwell and Joshi, 2013). The understanding that organizations function within a larger social network and are not just impacted by one-on-one connections is one of the fundamental principles of institutional theory. As a result, social effects that are engrained in institutional systems and linked networks of organizations greatly impact how enterprises behave (Lin and Sheu, 2012). Institutional pressure describes how an organization's structure and behavior are influenced by its institutional environment, which includes social conventions, regulations, and culture (Qian and Burritt, 2009). The idea of institutionalism looks at how the organizational structure is shaped by outside forces. According to Sharma et al. (2023), these elements include environmental laws such as technical standards, taxation schemes, emission permit schemes, and procedures meant to lessen adverse environmental effects. It is generally accepted that social institutions have a significant impact on how a business behaves and approaches its business (Scott, Smith, and Hitt, 2005). Coercive, normative, and mimetic factors are three facets of the institutional theory that have been recognized by prior research as explaining how institutional changes promote adherence to existing structures and procedures (DiMaggio and Powell 1983; Zsidisin et al. 2005). Strategically reacting to these external influences may help organizations accomplish their main goal of gaining legitimacy from stakeholders (Cavusoglu et al. 2015). Institutional theory views an organization's activities as the result of outside influences that mold the organization's decision-making procedures (Heugens and Lander, 2009). Organizations can recognize the impact of institutional theory on their performance and competitive advantage by coordinating supply vulnerability mitigation strategies with institutional pressures resulting from industry standards, government regulations, customer expectations, and social responsibility. Organizations may flourish in the fast-paced corporate world of today because of this alignment, which promotes a positive interaction between them and their larger institutional context.

Hypothesis Development

The authors labeled the following hypothesis about the study: Circular economy practices have a positive impact on the corporate profitability of the firm (h_1), circular economy has a significant influence on the process innovation of the firm (h_2), a positive relationship between process innovation and corporate profitability (h_3), and process innovation positively mediates the relationship between circular economy practices and the corporation's profitability (h_4).

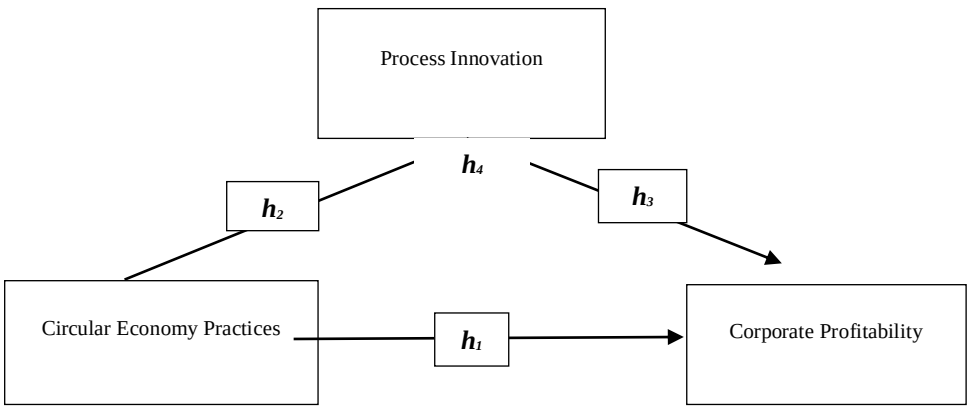

Fig. 1 Study Model Framework

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METHODOLOGY

Understanding the connection between company profitability and circular economy practices at Voltic Ghana Company Ltd. was the goal of the study's research design. By establishing the conceptual and theoretical framework, explanatory research sought to explain the phenomena using theories or hypotheses. Procurement managers, supply chain and logistics managers, production managers, operations managers, store and marketing managers, warehouse managers, and senior executives were all involved in the research. Cronbach's alpha reliability analysis and pilot testing were used to validate the selection of a sample of 100 industry respondents. Respondents with an extensive understanding of sustainability concerns and circular economy activities were chosen using purposive sampling approaches. For more than 20 years, Voltic (GH) Limited, a division of Coca-Cola Beverages Africa, has been providing Ghanaian customers with pleasant Natural Mineral Water and more recently, Value Added Dairy (VAD) products. The business just completed its EMS audit and has NOSA, FSMS, and QMS certifications. It was named 'Water Brand of the Year' at the Ghana Beverage Awards in 2019 and 2020, and it is the only water firm in Ghana with an ISO Certification. The most popular bottled water brand in Ghana is Voltic Natural Mineral Water, which offers high-quality water that is enriched with vital natural ingredients for strong, healthy development.

DATA ANALYSIS AND RESULTS

The demographic analysis in Table 1 revealed diverse characteristics of the respondents and their essential for this study. For this study, a total of 100 questionnaires were distributed. Out of these, 71 were successfully received, representing a 71% response rate, while 29 were not successful, accounting for 29%. The importance of a high response rate was emphasized, as it ensures that the collected data accurately represents the intended population, while a low response rate increases the risk of nonresponse bias. The demographic data from this study highlights key characteristics of the respondents, focusing on gender, age, education level, and work experience within the organization. The gender distribution shows that a majority of participants were male (56.3%), with females making up 43.7%. The mean value for gender was 1.44 with a standard deviation of 0.499, indicating a fairly balanced gender representation. Regarding age, most respondents were in the younger age groups, with 46.5% between 18 and 30 years and another 46.5% between 31 and 40 years. Only a small percentage were over 40 years old, reflecting a largely youthful workforce (mean = 1.62, std. dev. = 0.663). In terms of educational attainment, the majority of participants had advanced degrees, with 46.5% holding undergraduate qualifications and another 46.5% holding master’s degrees. Only 1.4% had a Ph.D., indicating a highly educated group overall (mean = 2.44, std. dev. = 0.626). The majority of employees had 1-5 years of experience (63.4%), while 25.4% had 6-10 years, and just 11.3% had over 10 years of experience. This suggests the organization may be relatively young or experiencing growth (mean = 1.48, std. dev. = 0.694). These findings reflect a predominantly young workforce, well-educated in the organization.

Table 1. Demographics of Respondents

Items	**Variables**	**Frequency**	**Valid Percentage**	**Mean**	**Std. Deviation**
Gender	Male	40	56.3%	1.44	0.499
	Female	31	43.7%		
Age	18 - 30 years	33	46.5%	1.62	0.663
	31 - 40 years	33	46.5%		
	41 - 50 years	4	5.6%		
	Above 50 years	1	1.4%		

Highest Educational Level	Diploma/HND	4	5.6%	2.44	0.626
	Undergraduate	33	46.5%		
	Masters	33	46.5%		
	PHD	1	1.4%		
Years working in the Organization	1-5 years	45	63.4%	1.48	0.694
	6-10 years	18	25.4%		
	Above 10 years	8	11.3%		

Descriptive Statistics

To guarantee construct reliability and comparability with previous research, the questionnaire included validated scales from other investigations. Established scales from Reikev et al. (2017) and Ghisellini et al. (2016), which cover crucial aspects of sustainability, resource optimization, and waste reduction, served as the foundation for the construct of circular economy activities. To assess the firm's capacity to implement innovative procedures that boost productivity and profitability, the research modified scales from Pisano et al. (2015), Bessant et al. (2018), and Damanpour et al. (2012). The business profitability construct focused on financial performance measures related to the effect of the circular economy and used scales from Behrens et al. (2016) and Kirchherr et al. (2017). Every scale was thoroughly examined and, if required, gently adjusted to conform to Voltic Ghana Company Ltd., guaranteeing that it was pertinent to the participant's responsibilities and that they were acquainted with the constructions. This research used descriptive statistics, which include statistical methods for organizing, summarizing, and interpreting important aspects of a dataset, to provide succinct descriptions of the measurements and samples used. In particular, the constructs were analyzed using the mean and standard deviations. A 5-point Likert scale, with 1-2 representing "strongly disagree" and 4-5 representing "strongly agree," was used to gauge participants' degree of agreement with the research constructs. Intermediate points allowed for more accurate answers. Ratings of 4 and above were viewed as agreement, while a score of 3 denoted neutrality or ambiguity. In this research, constructs with mean values higher than 3.00 were deemed adequate.

Descriptive Statistics Results for Circular Economy

A descriptive statistical study of several circular economy and sustainability strategies inside a business is shown by the data. The mean score for recycling practice implementation was 3.35 with a standard deviation of 1.122, suggesting considerable agreement. The kurtosis (-0.501) and negative skewness (-0.429) point to a somewhat flat and left-skew distribution. With a mean score of 3.17 (standard deviation = 1.183), the utilization of renewable resources performed marginally worse. It also showed a flatter kurtosis (-0.935) and a minor negative skew (-0.178). With a mean of 3.69 and a standard deviation of 0.935, a more noticeable left-skew (-0.738), and a near-normal kurtosis (0.153), efficient waste management techniques were evaluated higher. The mean score for ways to reduce resource consumption was 3.45 (std. dev. = 0.953), indicating considerable agreement. It also showed negative kurtosis (-0.513) and a small left-skew (-0.314). The integration of the circular economy into supply chain operations received a rating of 3.56 (std. dev. = 0.890), with a near-normal kurtosis (0.123) and a greater left-skew (-0.759). Repair and refurbishing are examples of product life extension activities that received a score of 3.72 (std. dev. = 0.959), with a considerable left-skew (-0.600) and a distribution that is almost normal (-0.071). With a somewhat left-skewed distribution (-0.459) and a positive kurtosis (0.766), the circular economy efforts that resulted in cost savings had the highest mean score of 3.82 (std. dev. = 0.816), suggesting some concentration of greater agreement among responders. According to this research, there are generally moderate to high levels of agreement on the organization's adoption of and benefits from sustainability and circular economy policies.

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Table 2. Descriptive Statistics Results of Circular Economy

Items	Min	Max	Mean	Std. Deviation	Skewness	Kurtosis
Recycling practices are effectively implemented in our operations.	1	5	3.35	1.122	-.429	-.501
Our company actively uses renewable resources in production.	1	5	3.17	1.183	-.178	-.935
Waste management practices are efficient and well-organized.	1	5	3.69	.935	-.738	.153
There is a clear strategy in place for reducing resource consumption.	1	5	3.45	.953	-.314	-.513
Circular economy principles are integrated into our Supply Chain activities.	1	5	3.56	.890	-.759	.123
Our company actively engages in product life extension practices (e.g., repair, refurbishment).	1	5	3.72	.959	-.600	-.071
Circular economy initiatives have led to cost savings for our company.	1	5	3.82	.816	-.459	.766

Descriptive Statistics Results for Process Innovation

The data provides descriptive statistics on various aspects of technological and process innovations within a company. The statement "Our company frequently introduces new technologies to improve production processes" has a mean score of 3.80, with a standard deviation of 0.980, indicating a generally positive agreement among respondents. The negative skewness (-0.901) suggests that more responses leaned toward the higher end of the scale, while the kurtosis (0.658) indicates a slightly peaked distribution. Similarly, for the implementation of new production processes within the last five years, the mean score was 3.63 (std. dev. = 1.045), with a negative skew (-0.753) and a relatively flat kurtosis (0.120), showing a moderate tendency toward agreement. When asked whether process innovations have significantly enhanced operational efficiency, respondents reported a mean of 3.85 (std. dev. = 0.786), the highest in this dataset, with a notable negative skew (-0.804) and a strong positive kurtosis (1.677), suggesting a concentration of responses in favor of the statement. The encouragement of employees to suggest process improvements had a mean score of 3.70 (std. dev. = 0.977), showing moderate agreement, with a smaller negative skew (-0.598) and a positive kurtosis (0.228). Lastly, the existence of a structured approach to evaluating and adopting new process innovations received a mean score of 3.65 (std. dev. = 1.001), with skewness of -0.728 and kurtosis of 0.080, reflecting a generally positive but slightly more dispersed set of responses.

Table 3. Descriptive Statistics Results of Process Innovation

Items	Min	Max	Mean	Std. Deviation	Skewness	Kurtosis
Our company frequently introduces new technologies to	1	5	3.80	.980	-.901	.658

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improve production processes.						
We have implemented new production processes within the last five years.	1	5	3.63	1.045	-.753	.120
Process innovations have significantly enhanced our operational efficiency.	1	5	3.85	.786	-.804	1.677
Our company actively encourages employees to suggest process improvements.	1	5	3.70	.977	-.598	.228
There is a structured approach to evaluating and adopting new process innovations.	1	5	3.65	1.001	-.728	.080

Descriptive Statistics Results for Corporate Profitability

The data illustrates the relationship between profitability, process innovations, and circular economy practices within the company. The statement "Our company has experienced an increase in profitability over the past five years" has a mean of 3.96, with a standard deviation of 0.901. The negative skewness (-0.999) indicates that most responses are on the higher end of the scale, while the kurtosis (1.111) suggests a concentration of responses near the mean. Circular economy practices also appear to have had a positive influence on profitability, with a mean score of 3.72 (std. dev. = 0.796), showing a mild negative skew (-0.143) and relatively flat kurtosis (-0.386), indicating a broad range of responses around the mean. The contribution of process innovations to cost savings had a high mean of 3.93 (std. dev. = 0.724), with a moderate negative skew (-0.591) and a positive kurtosis (0.707), indicating some concentration of higher responses. Profitability as a strategic objective scored 4.07 (std. dev. = 0.762), showing strong agreement among respondents, with a mild skew (-0.519) and a nearly normal kurtosis (0.014). The alignment of circular economy practices with financial goals had a mean of 3.89 (std. dev. = 0.747), with a negligible skew (-0.024) and slightly negative kurtosis (-0.703), reflecting generally positive agreement with little variation. Lastly, profitability as a measure of success in sustainability initiatives received the highest mean score of 4.18 (std. dev. = 0.743), with a more pronounced negative skew (-0.741) and a moderate positive kurtosis (0.563), indicating strong agreement and consistency among respondents. The data reflects a clear perception that both process innovations and circular economy practices contribute positively to the company's profitability and align well with its strategic financial objectives.

Table 4. Descriptive Statistics Results of Corporate Profitability

Items	Min	Max	Mean	Std. Deviation	Skewness	Kurtosis
Our company has experienced an increase in profitability over the past five years.	1	5	3.96	.901	-.999	1.111
Circular economy practices have positively influenced our company's profitability.	2	5	3.72	.796	-.143	-.386
Process innovations have contributed to cost savings for our	2	5	3.93	.724	-.591	.707

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company.						
Corporate profitability is a key metric in our company's strategic objectives.	2	5	4.07	.762	-.519	.014
The implementation of circular economy practices aligns with our financial goals.	2	5	3.89	.747	-.024	-.703
Our company views profitability as a measure of success in sustainability initiatives.	2	5	4.18	.743	-.741	.563

Correlational Analyses

In this section of the study, bivariate correlational analyses of the main constructs of the study are examined. Individual and composite constructs developed were tested in terms of their correlational relationships. The bivariate correlational analysis of the study is shown in Table 5 Spearman's Rho is below the diagonal. Considering the transformation of latent constructs from observed variables, Spearman's correlation method was deemed more appropriate for non-numerical or discrete variables. The correlation matrix provides insights into the relationships between gender, education level, years of experience, circular economy practices, process innovation, and corporate profitability. Gender shows a small negative correlation with corporate profitability ($r = -0.253$, $*p < 0.05$), indicating a weak but statistically significant relationship. This suggests that gender may have a slight inverse association with profitability, although the effect size is minimal. Additionally, gender does not exhibit significant correlations with other variables such as circular economy or process innovation. The highest educational level shows no significant correlation with other variables in this matrix, with very weak associations across the board. Years working in the organization also exhibit weak correlations, none of which are statistically significant, though it has a slight positive relationship with circular economy practices ($r = 0.136$) and process innovation ($r = 0.081$). The most notable correlations involve circular economy practices and process innovation, which are strongly correlated ($r = 0.561$, $**p < 0.01$). This indicates a robust relationship, suggesting that organizations focusing on circular economy principles are also likely to engage in process innovations. Both of these factors are also significantly correlated with corporate profitability and circular economy ($r = 0.526$, $**p < 0.01$) and process innovation ($r = 0.629$, $**p < 0.01$) highlighting their positive impact on profitability. These findings suggest that circular economy initiatives and process innovations are key drivers of corporate profitability within the organization.

Table 5. Inter-Construct Correlation

	Items	Gender	Highest Educational Level	Years working in the organization	CE	PI	CP
Gender		1					
Highest Educational Level		.158	1				
Years working in the organization		-.200	.137	1			
Circular Economy		-.043	-.074	.136	1		

Process Innovation	-.195	-.026	.081	.561**	1	
Corporate Profitability	-.253*	.049	.043	.526**	.629**	1
*. Correlation is significant at the 0.05 level (2-tailed).						
**. Correlation is significant at the 0.01 level (2-tailed).						

CONFIRMATORY FACTOR ANALYSIS

For measurement model validity and reliability, Confirmatory Factor Analysis was conducted using AMOS graphics and Fornell 1981 formulated Excel file. The process employed the maximum likelihood estimation method for testing the validity and reliability of the constructs. The model measurement evaluation was conducted, as a pre-requisite for the structural model analysis. Examining the reflective model measurement is the first step in the model measurement evaluation, the use of indicator loading was employed, and the result is presented in Table 8. The table presents the factor loadings, Cronbach's Alpha (CA), Composite Reliability (CR), and Average Variance Extracted (AVE) for three constructs: Circular Economy, Process Innovation, and Corporate Profitability. These measures help assess the reliability and validity of the constructs in the study. For Circular Economy, all five items (CE1 to CE5) have loadings ranging from 0.624 to 0.784, indicating moderate to strong relationships with the construct. The Cronbach's Alpha (CA) of 0.839 and Composite Reliability (CR) of 0.853 indicate good internal consistency, while the AVE of 0.538 suggests that the construct explains more than half of the variance in its items, indicating acceptable convergent validity. Process Innovation has four items (PI1 to PI4), with loadings from 0.572 to 0.839, showing varying strength in their relationships with the construct. The CA of 0.849 and CR of 0.818 show good reliability, though the AVE of 0.535 is on the lower side, but still meets the threshold for convergent validity. For Corporate Profitability, the loadings for the five items (CP2 to CP6) range from 0.657 to 0.843, indicating moderate to strong item-construct relationships. The CA of 0.866 and CR of 0.860 reflect excellent internal consistency. The AVE of 0.509, though slightly lower, still supports acceptable convergent validity. All three constructs demonstrate satisfactory reliability and validity, with strong internal consistency and acceptable levels of variance explained by the respective items.

Table 6. Reliability and Validity Test

Constructs	Items	Loadings	CA	CR	AVE
Circular Economy	CE1	0.759	0.839	0.853	0.538
	CE2	0.784			
	CE3	0.753			
	CE4	0.736			
	CE5	0.624			
Process Innovation	PI1	0.839	0.849	0.818	0.535
	PI2	0.815			
	PI3	0.572			
	PI4	0.667			
Corporate Profitability	CP2	0.843	0.866	0.860	0.509

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	CP3	0.751			
	CP4	0.657			
	CP5	0.723			
	CP6	0.67			

Goodness of Fit Measure

The next phase of the analysis is the structural model assessment and hypothesis testing via the variances of dependent variables, as well as the model's predictive relevance using Stone-Q2, Geisser's path coefficients, and significance levels, once the measurement model evaluation meets all of the reliability and validity thresholds (t-values).

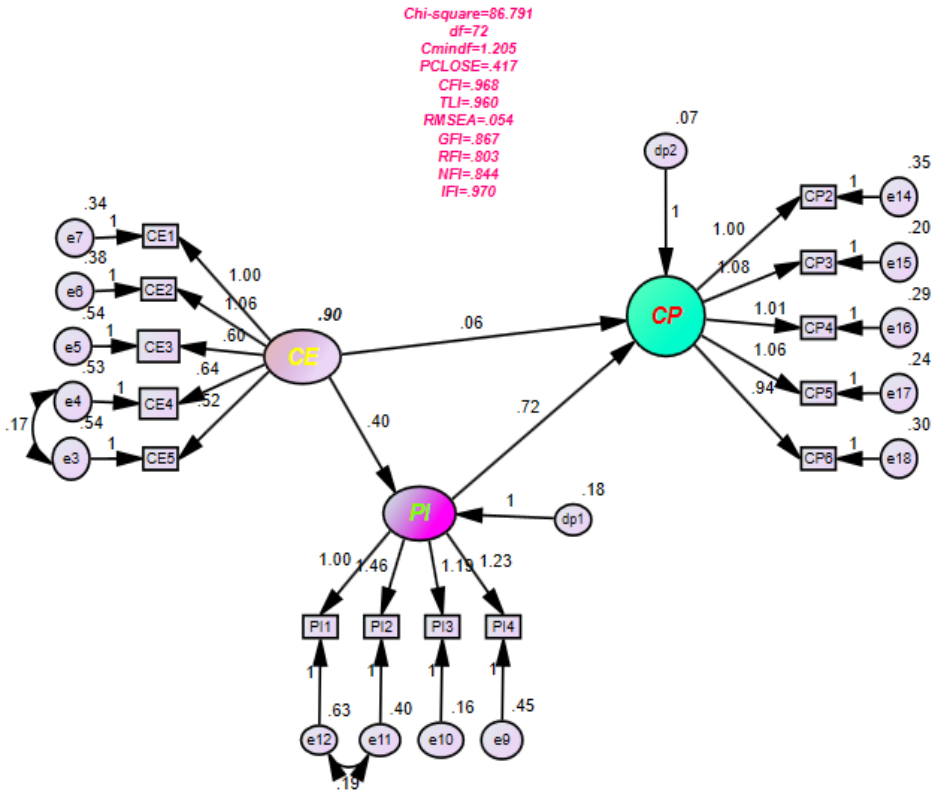

Fig. 2. Measurement Model Evaluation

The model depicts how these constructs interact and the strength of their respective influences, supported by factor loadings and path coefficients. The model fit indices provide a mixed assessment of the model's overall fit. A chi-square value of 86.791 with 72 degrees of freedom results in a chi-square/df ratio (CMIN/df) of 1.205, indicating an excellent fit, as values close to 1 suggest minimal deviation between the observed and predicted data. The P-CLOSE value of 0.417, above the recommended 0.05 threshold, supports the null hypothesis of a close model fit. The Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI) scores of 0.968 and 0.960, respectively, further validate the strong fit, as both values exceed the 0.90 benchmark. The Root Mean Square Error of Approximation (RMSEA) value of 0.054, below the 0.08 threshold, reinforces the model's adequacy. The Goodness of Fit Index (GFI) of 0.867 and Normed Fit Index (NFI) of 0.844, although slightly below the ideal 0.90 mark, indicate a satisfactory fit. The Incremental Fit Index (IFI) score of 0.970 highlights the model's excellent performance, capturing meaningful relationships among the constructs. These indices confirm the reliability of the pathways, showing that Circular Economy practices positively influence Corporate Profitability, with Process Innovation playing a critical mediating role.

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Structural Evaluation Model

The analysis begins with the relationship between circular economy practices and corporate profitability. The path coefficients indicate a strong positive relationship of 0.65 between the circular economy and process innovation, suggesting that initiatives in sustainability significantly drive innovations in processes. The coefficient of 0.49 between process innovation and corporate profitability implies that innovations lead to improved profitability. The relationship of 0.29 between the circular economy and corporate profitability, while weaker, shows that circular economy practices can still affect profitability, primarily through process innovation. Additionally, a strong direct effect of 0.50 from corporate profitability to an unspecified factor suggests other unmeasured influences impacting profitability. Error terms in the model, denoted as d1 and d2, represent unexplained variance in process innovation and corporate profitability, respectively, accounting for additional factors not captured within the model. The insights from this framework reveal the interconnectedness of sustainability, innovation, and financial performance, highlighting that a focus on sustainability can enhance financial outcomes through innovation. This suggests that companies adopting circular economy practices may experience financial benefits by fostering process innovations. Furthermore, process innovation is a crucial mediator, indicating that improvements in business processes are essential for translating circular economy efforts into better profitability.

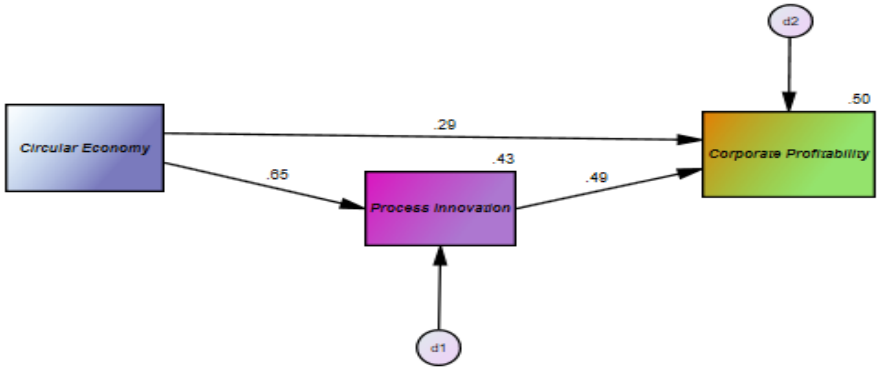

Fig. 3. Structural Evaluation Model

Hypothesis Findings

The study started by developing three hypotheses based on a literature review. The hypotheses were tested after gathering and analyzing data to determine their validity. Table 7 summarizes the hypotheses, including the regression weight, significance level, and remarks on the findings.

Table 7: Hypothesis

	Coefficient	T-Statistics	P-Values	Results
H_1: Circular Economy -> Corporate Profitability	0.2047	2.5353	0.0135**	Supported
H_2: Circular Economy -> Process Innovation	0.5107	7.1800	0.000***	Supported
H_3: Process Innovation -> Corporate Profitability	0.4480	4.3344	0.000***	Supported
H_4: CE-> PI -> CP	Indirect Effect 0.2288	T-value 3.36	Boot SE 0.006***	Supported

The findings of the structural model analysis evaluate several theories on the connections among business profitability, process innovation, and circular economy practices. To ascertain the relevance and strength of the associations, these hypotheses were examined using statistical metrics such as path coefficients, t-statistics, and p-values. With a coefficient of 0.2047, the first hypothesis, that the circular economy affects company profitability showed a strong correlation. Furthermore, there is ample evidence of how CE influences corporate performance via innovation, confirming that incorporating CE methods enhances a company's capacity for both innovation and profitability (Le et al., 2024). At the 0.05 threshold of significance, the T-statistic was 2.5353 and the p-value was 0.0135. As a result, this hypothesis is validated, indicating that enhancements in circular economy practices have a favorable effect on business profitability. With a coefficient of 0.5107, the second hypothesis, which looked at how the circular economy affected process innovation, revealed a significant positive correlation. With a p-value of 0.000 and a t-statistic of 7.1800, the association was deemed very significant. This theory is validated, showing that implementing circular economy projects encourages process innovation in businesses. According to research that highlights eco-innovation as a crucial mediator in the link between governance elements and sustainable outcomes, the results indicate that CE practices substantially promote PI (Wujin & Yahya, 2024). With a coefficient of 0.4480, the third hypothesis, which evaluates the influence of process innovation on corporate profitability, showed a significant effect. The p-value was 0.000 and the t-statistic was 4.3344. Additionally, this theory is validated, demonstrating that improvements in process innovation resulted in higher business profitability. Lastly, an evaluation of the circular economy's indirect impact on business profitability via process innovation produced a coefficient of 0.2288. With a bootstrap standard error of 0.006 and a t-value of around 3.36, the indirect impact was significant. Additionally, studies showing that green process innovations promote enhanced firm performance by using dynamic capacities, even in turbulent circumstances, is consistent with the function of innovation as a mediator (Chen, 2023). The link between the circular economy and business profitability is mediated by process innovation, which is supported by this mediation theory. All of the assumptions are supported by the study, which shows a strong correlation between process innovation, business profitability, and the circular economy. Process innovation is a crucial mediator in this connection, and the results underscore the significance of circular economy policies in boosting both process innovation and business profitability.

DISCUSSION OF FINDINGS

With an emphasis on both direct and mediated impacts, the study's results provide a thorough knowledge of the connections among company profitability, process innovation, and circular economy practices. Even if circular economy techniques by themselves don't always result in appreciable gains in profitability, they do have an impact when considered from the perspective of process innovation. This implies that even if sustainability initiatives are good, they could not result in quick financial advantages unless they are combined with innovations that boost operational effectiveness and reduce costs. The close connection between process innovation and circular economy practices is one of the analysis's main conclusions. Businesses are more likely to promote an innovative culture if they embrace CE principles, which include cutting down on resource use, recycling, and incorporating sustainable practices into daily operations. Given that sustainable techniques sometimes call for rethinking and revamping conventional procedures, this lends credence to the idea that sustainability and innovation are closely related. The beneficial effect of CE on PI emphasizes that embracing sustainability involves encouraging businesses to use more creative and efficient procedures in addition to being environmentally conscious. Additionally, the substantial impact that process innovation has on business profitability highlights how important innovation is to enhancing financial performance. Profitability is largely influenced by process innovation, which lowers costs, boosts productivity, and increases overall operational efficiency. This supports the notion that companies need to make innovation a key component of their strategy if they want to reap the benefits of their sustainability initiatives. A more complex view of the relationship between circular economy practices and financial performance is offered by the mediated influence of CE on CP via PI. According to the indirect approach, sustainability may not by itself much boost profitability, but when it fosters innovation, its full potential is shown. In contemporary firms, where innovation is increasingly seen as a driver of long-term competitiveness and profitability, this conclusion is especially pertinent. Therefore, businesses are more likely to succeed financially if they include CE standards while also encouraging innovation. The results show that circular economy strategies work best when paired with an emphasis on process innovation. Businesses hoping to boost their financial results should see sustainability as

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a component of a larger plan that incorporates ongoing innovation rather than as a stand-alone project. Through more creative and effective procedures, this integrated strategy helps businesses not only achieve their sustainability objectives but also increase their profitability. These observations emphasize the need for companies to take a comprehensive approach, understanding that, with innovation, sustainability and profitability may coexist.

CONCLUSION

The study's conclusions show that circular economy strategies not only directly increase business profitability but also foster process innovation, which raises profitability even more. This dual impact highlights how circular economy activities are both commercial drivers and environmental policies. Innovation has a crucial role in connecting sustainable practices to financial success, as shown by the substantial positive correlations found between the circular economy and process innovation as well as between process innovation and profitability. According to the mediation effect of process innovation, businesses that use circular economy principles are better able to maximize resources, cut waste, and investigate untapped markets, all of which eventually result in increased profitability. These findings highlight the strategic significance of integrating circular economy concepts into corporate operations, showing that innovation and sustainability are not only complimentary but also necessary for long-term financial success. The report promotes an integrated approach to sustainability and innovation as a way to get a competitive edge, providing managers and policymakers with useful information. This is especially important for businesses that operate in other areas in addition to the Ghanaian market. Practices of the circular economy, which emphasize sustainability and resource efficiency, encourage businesses to reconsider and improve their operating procedures, which in turn spurs innovation. Innovation, in turn, is essential to raising profitability by raising production, cutting expenses, and boosting efficiency.

RECOMMENDATIONS AND FURTHER AREAS OF STUDY

Future studies might examine how an organization's long-term profitability is impacted by circular economy practices, with a particular emphasis on the time lag between implementing circular economy tactics and seeing financial outcomes. It could also look at how businesses might accelerate this transitional phase to turn a profit more quickly. To find out if certain industries gain more from circular economy methods and how they affect process innovation, industry-specific aspects might also be investigated. Organizations must integrate sustainability initiatives with ongoing innovation to fully realize financial rewards. This entails developing a precise framework that connects operational enhancements with sustainability objectives. Investing in research, staff development, and technology would foster innovation and integrate circular economy principles into routine business operations. To guarantee that sustainability initiatives are successfully translated into creative processes, cross-functional cooperation between sustainability, R&D, and operations is also essential. Businesses may increase their profitability and environmental impact by using these measures. How business culture and leadership styles impact the success of circular economy initiatives and innovation might be the subject of another worthwhile study topic. Furthermore, studies that compare various industries or geographical areas may show how certain industries—such as manufacturing, technology, or services—face particular possibilities or difficulties when implementing circular economy principles. The success of these initiatives may also be influenced by regional laws. Such study would help businesses improve their sustainability policies by offering useful insights into the elements that support or impede innovation and the circular economy across a range of sectors.

LIMITATIONS OF THE STUDY

The study's use of cross-sectional data limits its capacity to show causal correlations, which is one of its limitations. To further determine causation and evaluate the time-varying impacts of circular economy activities on business profitability, including the influence of process innovation, future research should use experimental or longitudinal approaches. Furthermore, since this study was limited to a single industry, further research should be conducted across a wider range of sectors to improve the results' generalizability. Lastly,

this study looked at circular economy practices as a whole; future studies might explore the many ways that different aspects and capacities of the circular economy affect business profitability.

Conflicts of Interest

No conflicts of interest are disclosed by the writers.

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