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Stakeholder Engagement for Green Process Innovation: Exploring the Link and Boundary Conditions

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ABSTRACT

Despite the growing research attention towards the role of stakeholders in developing green innovations, there is limited understanding of the mechanism and specific firm-level conditions under which stakeholder engagement enhances green innovation. Drawing on the Stakeholder theory and the Natural Resource Based View, this paper theorizes that absorptive capacity and risk-taking behaviour are underlying mechanisms and boundary conditions respectively in the stakeholder engagement-green process innovation relationship. The model is tested with survey data obtained from manufacturing firms in Ghana. The results show that absorptive capacity mediates the relationship between stakeholder engagement and green process innovation. Also, the relationship between stakeholder engagement and green process innovation is conditioned by risk-taking behaviour. The implication of these findings for theory and practice is discussed in the text.

Keywords: *absorptive capacity, Ghana, green process innovation, risk-taking behaviour, stakeholder engagement, sustainability*

1. INTRODUCTION

The last few decades has seen worsening levels of environmental pollution, prompting stakeholders to increase pressure on business entities to adopt green process innovations (Khan *et al.*, 2021; Takhar and Liyanage, 2021). Sustainability issues have received significant research attention and have now become a mainstream research area in supply chain management (Carter and Washispack, 2018). These stakeholders – governments, consumer groups, local communities and non-governmental organizations - are continuously demanding that businesses be mindful of how their operations contribute to greenhouse gas emissions, toxic gases, non-renewable resource consumption and energy usage (Appiah and Abul- Majeed, 2021; Masfiza *et al.*, 2022).

Green process innovation, which denotes the modification of existing processes, and/or introduction of new production processes to consider their environmental impact has been recognized as a means through which firms can mitigate the impact of their operations on the environment (Khan *et al.*, 2021). Empirical evidence suggests that green process innovation increases the productivity of resources (Chang, 2011), reduces environmental pollution (Qiu and Wang, 2020), reduces energy consumption and improves the reuse of waste (Xie *et al.*, 2019). Although a considerable number of studies have been published on green process innovation, the literature is disjointed and there is no comprehensive understanding of the issues, challenges and gaps (Khan *et al.*, 2021).

Management research has highlighted the role of stakeholders in firms' strategies and their importance to value creation (Pucci *et al.*, 2020). These stakeholders, both internal and external, are considered to have influencing powers on organizational decision-making as granters of "legitimacy" (Freeman, 1994). Innovation for environmental sustainability requires firms to engage with external stakeholders to access expertise, solve complex problems, and gain social legitimacy (Watson *et al.*, 2018). The natural resource-based view (NRBV) of the firm suggests that "through stakeholder engagement, the "voice of the environment" can be effectively integrated into the product design and development process" (Hart and Dowell, 2011). Whereas research has shown that stakeholder engagement is relevant for green innovations (Wiesmeth, 2018), a key question that remains unanswered, and that which forms the basis of this study, is how and when does stakeholder engagement result in green process innovation?

The literature identifies absorptive capacity as a key capability for green innovations (Gluch *et al.*, 2009). Absorptive capacity is the "ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends is critical to its innovative capabilities"(Cohen and Levinthal, 1990). Innovation is a knowledge-intensive activity, and the integration of specialist knowledge from external sources is key to obtaining successful innovations. Extant research has shown that absorptive capacity is required for successful green process innovation (Albort-morant *et al.*, 2018; Pacheco *et al.*, 2018; Aboelmaged and Hashem, 2019) and it is known that a firm's absorptive capacity can affect the adoption process and the cost of green innovation (Qi, *et al.*, 2021). As such, absorptive capacity is considered a "critical" capability for green innovation processes within firms

(Pacheco *et al.*, 2018). Studies have shown that knowledge-sharing and organizational learning processes enhance absorptive capacity (Song *et al.*, 2020; Hoosbeek and de Vries, 2021). Despite receiving a lot of attention in the green innovation literature there is limited understanding of the structures that enhance the absorptive capacity of firms in their green process innovation efforts (Khan *et al.*, 2021).

To date, research on green process innovation in Africa is limited, as shown in the systematic literature review of Khan *et al.* (2021). Not only does this constrain the global applicability of green process innovation theory, but it also signifies a contextual gap as industrialization increases in Africa. Such an increase in economic growth is coupled with significant environmental constraints that should attract research attention (Appiah, 2019; Song *et al.*, 2020). Whereas greening could be a source of competitive advantage in developed countries, there is still uncertainty about the outcome of green innovation investments in developing countries (Yao *et al.*, 2019). Understanding the determinants of green process innovation is important, as these countries risk suffering the Pollution Haven Hypothesis in the wake of increasing industrialization and the influx of foreign direct investments for production.

This paper seeks to bridge three research gaps by proposing and testing a model through which stakeholder engagement enhances green process innovations via an indirect mechanism through absorptive capacity and a direct mechanism conditioned by risk-taking behaviour in a developing country context. Roper and Tapinos (2016) suggest that uncertainty in the macro-environment shapes the willingness of firms to undertake environmental innovations. This study argues that the risk-taking behaviour of the firm conditions the outcome of stakeholder engagement for green process innovations in developing economies. With a low level of consumerism, lax regulations and low environmental activism (Ado and Wanjiru, 2018), green process innovations may be considered riskier in developing economy contexts (Forsman, 2013; Yao *et al.*, 2019). The demands of stakeholders could potentially put off planned investment when business owners consider the cost-benefit analysis. Because the developing country environment does not compel (because of weak monitoring and regulation) or entice (because of the low consumer interest in greening) firms to engage in green process innovation, the outcome of stakeholder engagement may depend on the firm's risk-taking behaviour. Again, firms in developing countries are resource-constrained, and decision-making in such environments is dependent on the level of risk-taking behaviour.

This paper contributes to the theoretical understanding of how stakeholder engagement enhances green process innovations. First, the paper proposes and tests a mechanism through which stakeholder engagement enhances green process innovation via absorptive capacity. Second, the difference in the magnitude of green process innovations across firms is explained, using the firm's risk-taking behaviour. Third, the study contributes to a better scholarly understanding of how the scarcity of resources, low level of consumerism and weak regulations in developing countries shape firms' investment decisions on green process innovation.

2. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

2.1 *Stakeholder Engagement and Green Process Innovation*

Most organizations recognize that internal knowledge and resources cannot be depended on solely to plan, monitor and implement innovations (Riad Shams *et al.*, 2020). Stakeholder engagement is considered one of the key elements to help facilitate the uptake of green business models (Abuzeinab and Arif, 2014). The NRBV suggest that stakeholder engagement enables firms to hear the "voice of the environment", required for the development of green products and processes (Hart, 1995). This engagement, which entails recognizing and calling for stakeholder input in environmental decisions making is considered a primary enabler of green innovations. The implementation of proactive environmental strategies requires the development of new capabilities in close relationships with stakeholders inside and outside an organization (Martín-de Castro, 2021). External knowledge is crucial to the innovation process, irrespective of the organizational level at which the innovating unit is defined (Cohen and Levinthal, 1990). Stakeholder integration in the innovation process is a driving factor that ensures the success of environmentally sustainable innovations (Redante *et al.*, 2019). Proactive and effective stakeholder engagement builds an innovation climate in organizations (Riad Shams *et al.*, 2020). Innovation is a knowledge-intensive activity that requires that external knowledge is obtained to complement a firm's internal capabilities. Stakeholder engagement is useful in generating knowledge for co-creating environmental initiatives (Wiesmeth, 2018). Stakeholder engagement enables organizations to implement sustainability-oriented innovations by helping the firm to capture a wide range of external knowledge that is useful to the innovation process (Ghassim and Bogers, 2019). Again, firms' green process innovations are often in response to stakeholder demands. Thus, these stakeholders possess a repertoire of knowledge that could be useful in the innovation process. Stakeholder engagement does not only help organizations acquire external knowledge for innovation but also assists in commercializing the information (Ghassim and Bogers, 2019). Engagement with these stakeholders enables the organization to access this knowledge and clearly understand the expectation of stakeholders to ensure the investment in green process innovation returns the expected outcome. To this end, this study hypothesizes that:

H1: stakeholder engagement is positively related to green process innovation.

2.2 *The Mediating Role of Absorptive Capacity*

Absorptive capacity is largely a function of an organization's prior related knowledge (Cohen and Levinthal, 1990). Cohen and Levinthal, (1990) argued that absorptive capacity could be the byproduct of a knowledge searching and creation process, such as "R&D investment". Theoretically, absorptive capacity is influenced by external knowledge sources and past experiences (Gluch *et al*., 2009).

Considering that stakeholder engagement is also an attempt to create new knowledge through the integration of stakeholder views, stakeholder engagement could facilitate the development of absorptive capacity. Again, absorptive capacity could be the result of direct investment, most of which seek to provide prior experience. Many studies consider absorptive capacity as a capability that is required to enhance green innovations (see e.g. Pacheco *et al.*, 2018; Aboelmaged and Hashem, 2019; Qi, *et al.*, 2021). This paper argues that absorptive capacity is enhanced through stakeholder engagement, and this, in turn, enhances green process innovation adoption. Continuous engagement with stakeholders enhances a firm's capacity to capture, integrate and apply external information to environmental initiatives. Engaging stakeholders in the innovation process opens up the firm for recognition, assimilation and application of external knowledge. Empirical evidence from Song *et al.* (2020) suggests that green knowledge sharing with supply chain partners enhances the absorptive capacity for green innovation. Open conversation, collaborating, experimenting and reflecting - all of which are teaming behaviors, are important factors that affect the development of absorptive capacity (Hoosbeek and de Vries, 2021). Stakeholder engagement facilitates knowledge sharing among parties, which enhances absorptive capacity by extending the organization's knowledge base (Song *et al.*, 2020). Engaging stakeholders thus enables firms to improve their ability to sense relevant knowledge external to the organization, seize this knowledge and apply it to the green process innovation development. When firms engage stakeholders, they draw deliberate programs that may help to capture the desired external knowledge that can enhance their capacity to engage in green innovations. Even where engaging stakeholders is considered a mere tactic to signal stakeholders, there is a tendency for valuable information transfer from stakeholders that may be useful in future innovation decisions.

H2: Absorptive capacity mediates the relationship between stakeholder engagement and green process innovation.

2.3 The Moderating Role of Risk-taking Behaviour

Whereas stakeholder engagement may clarify the environmental expectations of these stakeholders and improve firms' understanding of stakeholders' environmental demands (Wiesmeth, 2018), this study argues that risk-taking behaviour conditions the relationship between stakeholder engagement and green process innovation in developing countries. The willingness of firms to engage in innovation will be positively related to anticipating returns post-innovation, and negatively related to the perceived risk of the project (Roper and Tapinos, 2016). Green innovations are still considered a risky investment in developing countries where consumerism is low and environmental regulation is weak. Thus, even though most organizations may be abreast with the modern trends of business moving towards sustainability, firms in developing economies may be less committed to green process innovation because the benefits may be unclear at this point. Following Zahra and George (2002) model, this study argues that the level of a firm's risk-taking behaviour conditions their decision to adopt green process innovations even after engaging with stakeholders. There is evidence of increasing awareness, albeit at a much slower pace, of environmental issues in developing economies that could be forcing firms to reconsider the environmental impact of their production processes (Das and Mitra, 2018; Appiah and Odartey, 2021). At this early stage, pressure from non-market actors (e.g., regulators, NGOs, communities) is much higher than pressure from market actors (e.g., customers, suppliers, etc.). Thus, there is still a managerial concern about whether responding to these demands could be beneficial to the organization in the long term. This concern is fueled by two conditions – first, the commitment of non-market actors and their ability to mete out punitive measures for non-compliance is limited, leaving managers to decide on whether the investment in green process innovation may be worth it, especially if rival firms may be allowed to forego the investment and make profits at the expense of the environment. Second, since market actors are not vocal in the fight for sustainability, there is little incentive to persuade managers that green process innovations could obtain advantages in the market over the competition. Although the future for green innovations is bright and first-mover advantages could accrue to proactive firms, it is still a risky venture in most developing countries (Yao *et al.*, 2019). Thus, this study argues that when firms engage stakeholders on the environmental front, investment in green process innovation is conditioned by the firm's risk-taking behaviour. Therefore, it is hypothesized that:

H3: Risk-taking behaviour moderates the relationship between stakeholder engagement and green process innovation.

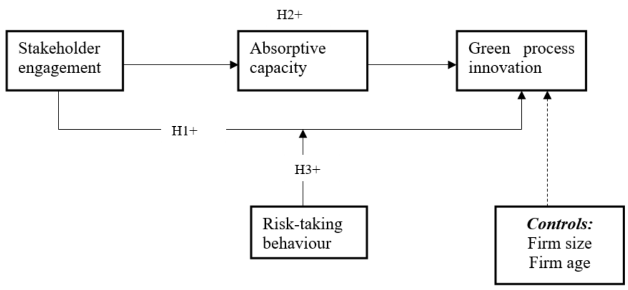

Figure 1. Research Model

3. RESEARCH METHODS

3.1 Research Context and Data Collection

The empirical data for this study is from a large-scale dataset collected on the sustainability and digitalization of manufacturing firms in Ghana. Ghana is one of the fastest-growing economies in Africa and is considered a model country for Sub-Saharan Africa. There are growing levels of industrialization in the country, leading to major concerns about the future state of the environment. The government of Ghana launched an ambitious "One-district-one-factory" program that seeks to build at least one factory each in the over 228 districts in the country. The data collection took place between March and August 2021. A total of 224 responses were obtained from a target of 672 firms. Responses were obtained from CEOs, senior executives and managers in the supply chain, logistics, procurement, operations, environment, and marketing roles for the respective firms. A paper-based questionnaire was delivered to these respondents, and field agents remained in contact throughout the period to retrieve the filled questionnaires from the respondents.

3.2 Construct Operationalization and Questionnaire Development

The measurement items were all adapted from already validated scales in the literature.

3.2.1 Main Variables

Green process innovation is defined as the extent to which an organization's production process incorporates environmental considerations, such as pollution reduction, material efficiency etc. Five items adapted from Chen *et al*. (2006) and Wong (2013) were used to measure green process innovation. *Stakeholder engagement* is defined as the extent to which an organization recognizes and engages stakeholders in environmental decision-making. In this study, stakeholder engagement was measured using a five-item scale developed with insight from Wiesmeth (2018). *Absorptive capacity* is defined as the organization's capability to recognize and integrate external knowledge into its green process innovation decisions. Absorptive capacity is measured using six items adapted from Aboelmaged and Hashem (2019). Risk-taking behaviour reflects the extent to which a firm's management takes risks as a means to achieve business performance. Risk-taking behaviour is measured using five items adopted Jambulingam *et al*. (2005). All the items were measured on a 7-point scale where 1 = "not at all", 7 = "to the largest extent" for green process innovation and stakeholder engagement, 1 = "strongly disagree" and 7 = "strongly agree" for absorptive capacity and risk-taking behaviour.

3.2.2 Control Variables

Firm size (measured using the number of employees as a proxy) and firm age (measured as the number of years the firm has been in operation) were used as control variables. There is empirical evidence that the size of the organization influences performance (Duque-Grisales *et al.*, 2020), leading to many studies on green innovation and firm performance to control the effect of firm size. When compared with old firms, young firms are often smaller and more open to taking innovation risks (Zhang *et al*., 2020).

3.2.3 Sample Characteristics

The firms are involved in the production of over 10 different product groups. The sample is dominated by local private manufacturers, who constitute about 95.1% of the total. The findings of the study thus represent to a larger extent the happenings in the local industry. The firm size (measured by the number of full-time employees) ranges between 6 and 384. The average firm size is 22 full-time employees, indicating that the study was conducted largely among SMEs. The firm age (measured by the number of years since the firm began operations) ranges between 3 and 45, and the average firm age is 15 years.

Table 1. Firm Characteristics

	Variable		*Count*	*Percent*
Industry	Industrial machinery, machine, tools		8	3.6
	Chemicals		2	.9
	Plastics & rubber		12	5.4
	Food, beverages, and drinks		59	26.3
	Metals, metalworking		39	17.4
	Pharmaceutical, healthcare		8	3.6
	Paper and packaging		14	6.3
	Engineering, construction		20	8.9
	Textiles and clothing		12	5.4
	Electronics		5	2.2
	Others (Woodwork, paint, etc.)		45	20.1
Firm Size	*Min*	Max	*Mean*	*SD*
	6	384	21.5	34.6
Firm Age	*Min*	*Max*	*Mean*	*SD*
	3	45	15.16	7.47

4. DATA ANALYSIS AND RESULTS

Partial least squares structural equations modelling (PLS-SEM) is used to verify the research framework and hypothesis. This study also utilizes Hayes PROCESS to corroborate the PLS-SEM results and to generate the plot for the moderating effects. PLS-SEM was selected because it is useful in modelling both the measurement and the structural model. Also, PLS-SEM is considered to better estimate complex models that include intervening and interaction variables. Further, PLS models are not impeded by a large number of strict and impractical assumptions (Streukens and Leroi-Werelds, 2016). The bootstrapping approach was used to make statistical inferences (Zeng *et al.*, 2021). The outcome variable in the research framework is green process innovation, and the predictors are stakeholder engagement and absorptive capacity. Risk-taking behaviour is considered a moderator, and two control variables – firm age and firm size are also considered.

4.1 Measurement Model

The measurement model establishes the relationship between the constructs and the individual items that measure them. The measurement model is examined using PLS-SEM procedures implemented in SMART PLS 3. Following established standards (Hair et al., 2020), the indicator loadings and significance, indicator reliability, composite reliability, average variance extracted and discriminant validity were examined to test the measurement model. All the outer loadings of the indicators were greater than the recommended threshold of 0.7 and were significant at 5%. Cronbach's alpha and composite reliability were used to examine the internal consistency of the constructs, and the lowest result was 0.865 and 0.902 respectively. The average variance extracted (AVE) for all constructs was above 0.5. Two methods of discriminant validity assessments are provided by the PLS-SEM results. First, the results of the Fornell-Lacker criterion suggest that the square root of the AVE for the various constructs is significantly higher than the correlation matrix of the constructs. Again, the Heterotrait-Monotrait ratio of correlations was all below the cutoff point of 0.85.

Because a single respondent was used for all the variables, there is the potential for common method variance (Podsakoff *et al.*, 2003). Both procedural and statistical methods have been used to deal with potential common method variance, in line with the guidelines of Podsakoff, *et al.*, (2012). First, because the data collection is from a large dataset, no respondent could reasonably predict the relationship among the variables to influence their responses. Also, the scale anchors were different for many groups of constructs. Statistically, Harman's one-factor test conducted in SPSS revealed that multiple factors exist among the observed items, and the first factor accounted for less than 50% of the variance.

Table 2. Measurement Model

Construct/Items		Loading	Source
Stakeholder engagement (CR = 0.951, CA = 0.932, AVE = 0.831)			
We encourage our stakeholders to…….			
SE1	provide their perspectives about how to successfully solve our company's environmental problems	0.871	Wiesmeth (2018)
SE2	provide new ideas for improving environmental management practices	0.926	Wiesmeth (2018)
SE3	participate in defining environmental performance indicators that we should use and report on	0.911	Wiesmeth (2018)
SE4	participate in identifying policies, objectives, and programmes of corporate environmental management systems	0.936	Wiesmeth (2018)
Absorptive capacity (CR = 0.918, CA = 0.893 , AVE = 0.652)			
AC1	Our company recognizes valuable novel knowledge	0.769	Aboelmaged and Hashem (2019)
AC2	Our company absorbs useful external knowledge	0.788	Aboelmaged and Hashem (2019)
AC3	Our company uses novel knowledge to enhance performance	0.800	Aboelmaged and Hashem (2019)
AC4	Our company identifies new and useful ideas	0.760	Aboelmaged and Hashem (2019)
AC5	Our company uses novel ideas to enhance performance	0.877	Aboelmaged and Hashem (2019)
AC6	Our company encourages novel and useful ideas	0.843	Aboelmaged and Hashem (2019)
Green Process Innovation (CR = 0.902, CA = 0.865, AVE =0.649)			
GPC1	effectively reduces the emission of hazardous substances or waste	0.813	Chen et al. (2006)
GPC2	recycles waste and emissions that allow them to be treated and re-used	0.831	Chen et al. (2006)
GPC3	reduces the consumption of resources (e.g., water, electricity)	0.796	Chen et al. (2006)
GPC4	reduces the use of raw materials	0.776	Chen et al. (2006)
GPC5	redesigns production and operation processes to improve environmental efficiency	0.809	Wong (2013)
Risk taking behaviour (CR = 0.942, CA = 0.908, AVE = 0.843)			
RTB1	Taking gambles is part of our strategy for success	0.899	Jambulingam et al. (2005).
RTB2	We take above average risks in our business	0.942	Jambulingam et al. (2005).
RTB3	Taking chances is an element of our business strategy	0.912	Jambulingam et al. (2005).

Table 3. Descriptive statistics, Inter-correlations and Discriminant Validity

	Mean	SD	1	2	3	4	5	6
1. Absorptive capacity	4.95	1.03	**0.80**					
2. Firm Age	15.16	7.47	0.05	-				
3. Firm Size	21.55	34.6	0.01	0.40	-			

4. Green Process Innovation	4.68	1.01	0.51	0.05	-0.03	**0.80**		
5. Risk-taking behaviour	3.63	1.65	0.46	0.03	-0.07	0.39	**0.91**	
6. Stakeholder engagement	4.04	1.38	0.45	0.01	0.05	0.51	0.51	**0.91**

4.2 Structural Model

The structural model examines the extent to which the empirical data supports the theoretical model. Following (Hair et al., 2020), initial steps were taken to examine collinearity, size and significance of path coefficients and the R^2 of endogenous variables. The overall model fit is acceptable, as the Standardized Root Mean Square Residual (SRMR) is 0.073, less than the 0.08 threshold (Benitez *et al.*, 2020). To rule out the presence of multicollinearity, the Variance Inflation Factors (VIF) were checked for the various items, and the highest is 4.5, which is below the threshold of 5. All path coefficients are above 0.7, and significant at 5%. The R^2 for the endogenous variables in the model – absorptive capacity and green process innovation were 0.211 and 0.423 respectively. A bootstrapping approach, using 5000 subsamples was used to compute the standard errors and t-statistics of the estimated model, to allow for the determination of statistical significance (Hair et al., 2019).

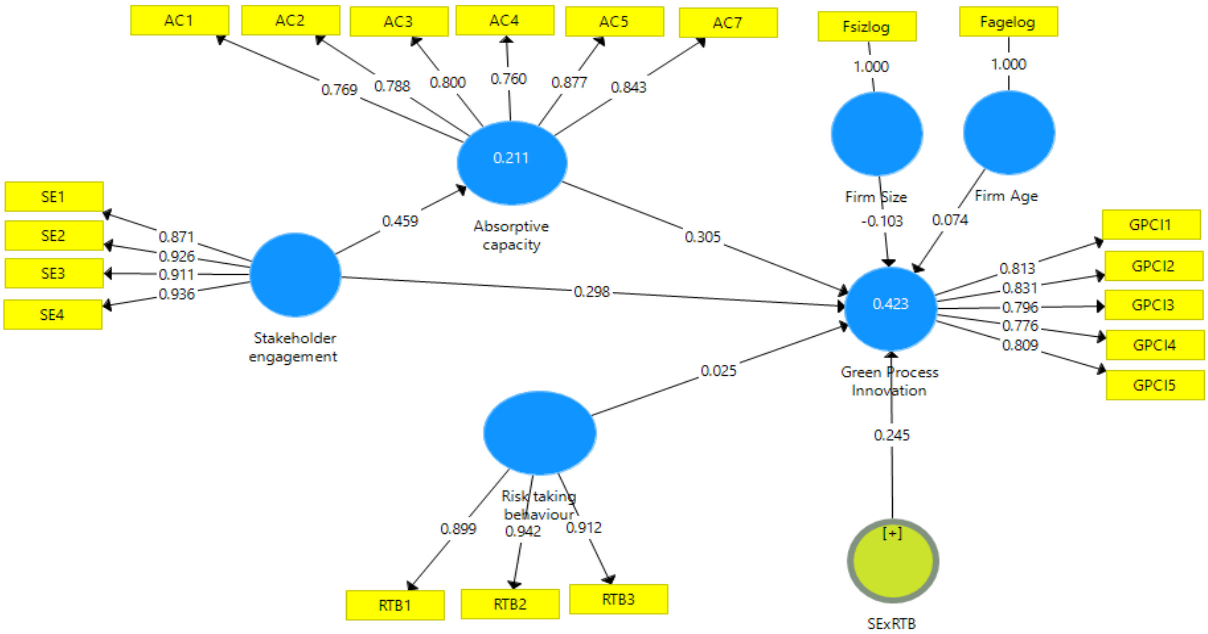

Figure 2. Structural Model Results

The results, as presented in **Table 4** and depicted in **Figure 2** indicate that there is a positive, significant relationship between stakeholder engagement and absorptive capacity (β = 0.459, t = 8.134). Again, there is a positive relationship between stakeholder engagement and green process innovation adoption (β = 0.298, t = 3.898), supporting the proposition made in hypothesis one.

Table 4. Hypothesis Tests

	β	T-value	P Values	Decision
Control Paths				
Firm Age → GPCI	0.074	1.496	0.135	
Firm Size → GPCI	-0.103	1.789	0.074	
RTB → GPCI	0.025	0.389	0.697	
Direct Paths				
SE → AC	0.459	8.134	0.000	
SE → GPCI (H1)	0.298	3.898	0.000	Supported
AC → GPCI	0.305	4.339	0.000	
Indirect Path				
SE →AC → GPCI (H2)	0.140	3.860	0.000	Supported
Interaction path				
SExRTB → GPCI (H3)	0.245	4.294	0.000	Supported

RTB = Risk-taking behaviour, SE = Stakeholder engagement, AC = Absorptive capacity, GPCI = Green Process Innovation

To query the moderating role of risk-taking behaviour, the pick-a-point approach (Aiken and West, 1991) was used to plot a graph of the interactions. The graph depicts the relationship between stakeholder engagement and green process innovation at differing levels of risk-taking behaviour. The levels of risk-taking behaviour plotted are low (RTB = 1 standard deviation below the mean), moderate (RTB = the mean level) and high (RTB = 1 standard deviation above the mean).

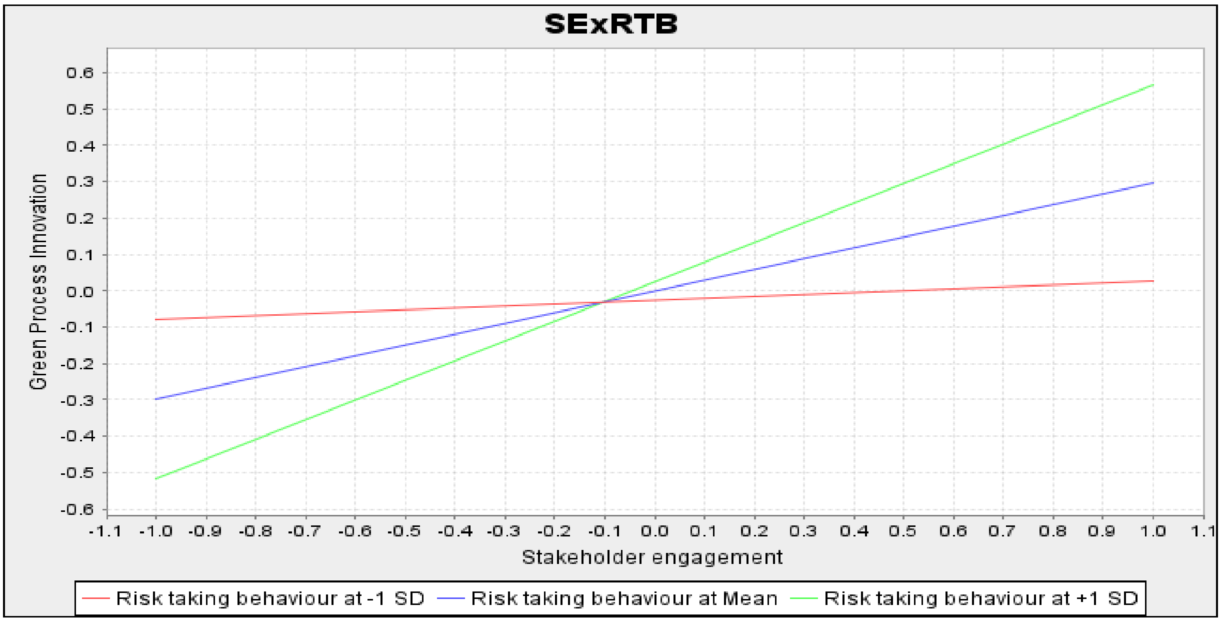

Figure 3. Interaction Plot of Stakeholder Engagement and Risk-taking Behaviour

Figure 3 shows that the relationship between stakeholder engagement and green process innovation is highest and positive when risk-taking behaviour is high (at 1 SD above the mean, depicted by the green line). Whereas moderate levels of risk-taking behaviour also produce a positive relationship, the slope is lesser than the former (as depicted by the blue line). At low levels of risk-taking behaviour, the slope is gentle and does not depict a significant positive effect. Overall, **Figure 3** suggests that the relationship between stakeholder engagement and green process innovation is more positive and stronger when firms possess high risk-taking behaviour.

Despite the insights provided by the pick-a-point approach, it has been criticized for being conservative and arbitrary in selecting at which points to explore the relationship. The Johnson-Neyman approach has been suggested as one approach for dealing with this arbitrariness (Dawson, 2014). Thus, the Johnson-Neyman approach was implemented in Hayes PROCESS to further explore the interaction effects. Unlike the pick-a-point approach, the Johnson-Neyman approach outlines the relationship between the independent and the dependent variable at all levels of the moderator, whiles also indicating what levels of the moderator at which the independent–dependent variable relationship is significant (Hayes, 2013).

Table 5. Results of the Johnson-Neyman Technique

Level of RTB	*Effect*	*t*	*p*	*LLCI*	*ULCI*
1	-.0412	-.4834	.6293	-.2090	.1267
1.3	-.0109	-.1372	.8910	-.1668	.1451
1.6	.0194	.2652	.7911	-.1251	.1639
1.9	.0497	.7334	.4641	-.0839	.1834
2.2	.0800	12.763	.2032	-.0436	.2036
2.5	.1103	18.996	.0588	-.0041	.2248
2.8	.1406	26.011	.0099	.0341	.2472
3.1	.1709	33.646	.0009	.0708	.2711
3.4	.2012	41.539	.0000	.1058	.2967
3.7	.2315	49.129	.0000	.1386	.3244
4.0	.2618	55.782	.0000	.1693	.3543
4.3	.2921	60.998	.0000	.1977	.3865
4.6	.3224	64.587	.0000	.2240	.4208
4.9	.3527	66.671	.0000	.2485	.4570
5.2	.3830	67.563	.0000	.2713	.4948
5.5	.4133	67.612	.0000	.2928	.5338
5.8	.4436	67.120	.0000	.3134	.5739
6.1	.4739	66.311	.0000	.3331	.6148
6.4	.5042	65.337	.0000	.3521	.6563
6.7	.5345	64.295	.0000	.3707	.6984
7.0	.5648	63.245	.0000	.3888	.7408

LLCI = Lower-level confidence Interval, ULCI = Upper-level confidence Interval

Table 5 presents the results of the Johnson-Neyman technique. The table indicates the relationship between stakeholder engagement and green process innovation at varying levels of risk-taking behaviour (measured from 1 to 7 as on the questionnaire). The results show that for firms with levels of risk-taking behaviour less than 2.5 on the 7-point scale, the relationship between stakeholder engagement and green process innovation is not significant (as indicated by the p-values and confidence intervals in the shaded region). Firms that have risk-taking behaviour above 2.5 on the scale experience a positive relationship between stakeholder engagement and green process innovation. The effect size (β) increases as the level of risk-taking behaviour increases on the scale. Thus, the relationship between stakeholder engagement and green process innovation is positive and strongest (β = .5648) at the highest level of risk-taking behaviour (7 on the scale).

5. DISCUSSION

This study sought to examine the mechanisms and boundaries of the relationship between stakeholder engagement and green process innovation. Three hypotheses were set forth, all of which are supported by empirical data. The results indicate that capacity stakeholder engagement is positively related to green process innovation and that absorptive mediates the relationship between stakeholder engagement and green process innovation. Further, risk-taking behaviour moderates positively the relationship between stakeholder engagement and green process innovation. These findings add an interesting extension to scholarly knowledge on how stakeholder engagement supports green innovations.

On the relationship between stakeholder engagement and green process innovation, the finding of this study complements existing knowledge on the relevance of considering stakeholder input in green innovations. Stakeholders are influential in the environmental decisions of most organizations (Theyel and Hofmann, 2012) and the "voice of the environment" is a crucial input required to develop green innovations (Hart and Dowell, 2011). Generally, innovations are seldom carried out successfully in a single organization, as it requires the integration of knowledge from external sources (Giacomarra *et al.*, 2019). The open innovation literature suggests that utilising external sources of information is foundational for developing successful innovations (West and Bogers, 2013). For successful green innovations, firms are required to engage external stakeholders to acquire expertise, solve challenging problems and obtain social legitimacy (Watson *et al.*, 2018). This finding supports the NRBV's position that firms are better able to successfully implement green process innovations when they engage external stakeholders.

On the mediating role of absorptive capacity, the findings provide a nuanced view of the mechanism through which stakeholder engagement enhances green process innovation. Stakeholder engagement enhances a firm's ability to develop capabilities that support the development of sustainability innovations (Ghassim and Bogers, 2019). One such capability is absorptive capacity, which is long known to support the development of successful innovations (Xie *et al.*, 2016). Absorptive capacity is developed largely through the accumulation of "prior related knowledge"(Cohen and Levinthal, 1990) through continuous engagement with external stakeholder sources. Studies have shown, for instance, that customer involvement is useful in developing the absorptive capacity of firms for radical innovations (Scaringella *et al.*, 2017). Understanding the mechanism through which stakeholder engagement enhances green innovations is important because simply engaging with external sources does not imply innovative capability has improved. Instead, developing the capability to identify, assimilate, and deploy knowledge from the external source – absorptive capacity is required to channel external knowledge into useful innovations (Dangelico *et al.*, 2013). Extant studies suggest that knowledge-sharing and organizational learning processes, which are amplified through engagement with stakeholders, enhance absorptive capacity (Song *et al.*, 2020; Hoosbeek and de Vries, 2021). Thus, engaging stakeholders enables organizations to increase their capability in recognizing, assimilating, and deploying relevant information to support green process innovations. This finding increases scholarly understanding of how firms develop capabilities to support their environmental initiatives when they engage stakeholders.

Further, the results of this study also shed light on boundary conditions that exist in the stakeholder engagement and green process innovation relationship. Green innovations are considered risky, especially in the developing economy contexts (Yao *et al.*, 2019), and as such firm attitudes towards risk conditions their attitude towards such investment (Aray *et al.*, 2020). Thus, whereas engagement with stakeholders provides valuable information for green process innovations, the risk-taking behaviour of firms conditions this relationship. Low resource contexts are characterized by institutional voids, low consumerism, weak governance structures and limited stakeholder attention to environmental issues (George, 2015). These conditions increase the uncertainty associated with the environment, and the perceived risk of green innovations (Roper and Tapinos, 2016). Risk-taking behaviour, as a firm-level competence, is key to the development of successful innovations. Given the level of uncertainty surrounding green innovations in this context, risk-taking behaviour enables firms to develop comprehensive risk mitigation strategies to guide their investments (Al-Hakimi *et al.*, 2022). With these strategies, firms can benefit from the uncertainty by turning out successful green process innovations.

The results have implications for practice and policy development on green innovations. Managers are advised to increase attention and resources towards engaging stakeholder groups to enhance the effectiveness of their green process innovation implementation. Broader consultation across stakeholder groups offers platforms to obtain external knowledge that can support green process innovation initiatives. Stakeholder engagement also enhances the firm's ability to draw in external knowledge and utilize it for the organization's benefit. Despite the risky nature of green innovation investments in developing economies, managers are advised to consider the environmental impact of their operations, as there is still hope that future competitive advantage will accrue to firms with greener processes. Thus, firms should be willing to take risks to obtain first-mover advantages in the future. Again, to enhance the assimilation of external knowledge to support green process innovation implementation, managers are advised to draw deliberate plans for exchanging information with stakeholders to support their green process innovation.

The outcome of this research suggests that green process innovation is still considered a risky investment by firms. Policymakers should move to grant support to manufacturing firms in developing economies in the form of subsidies, grants, training etc. to reduce the perceived risks associated with these investments. Again, the government should move towards stricter environmental regulation and demonstrate more commitment to dealing with environmental offenders. This could stimulate the innovation process (Porter and Van Der Linde, 1995), and encourage many firms to invest in green process innovation in an attempt to lead the competition.

6. CONCLUSION, LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

Although a significant body of knowledge exists on the need for stakeholder engagement for successful environmental innovations, a clear understanding of the mechanisms and boundary conditions for this relationship had not been thoroughly explored. This study addresses this research gap by introducing absorptive capacity and risk-taking behaviour as two important variables that improve our understanding of the relationship between stakeholder engagement and green process innovation. This study has built on the NRBV to provide additional insights into how stakeholder engagement translates into green process innovation. The study found evidence of a positive relationship between stakeholder engagement and green process innovation. The results also confirm the role of absorptive capacity and risk-taking behaviour as a mechanism and boundary conditions of the relationship respectively.

Despite the contributions made by this paper to the literature on green process innovation, it is not without limitations. First, the study uses cross-sectional data to examine the proposed relationship between the variables. Whereas this provides important insights, causality cannot be inferred among the variables. A longitudinal research design is required to test the study's model to establish causality among the variables. Second, the study is deficient in sample size and geographic coverage. The data is obtained from 224 firms in a single country so caution should be taken when generalizing the findings to other countries. Whereas Ghana's growing economy and increasing industrialization offer a perfect setting for the study, countries have different institutional arrangements which may affect green process innovation development and investment. Cross-country studies will be relevant in the future to provide more generalizable findings. Third, there are several dimensions of green innovations, but this study has only focused on process innovations. Given that stakeholder engagement is considered in the general innovation environment, future studies should consider examining its role in other enhancing other forms of green innovation such as product, technology, management, or marketing. Finally, there is the need to understand how learning from stakeholder engagement occurs within the context of buyer-supplier relationships. The role of social capital in such situations may be crucial to support the development of novel knowledge that support green innovations (Appiah and Obey, 2023). Especially in developing economy contexts, social capital theory can be leveraged to understand how interactions among supply chain partners can support green process innovations in the focal firm.

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