# Environmental innovations and sustainability practices of manufacturing firms in Uganda

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## Abstract

**Purpose** – The purpose of this study is to investigate the pivotal role of environmental innovations in driving sustainability practices within medium and large manufacturing firms operating in Uganda.

**Design/methodology/approach** – Using a cross-sectional and quantitative methodology, data were collected through a questionnaire survey involving 208 manufacturing companies. The smart partial least squares path modelling technique was used for the analysis.

**Findings** – The analysis unveils significant and positive associations. Specifically, product innovation exhibits a robust and affirmative relationship with sustainability practices. Similarly, the correlation between process innovation and sustainability practices emerges as statistically significant. Moreover, the findings underscore the noteworthy and constructive predictive influence of environmental innovation on sustainability practices.

**Practical implications** – These empirical results present substantial implications for theoretical frameworks and practical applications. From a policy perspective, the findings emphasise the importance of incentivising eco product and eco process innovations as potential drivers of eco-friendly practices. On the managerial front, strategic resource allocation and the adoption of integrated environmental innovation strategies are advocated, with the ultimate goal of enhancing sustainable business approaches within Uganda's manufacturing subsector.

**Originality/value** – To the best of the authors' knowledge, this study represents the inaugural attempt to investigate the role of environmental innovations in elucidating sustainability practices within a least developed country. Notably, while all dimensions demonstrate significance, it is noteworthy that product innovation emerges as the more substantial contributor to the promotion of sustainability practices.

**Keywords** Product innovation, Sustainability practices, Manufacturing firms, Environmental innovations, Process innovations

**Paper type** Research paper

## 1. Introduction

In recent times, the global landscape has become fraught with a pressing challenge, prominently characterised by environmental pollution and climate change, as underscored by



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the United Nations Environmental Programme (UNEP, 2023). The degradation of the Earth's natural environment and the subsequent ecological imbalances have witnessed a noticeable escalation. This situation has amplified the appeals emanating from academia, practitioners, policymakers and social movements, all advocating for a departure from conventional, unsustainable practices (Martin *et al.*, 2021; Whiteman *et al.*, 2013). Moreover, human activities, primarily characterised by the release of greenhouse gases, have undeniably played a central role in driving global warming. This is substantiated by empirical evidence revealing that the global surface temperature has risen by approximately 1.1°C above pre-industrial levels during the period of 2011–2020 (UNEP, 2023). The escalation of global greenhouse gas emissions persists, underscored by a complex interplay of historical and ongoing factors stemming from unsustainable energy consumption, land utilisation and changes, varied lifestyles, consumption patterns and production practices. These factors exhibit disparities not only across different regions but also within and between countries, highlighting the multifaceted nature of this global challenge (UNEP, 2023).

Thus, effectively addressing this challenge necessitates a concerted global effort and an unwavering commitment from businesses spanning various sectors. Moreover, governments worldwide are intensifying their efforts to compel firms to adopt sustainability practices (SPs). However, it is evident that not all firms exhibit equal dedication to their environmental obligations, with some encountering difficulties in achieving comparable levels of SPs (Balasubramanian and Shukla, 2020). To this end, we pose a pivotal question with potentially profound implications:

*Q1.* Can the concept of environmental innovation (EI) offer valuable insights into deciphering the disparities witnessed in firms' dedication and contributions to SPs?

At the heart of this discussion lies the essential role that SPs play in safeguarding the environment and addressing the consequences of climate change. These practices encompass a wide array of approaches designed to decrease emissions, enhance the efficiency of resource utilisation and diminish the creation of waste. This standpoint concurs with the observations detailed in National Environmental Management Authority (NEMA, 2019). Beyond their ecological implications, the adoption of environmentally friendly initiatives also yields various advantages, including improved operational efficiency, cost-effectiveness and enhanced competitiveness (Desore and Narula, 2018). Additionally, these initiatives contribute to long-term economic growth. According to NEMA (2019), the implementation of SPs can result in better working conditions, better occupational health, increased social inclusivity and general community well-being, in addition to economic benefits. Hence, the integration of SPs within Uganda's manufacturing subsector holds the potential to chart a path towards a more sustainable developmental trajectory.

According to the NEMA (2019) report, the manufacturing subsector in Uganda significantly contributes to environmental degradation and sustainability challenges. This report highlights several pressing issues, including alarming levels of air and water pollution as well as the generation of substantial waste within the manufacturing processes. These activities have resulted in adverse consequences, such as ozone layer depletion and reduced material efficiency, thereby negatively affecting industrial productivity. The NEMA report underscores the urgency of addressing these critical issues to mitigate their environmental impact and enhance the sustainability of Uganda's manufacturing sector. To tackle these challenges effectively, Ugandan manufacturers must take proactive measures, specifically through the adoption of SPs. This viewpoint is consistent with the conclusions drawn from the recent research conducted by Alinda *et al.* (2023), who urge companies to adopt EI as a means to facilitate the incorporation of SPs.

Recent scholarly literature suggests that the integration of EI is important in fostering SPs within the realm of manufacturing firms (Tang *et al.*, 2022; Lee and Lee, 2022; Su *et al.*, 2022). As global environmental concerns, notably climate change and resource depletion, continue to intensify, a prevailing consensus is emerging that traditional business paradigms need a profound metamorphosis (Handfield and Sroufe, 2018; Zwergel and Ziegler, 2021). Another debate relates to the role of eco process innovation in facilitating SPs. Linnenluecke *et al.* (2019) argue that eco process innovation can enhance environmental performance by enabling the adoption of cleaner technologies, improved efficiency, and reduced emissions. They highlight the potential for eco process innovation to result in significant environmental benefits by minimising resource consumption and waste generation. However, Chen and Rathore (2016) raise concerns that eco process innovation alone may not guarantee sustainability outcomes. They argue that process innovation may inadvertently lead to rebound effects, where efficiency gains are offset by greater production levels or increased consumption, ultimately negating potential environmental benefits.

Some scholars have also debated the distinction between eco product innovation and eco process innovation in terms of their relative impact on SPs. Balachandran and Ramanathan (2019) suggested that eco process innovation may have a more substantial and direct impact on sustainability, as it focuses on improving manufacturing processes rather than introducing new products. However, Große-Bölting and Pietzsch (2020) contend that product innovation can be a powerful driver of sustainability, particularly when it incorporates a life-cycle perspective. They argue that innovative product designs and functionalities, along with associated business models, can lead to sustainable consumption patterns, circular economy practices, and a reduced environmental footprint overall. In their study, Jum'a *et al.* (2023) delve into the relationship between big data technological capabilities, personal competencies and sustainable performance within Jordanian manufacturing firms, emphasising the mediating role of innovation. By contrast, the present study centres its attention on SPs, encompassing the diverse actions undertaken by manufacturing firms that impact environmental, social and economic dimensions.

This type of innovation includes coming up with and using new technologies, methods and products that are meant to reduce pollution, use fewer resources and make the switch to an economy that cares more about the environment (Dangelico and Pujari, 2019; Nidumolu *et al.*, 2022). Empirical research shows that manufacturing companies that put EI first will not only improve their environmental performance but also gain a competitive edge in the market (Dangelico and Pujari, 2019; Zhu and Liu, 2022).

Despite the potential of EI to drive SPs, the intricate relationship between these two variables remains inadequately explored in the scholarly literature, especially in least-developed countries. Furthermore, contradictions persist in the literature regarding the role of EI in promoting SPs. This gap in research is notable, as there is a lack of comprehensive investigations into the direct association between EI and SPs. Although studies, including the work of Quintana-García *et al.* (2022) and others, suggest the significance of EI in shaping SPs, a specific exploration of this association within Uganda's manufacturing context is conspicuously absent.

Our study aims to address this scholarly void by systematically examining the influence of EI on the uptake of SPs within medium and large (M&L) manufacturing organisations. Grounded in dynamic capability theory, our study contributes on multiple fronts. Primarily, this research offers a comprehensive examination of how EI assumes a pivotal role as a driving force for SPs, embracing a holistic perspective. The capacity of firms to enhance resource efficiency, curtail environmental emissions and foster innovations in environmental product and process domains underscores a comprehensive approach to SPs.

Second, we delve into the unexplored terrain of assessing the influence of EI on the implementation of SPs. This uncharted research question holds significance, as despite the recognised importance of robust EI in engendering competitive advantages (Sánchez-Torné *et al.*, 2020), this particular relationship has not garnered attention in the existing literature. Third, our empirical enquiry is situated within a distinct context, examining a sample of Ugandan manufacturing firms. This unique research setting sets our study apart from prior studies, particularly those centred around EI, which have predominantly focused on developed economies or specific industrial sectors.

The paper's organisation unfolds as follows: Section 2 presents a thorough review of significant scholarly contributions, elucidating the development of the hypotheses. In Section 3, we offer an in-depth explanation of the research methodology. Section 4 elaborates on the empirical findings of the study, while Section 5 presents a comprehensive exploration of the ensuing discourse. Our overarching conclusions and corresponding implications are discussed in Section 6.

## 2. Literature review and hypothesis development

### *2.1 Theoretical underpinnings*

In the literature, SP often responds to EI because new products and processes in manufacturing encourage firms to implement SPs (Afshari *et al.*, 2020). The primary aim of this paper is to explore SP in Uganda using dynamic capability theory and quantitative analysis to investigate the connection between EI and SPs. Dynamic capability, which is discussed later, serves as the lens through which this correlation is examined.

Following Teece *et al.* (1997), the dynamic capability view extends resource-based theory by introducing dynamic capabilities. These represent a firm's inherent ability to effectively integrate, construct, and reconfigure both internal and external competencies, alongside a mix of resources and proficiencies. In dynamic contexts, these capabilities are crucial, enabling firms to continually reallocate resources to navigate the complex business environment. The importance of innovation capability is evident in this framework, particularly when firms confront changing technologies and market structures. This is particularly true in the context of EI, which encompasses eco product and eco process innovations tailored to addressing sustainability challenges. EI has been conceptualised as a dynamic capability that reflects firms' capacity to innovate within a dynamic environment (Huang and Li, 2017; Qiu *et al.*, 2020).

At its core, dynamic capabilities encapsulate an enterprise's intrinsic potential to actively shape, reshape, synthesise and re-synthesise its asset infrastructure. This inherent flexibility empowers firms to adapt, cultivate and strategically harness internal and external competencies within their unique context. As highlighted by Teece *et al.* (1997), these capabilities enable firms to navigate the fluid external environment, shaping and capitalising on their strategic advantage. In essence, the dynamic capability framework, grounded in dynamic capabilities, provides a sophisticated paradigm for enterprises to align with the evolving business landscape and catalyse positive influences and innovative initiatives within this ever-evolving milieu.

### *2.2 The concept of environmental innovations*

EI involves integrating ethical considerations into products, processes and organisational frameworks (Chen *et al.*, 2006a). Its characteristics, determinants and typologies guide environmental stewardship decisions. EI spans technological, organisational, institutional, and social facets (Rennings, 2000). Technological aspects include pollution prevention technologies, while organisational facets involve tools such as ISO 14001. Institutional manifestations include bodies such as the Intergovernmental Panel on Climate Change, and social aspects encompass shifts in consumption and lifestyles. EI's breadth warrants multifaceted exploration, from narrow definitions (Chen *et al.*, 2006b) to those transcending firm boundaries (OECD, 2009). EI definitions focus on mitigating environmental impacts through products, processes or management (Rennings and Zwick, 2002; Kemp and Pearson, 2008), aiming to reduce ecological footprints. According to Chen *et al.* (2006a), "green innovations" span hardware and software linked to green products or processes, including energy conservation, pollution prevention, waste recycling, green design and corporate management. Horbach (2008) view EI as novel processes, techniques, systems, or products for environmental harm mitigation. Rennings (2000) defines it as stakeholder actions that formulate, adopt or implement ideas, behaviours, products and processes for environmental pressure alleviation and ecological sustainability.

### *2.3 The concept of sustainability practices*

Sustainability embodies the fusion of environmental, social and economic dimensions (Haanes, 2016). Elkington's (1997) conceptualisation of sustainability reinforces these interconnected facets, while Leung and Rosenthal (2019) stress the importance of harmonising them holistically. Nasrollahi *et al.* (2020) distinguish weak and strong sustainability orientations, the former focusing on planet, people and profits, and the latter expanding to industrialisation and technology, consistent with Nave *et al.*'s (2021) green economy concept. Schaltegger and Burritt (2018) define SPs as deliberate strategies that merge environmental responsibility, economic advantages and social progress, echoed by Bansal and Roth (2000), who underscore policy alignment with stakeholder expectations. Lozano (2008) concurs, characterising SPs as seamless integration of economic, environmental and social concerns. In Uganda's manufacturing context, entities contribute to sustainability challenges through emissions, waste and consumption of non-renewable energy (NEMA, 2019). Addressing this requires SPs, which drive cleaner production, resource efficiency, waste management and renewable energy (Kaawaase *et al.*, 2021; NEMA, 2019). Such strategies align with environmental preservation and socio-economic well-being goals.

### *2.4 Environmental innovations and sustainability practices*

EI is a pivotal driver of SPs in manufacturing firms, predominantly through eco product and process innovations. The literature underscores the fusion of innovation and sustainability, underscoring their significance for SP enhancement (Silvestre, 2015a, b; Kibet and Korir, 2013). Drawing from dynamic capability theory, innovation serves as a catalyst for transformative shifts across sectors, enabling the adoption of sustainability initiatives (Huisingh *et al.*, 2013). The practical application of innovations, especially environmental product and process innovations, reshapes social, economic and environmental performance (Smerecnik and Anderson, 2011; Silvestre, 2015a, b). Product innovation, particularly environmental variants, drives SPs (Johansson and Ramanathan, 2016). Eco-friendly, energy-efficient and resource-efficient products offer the potential to enhance SPs by curbing energy consumption, emissions and raw material waste (Johansson and Ramanathan, 2016). However, considering the entire product lifecycle is vital because some innovations may inadvertently increase consumption and environmental impacts (Luchs *et al.*, 2011). Coupling environmental product innovation with manufacturing improvements is essential (Grinza *et al.*, 2018), as is aligning it with customer demand and long-term sustainability goals (Teixeira *et al.*, 2020). Similarly, process innovation, which addresses novel methods and operational efficiencies, is crucial for SPs (Cagliano *et al.*, 2013).

Environmental process innovation focuses on minimising impacts, enhancing efficiency and fostering sustainability (Johansson and Ramanathan, 2016). In addition, clean technology and renewable energy adoption reduce energy use, raw material consumption and fossil fuel dependence (Johansson and Ramanathan, 2016). Jum'a *et al.* (2022) find compelling evidence that both lean practices and sustainability-oriented innovations, either individually or jointly, play a noteworthy role in ensuring sustainability. Thus, intertwining EI and SPs within manufacturing is fundamental. Integrating innovative strategies that span both the product and process realms empowers firms to advance environmental, economic and social performance, fostering a sustainable future. Based on this premise, we advance the following hypothesis:

*H1.* A significant positive relationship exists between EIs and SPs.

*2.4.1 Product innovation and sustainability practices.* Numerous studies have highlighted the positive influence of environmental product innovation on the sustainability efforts of manufacturing firms (Moyano-Fuentes *et al.*, 2018; Grinza *et al.*, 2018; Teixeira *et al.*, 2020). However, the relationship between product innovation and enhanced SPs is not always straightforward. Environmental product innovation, as outlined by Luchs *et al.* (2011), can improve environmental outcomes, yet may unintentionally drive increased consumption, leading to negative ecological effects. To comprehensively assess a product's environmental impact, scholars emphasise accounting for its entire lifecycle, including its usage and end-of-life phases. Grinza *et al.* (2018) shed light on the automobile sector, revealing that although companies craft environmentally conscious vehicles, associated manufacturing processes exhibit significant environmentally harmful effects, raising the importance of synchronising manufacturing improvements with product innovation for substantial SP enhancement. Teixeira *et al.*'s (2020) findings offer another perspective: despite prevalent environmental product innovation in the electronics sector, a distinct impact on SPs was not discerned. Plausible explanations include consumer demand gaps for eco-friendly products and a preference for short-term financial gains over long-term sustainability. Therefore, we posit that:

*H2.* There is a significant positive relationship between product innovation and SPs.

*2.4.2 Process innovation and sustainability practices.* The concept of process innovation, as outlined by the Organization for Economic Cooperation and Development (OECD) (2009), involves adopting technologically novel or enhanced methods, equipment and skills for service delivery. This encompasses fresh work strategies, innovative process design and change implementation across technological, human and organisational dimensions. Graafland (2018) highlights the extensive research exploring the link between innovation and environmental sustainability. Ferasso *et al.* (2020) suggests avenues for achieving SPs, including using eco-friendly materials, advanced technology for efficiency and waste reduction and adopting pollution-free technologies (Zeng *et al.*, 2017). Correspondingly, Morseletto (2020), Bag and Pretorius (2020) and Gupta *et al.* (2021) stress SPs' role in circular economy practices, aligning with eco process innovation as a conduit for sustainable advancements. Moyano-Fuentes *et al.* (2018) found a strong association between eco process innovation and environmental sustainability engagement. Linden *et al.* (2006) emphasises technology's role in energy-saving behaviour, while Chuang and Yang (2014) emphasised technology's impact, particularly in design and manufacturing stages, highlighting its role in shaping sustainable approaches throughout the production process. Environmental process innovation in manufacturing focuses on curbing negative environmental impacts and fostering sustainability (Cagliano *et al.*, 2013). This industry commitment to SPs is further emphasised by practices amplified, as exemplified by the adoption of clean technology and renewable energy (Johansson and Ramanathan, 2016). Although the literature largely substantiates positive impacts of eco process innovations on SPs, Azapagic and Perdan (2011) reveal cost challenges in implementing SPs, Hong *et al.* (2016) identifies context-specific practices, stressing the need for tailored approaches based on local conditions and Michelini *et al.* (2019) discuss modest outcomes accentuating the importance of holistic perspectives in addressing the multifaceted challenges of sustainability. In their recent study, Umar *et al.* (2023) demonstrate the significant impact of adopting blockchain technology on green manufacturing (GM). Furthermore, the study highlights the substantial contribution of GM to enhancing overall business sustainability. These perspectives motivate the following hypothesis:

*H3*. There is a significant positive relationship between process innovation and SPs.

## 3. Methodology

### *3.1 Research design, population and sample*

This study used a cross-sectional and quantitative research design. The cross-sectional approach involves collecting data from a sample at a specific moment to examine patterns and relationships. This design allowed the researcher to gather data and responses from manufacturing companies in a single instance, thereby enhancing the credibility and applicability of the findings. The quantitative methodology was chosen to quantify data and draw generalisable conclusions from a representative sample of M&L manufacturing firms, guided by the principles outlined by Creswell and Plano Clark (2007). In addressing the challenges posed by the manufacturing subsector in Uganda, which comprises around 3,859 small businesses often lacking clear addresses and contact details (UBOS, 2018), the study targeted M&L manufacturing firms in the central, eastern, northern and western regions, totalling 713 enterprises. From this pool, a sample of 256 firms affiliated with the Uganda Manufacturers' Association was determined using Yamane's (1967) method. Accordingly, the simplified formula for proportions according to Yamane is given as follows:

$$n = \frac{N}{1 + N * (e)^2}$$

where $n$ is the required sample size, $N$ is the population size and $E$ is the acceptable sampling error (tolerable error); a 95% confidence level and $p = 0.05$ are assumed. Thus, the sample size of this study is computed as follows:

$$n = \frac{713}{1 + 713 * 0.05^2} = 256$$

Firm classification as medium or large relied on parameters such as annual turnover and workforce size, following the criteria set by the Uganda Investment Authority (UIA, 2020). Medium-sized firms had an annual turnover between UGX 360m (approximately US$97,000) and UGX 1.2bn (approximately US$323,000), employing 51–100 individuals. Large firms exceeded UGX 1.2bn in turnover and employed over 100 employees. Employing a stratified sampling approach, the researcher allocated a total sample of 256 firms across the four regions, as presented in Table 1. The survey focused on manufacturing firms as the unit of analysis, with production managers, chief finance officers, human resource managers, operations managers and environmental managers being surveyed due to their direct involvement in sustainability decisions. Their diverse roles ensure a comprehensive view of SPs, including production, finance, employee engagement, operations and environmental compliance. This study employed purposive sampling to select individuals based on their relevance and involvement in sustainability, aiming to capture varied insights within manufacturing firms.

The results presented in Table 1 indicate that a significant majority of the manufacturing firms surveyed were located in the central region, representing 90.4% of the total. This concentration of firms in the central region can potentially be attributed to factors such as proximity to markets and the availability of resources. The favourable geographic location of the central region likely contributes to the accessibility of markets and resources, making it an attractive choice for establishing manufacturing operations.

### *3.2 Demographic characteristics*

The findings in Table 2 highlight key aspects of the surveyed manufacturing firms' composition and leadership. Notably, 57.2% of respondents were within the 36–45 age group, reflecting experienced individuals in leadership roles. This age bracket's prevalence stems from industry expertise and career advancement, which aligns with a pivotal professional growth phase. Additionally, 54.6% of the participants held bachelor's degrees, indicating an educated workforce adept at comprehending and engaging in SPs. A gender disparity was obvious, with men at 60.6% and women at 39.4%, underscoring the need for gender diversity to encompass inclusive sustainability perspectives (Alinda *et al.*, 2023). In terms of experience, a significant 61.9% reported 5–10 years of manufacturing familiarity, suggesting their grasp of sustainability's importance. Among managers, human resource managers (30.3%) and operations managers (21.9%) significantly contributed to sustainability efforts, displaying their pivotal role in promoting SPs across functions. Notably, environmental managers (8.8%) formed a smaller portion, implying that sustainability was interwoven into broader managerial duties.

Table 3 displays the characteristics of the firms surveyed.

Table 3 highlights the surveyed manufacturing firms' key characteristics. A significant proportion (88.5%) were classified as medium-sized (51–100 employees), in alignment with local standards. Notably, 90.4% were located in the central region, likely due to proximity to resources and markets. The distribution of firms across 5–10 years (36.5%) and 10–16 years (31.3%) of existence suggests established structures for SPs. The food and beverage sector exhibited the largest representation, signifying its recognition of responsibility due to its direct impact on human sustenance. The textile, clothing and footwear industry's

| *Region* | Medium | Large | *Acquired* | Target | Response rate (%) |
|---|---|---|---|---|---|
| Central | 167 | 21 | 188 | 229 | 82.1 |
| Western | 4 | 1 | 5 | 7 | 71.4 |
| Eastern | 12 | 1 | 13 | 18 | 72.2 |
| Northern | 1 | 1 | 2 | 2 | 100.0 |
| Acquired | 184 | 24 | 208 | 256 | 81.3 |
| Target sample | 220 | 36 | | | |
| *Response rates (%)* | 83.6 | 66.7 | | | |

**Source:** Primary data

**Table 1.** Geographical distribution of the firm

| *Gender* | Count | Valid (%) | Cumulative (%) |
|---|---|---|---|
| Male | 398 | 60.6 | 60.6 |
| Female | 259 | 39.4 | 100.0 |
| *Age group* | | | |
| Less than 35 years | 207 | 31.5 | 31.5 |
| 36–45 years | 376 | 57.2 | 88.7 |
| 46–55 years | 67 | 10.2 | 98.9 |
| above 55 years | 7 | 1.1 | 100.0 |
| *Highest level of education* | | | |
| Diploma | 76 | 11.6 | 11.6 |
| Bachelor's degree | 359 | 54.6 | 66.2 |
| Master's degree | 207 | 31.5 | 97.7 |
| PhD | 9 | 1.4 | 99.1 |
| Others | 6 | 0.9 | 100.0 |
| *Tenure* | | | |
| Less than 5 years | 135 | 20.5 | 20.5 |
| 5–10 years | 407 | 61.9 | 82.5 |
| 11–15 years | 92 | 14.0 | 96.5 |
| 16 years and above | 23 | 3.5 | 100.0 |
| *Position* | | | |
| Environmental Manager | 58 | 8.8 | 8.8 |
| Operations Manager | 144 | 21.9 | 30.7 |
| Human Resource Manager | 199 | 30.3 | 61.0 |
| Production Manager | 123 | 18.7 | 79.8 |
| Chief Finance Officer | 133 | 20.2 | 100.0 |

**Source:** Primary data

**Table 2.**
Respondents characteristics, total $n = 657$ respondents

prominence reflects awareness of sustainability's importance in meeting fundamental needs, while the limited presence of the printing sector indicates the potential for improvement.

*3.3 Questionnaire and variables measurement*

Data were collected using a self-administered questionnaire featuring closed-ended items, using a six-point Likert scale inspired by Spector (1992), to ensure clarity in responses. This approach aimed to foster distinct expressions of agreement or disagreement with the research questions. The chosen six-point scale aimed to enhance data quality by minimising ambiguity. The questionnaire method was deliberately chosen for its efficiency in reaching a diverse respondent pool and deriving average ratings. The questionnaire's design drew from the relevant literature on EI and SPs. EI was operationalised using insights from Carrillo-Hermosilla *et al.* (2010) and Cheng and Shiu (2012), while SP encompassed environmental, social and economic dimensions based on Chow and Chen (2012), Høgevold *et al.* (2015) and Yacob *et al.* (2019). Detailed questionnaire questions are available in the Appendix.

*3.4 Control variables*

Existing research has pointed out the potential impact of firm-specific factors on a company's pursuit of sustainability objectives (Balasubramanian and Shukla, 2020). Additionally, Bartov *et al.* (2000) underscore the significance of considering confounding

| No. of employees | Frequency | Valid (%) | Cumulative (%) |
|---|---|---|---|
| Less than 101 | 184 | 88.5 | 88.5 |
| 101 and above | 24 | 11.5 | 100.0 |
| Geographical region of firm | | | |
| Central | 188 | 90.4 | 90.4 |
| Western | 5 | 2.4 | 92.8 |
| Eastern | 13 | 6.3 | 99.0 |
| Northern | 2 | 1.0 | 100.0 |
| Number of years this firm has been in operation | | | |
| Less than 5 years | 7 | 3.4 | 3.4 |
| 5–10 years | 76 | 36.5 | 39.9 |
| 11–15 years | 65 | 31.3 | 71.2 |
| 16 years and above | 60 | 28.8 | 100.0 |
| Nature of the manufacturing business | | | |
| Food and beverages | 66 | 31.7 | 31.7 |
| Chemicals, paint, soap, foam products | 37 | 17.8 | 49.5 |
| Textiles, clothing and footwear | 32 | 15.4 | 64.9 |
| Metal and furniture products | 33 | 15.9 | 80.8 |
| Sawmilling, paper | 12 | 5.8 | 86.5 |
| Packaging and label | 12 | 5.8 | 92.3 |
| Bricks and cement | 11 | 5.3 | 97.6 |
| Printing | 5 | 2.4 | 100.0 |

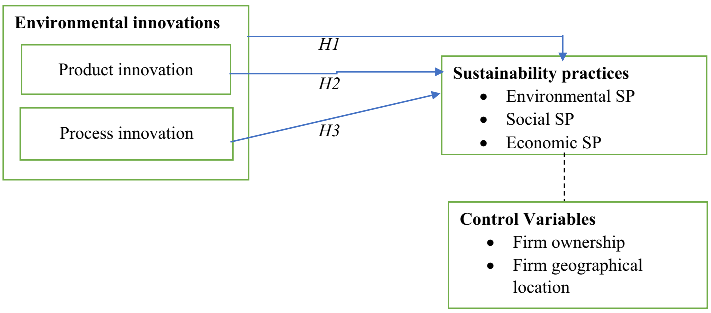
**Source:** Primary data

**Table 3.** Firm attributes, total $n = 208$ manufacturing firms

variables to prevent unwarranted rejections of research hypotheses that might otherwise have been corroborated. In alignment with this perspective, the current study takes into consideration the inherent characteristics of a firm's geographical location and its ownership as controlling variables. The study model is depicted in Figure 1 for reference.

### *3.5 Validity and reliability*

In the realm of research, validity pertains to the degree to which a measurement accurately reflects the intended concept it seeks to assess. To ensure the precision of the survey questions employed in this study, experts from academia, policymaking and research in the




**Source:** Authors' conceptualisation

**Figure 1.** Study model

field of SPs were consulted. These experts evaluated the appropriateness of the survey questions using a rating scale ranging from 1 (strongly disagree) to 6 (strongly agree). The input and ratings provided by these experts were used to compute the content validity index (CVI) for each variable being investigated. The resulting CVI scores surpassed the established threshold of 0.7, signifying the robust content validity of the survey instrument (Field, 2009). The expert feedback and CVI scores collectively affirmed the questionnaire's validity across all examined variables. Similarly, the instrument's reliability, which gauges its consistency in measuring a specific concept, was assessed using Cronbach's alpha coefficient. The calculated Cronbach's alpha values for the study's variables exceeded the recommended threshold of 0.7, as proposed by Nunnally (1978), confirming a high level of internal consistency (as depicted in Table 4). This underscores that the survey questions consistently and reliably gauged the intended concepts in a steadfast manner.

### *3.6 Data analysis*

The process of data collection, organisation, modification, coding, capturing and analysis was carried out using SmartPLS structural equation modelling (SEM) Version 3. Prior to analysis, the data underwent cleaning procedures using SPSS Version 23, following the recommended protocols outlined by Field (2009). Instances of missing data, constituting less than 5% of the dataset, were identified through thorough case, variable, and value examinations. Linear interpolation was then used to fill these gaps, thereby mitigating potential reductions in statistical power and potential inaccuracies in the results. To rectify any discrepancies, incorrect item entries were cross-tabulated and assigned numerical codes during the data entry phase.

The refined data set was subsequently subjected to analysis using SmartPLS Version 3 (Hair *et al.*, 2017). In light of the study's sample size of 208 manufacturing firms, SmartPLS was selected due to its appropriateness for larger samples. Partial least squares (PLS) path modelling, according to the guidance of Fornell and Bookstein (1982), does not rely on assumptions about scale measurement or population characteristics, distinguishing it from some alternative methods. The analysis encompassed both the measurement (outer) and structural (inner) models, in alignment with Henseler *et al.*'s (2014) recommendation, which enables a comprehensive interpretation of PLS-SEM outcomes. The structural model explored the relationships between the explanatory and criterion latent variables, while the measurement model examined the connections between indicators and their corresponding latent variables while upholding considerations of reliability and validity, as outlined by Hair *et al.* (2017).

| Constructs | Cronbach's *alpha* | Composite reliability | Average variance extracted (AVE) | Variance inflation factor (VIF) |
|---|---|---|---|---|
| Process innovation | 0.722 | 0.762 | 0.551 | 1.704 |
| Product innovation | 0.887 | 0.892 | 0.529 | 1.565 |
| *Environmental innovations* | 0.805 | 0.827 | 0.540 | 1.634 |
| Economic SPs | 0.783 | 0.799 | 0.610 | 1.924 |
| Environmental SPs | 0.776 | 0.786 | 0.539 | 1.396 |
| Social SPs | 0.749 | 0.770 | 0.575 | 1.688 |
| *Sustainability practices* | 0.769 | 0.785 | 0.575 | 1.669 |

**Source:** Primary data

**Table 4.**
Reliability and validity of the research instrument

The selection of SmartPLS for a sample size of 208 is justified by its capacity to accommodate larger samples while providing reliable results. While SmartPLS is often chosen for smaller samples, it also remains effective and robust for larger samples, offering advantages such as model flexibility, robustness in handling complex relationships and the ability to analyse both reflective and formative constructs effectively (Hair *et al.*, 2017, 2013). Furthermore, its suitability for exploratory research and its ability to accommodate non-normal data distribution make it an appropriate choice for a sample size of 208 (Henseler *et al.*, 2014; Hair *et al.*, 2017).

## 4. Results

### *4.1 Measurement models*

In the realm of construct validity, two distinct forms, namely, convergent and discriminant validity, were meticulously investigated, as highlighted by Neuman (2007). To assess convergent validity, we used the metric of average variance expected (AVE). The outcomes, as presented in Table 4, distinctly demonstrate that all the calculated AVE values surpassed the accepted threshold of 0.5, as per established norms. This finding concurs with the existence of convergent validity, as discussed by Henseler *et al.* (2014).

Discriminant validity refers to how well a measurement accurately captures a specific concept it is meant to assess, without being influenced by other concepts. Normally, both convergent validity (how well indicators of a concept converge) and discriminant validity are simultaneously evaluated for related concepts. To establish discriminant validity, an indicator's outer loadings on its intended concept should be higher than its correlations with other concepts (Fornell and Larcker, 1981). In this study, Tables 5 and 6 confirm that discriminant validity requirements were met. To ensure the measurement tool's reliability, we used Cronbach's alpha coefficient and composite reliability, assessed via SmartPLS. As shown in Table 4, the instrument demonstrated good internal consistency, with alpha coefficients and composite reliability values for each variable surpassing the recommended threshold of 0.7 (Fornell and Larcker, 1981; Nunnally, 1978). In this study, composite reliability was used, given the different outer loadings of the indicator variables (Hair *et al.*, 2017).

Before conducting the factor analysis, a preliminary assessment was carried out to ensure the data's suitability and reliability for exploratory factor analysis. The Kaiser–Meyer–Olkin (KMO) measure of sample adequacy was used to evaluate data appropriateness, while the Bartlett test was used to assess correlations among variable components. KMO values greater than 0.7 and statistically significant Bartlett's test results ($p < 0.05$) indicate that the sample is suitable and appropriate for analysis, as outlined by Field (2009) and Kaiser (1974). The results for the variables under investigation are

| Environmental innovations | PN | PI | |
|---|---|---|---|
| Process innovation (PN) | | | |
| Product innovation (PI) | 0.649 | | |
| *Sustainability practices* | *EC* | *EV* | *SS* |
| Economic SPs (EC) | | | |
| Environmental SPs (EV) | 0.614 | | |
| Social SPs (SS) | 0.732 | 0.521 | |

**Source:** Primary data

**Table 5.** Discriminant validity using the Heterotrait-Monotrait (HTMT) ratio

| Item | Product innovation | Process innovation |
|---|---|---|
| EVPI5 | 0.720 | |
| EVPI6 | 0.695 | |
| EVPI7 | 0.706 | |
| EVPI8 | 0.782 | |
| EVPI9 | 0.796 | |
| EVPI10 | 0.583 | |
| EVPI11 | 0.733 | |
| EVPI12 | 0.744 | |
| EVPI14 | 0.715 | |
| EVPN1 | | 0.718 |
| EVPN3 | | 0.643 |
| EVPN4 | | 0.625 |
| EVPN5 | | 0.833 |
| EVPN7 | | 0.921 |
| Eigen Values | 6.854 | 4.005 |
| Variance % | 38.084 | 25.796 |
| Cumulative % | 38.084 | 63.880 |
| *KMO measure* of sampling adequacy | | 0.927 |
| *Bartlett's test of sphericity* | | |
| Approx. chi-square | | 1,677.287 |
| df | | 136 |
| Sig. | | 0.000 |

**Source:** Primary data

**Table 6.** Exploratory factor analysis for environmental innovations

presented in Table 6. Factor analysis was performed on the data using principal axis factoring with orthogonal varimax rotation. Using an eigenvalue cutoff of 1.0, two factors (eco product innovation and eco process innovation) emerged for EI, explaining a cumulative eigenvalue of 63.880, as depicted in Table 6. The factors retained for EI are outlined in Table 6, with eco product innovation and eco process innovation exhibiting eigenvalues of 6.854 and 4.005, respectively. The total variance explained was 63.880%, aligning with the recommendations by Field (2009) and Hair *et al.* (2017). This confirms the presence of discriminant validity among the various components of EI.

Table 7 presents the findings from the exploratory factor analysis, which was conducted to evaluate the factors that were retained in the study for SPs.

Table 7 presents the extracted factors corresponding to SPs. These factors demonstrated eigenvalues of 4.532, 3.603 and 1.081, collectively accounting for 65.827% of the total explained variance. This adherence to the criteria established by Field (2009) and Hair *et al.* (2017) substantiates the existence of discriminant validity within the realm of SPs.

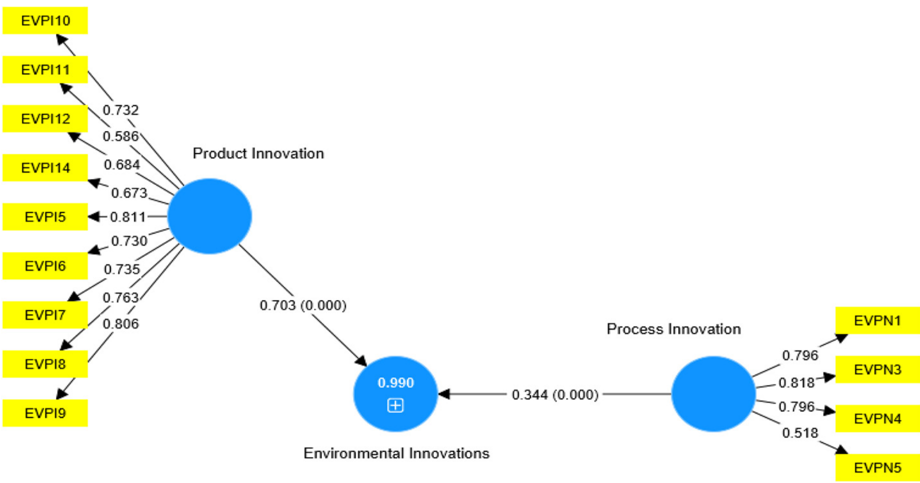
Figure 2 illustrates that each dimension of EI holds significant estimations, underscoring the significance of eco product and eco process innovations in comprehending EI. In line with Hair *et al.*'s (2017) recommendation of a minimum value of 0.400, all item loadings exceeded this threshold. Consequently, the observed variables serve as excellent indicators of their respective latent variables. Notably, eco product innovation ($\beta = 0.703$, $p < 0.05$) demonstrated the highest efficacy in elucidating EI, followed by process innovation, as indicated by the measurement model. The combined impact of these two factors comprehensively accounts for 99% of the observed variance in EI.

As depicted in Figure 3, the dimensions associated with SPs exhibited noteworthy estimates, signifying the pivotal role of social, economic and environmental SPs in

| Item | Social SPs | Environmental SPs | Economic SPs |
|---|---|---|---|
| SPSS4 | 0.506 | | |
| SPSS5 | 0.814 | | |
| SPSS6 | 0.746 | | |
| SPSS7 | 0.642 | | |
| SPSS10 | 0.861 | | |
| SPSS13 | 0.769 | | |
| SPSS15 | 0.594 | | |
| SPEP2 | | 0.741 | |
| SPEP3 | | 0.793 | |
| SPEP5 | | 0.762 | |
| SPEP6 | | 0.693 | |
| SPEP9 | | 0.777 | |
| SPEP11 | | 0.761 | |
| SPCS4 | | | 0.638 |
| SPCS5 | | | 0.638 |
| SPCS6 | | | 0.546 |
| SPCS7 | | | 0.691 |
| Eigen values | 4.532 | 3.603 | 1.081 |
| Variance % | 32.369 | 25.735 | 7.723 |
| Cumulative % | 32.369 | 58.104 | 65.827 |
| *KMO measure* of sampling adequacy. | | | 0.809 |
| *Bartlett's test of sphericity* | | | |
| Approx. chi-square | | | 1,085.797 |
| df | | | 91 |
| Sig. | | | 0.000 |

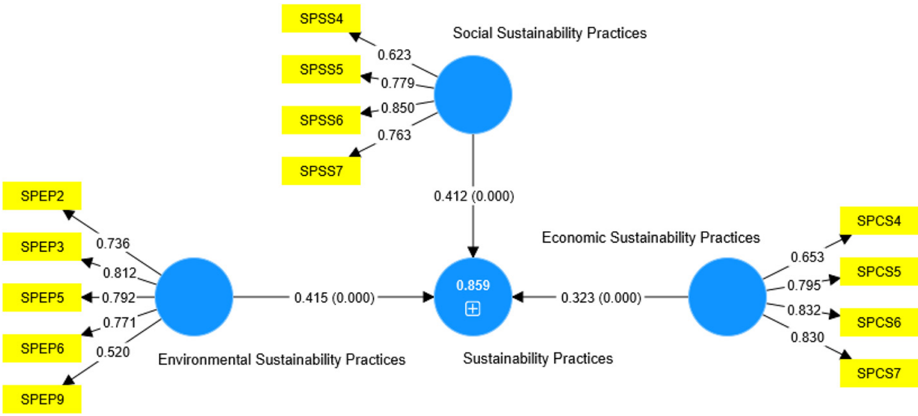
**Source:** Primary data

**Table 7.** Exploratory factor analysis for sustainability practices




**Source:** Authors' estimation using SmartPLS 3

**Figure 2.** Measurement model for environmental innovations




**Source:** Authors' estimation using SmartPLS 3

**Figure 3.**
Measurement model for SPs

elucidating the construct. Every item loading in the outer model surpassed the threshold of 0.400 recommended by Hair *et al.* (2017), affirming the efficacy of the observed variables as reliable indicators of their respective latent variables. Notably, environmental SPs ($\beta$ = 0.415, $p < 0.05$) displayed the highest loading within the SPs construct, suggesting that environmental SPs contribute significantly to explaining the variability in SPs. When collectively considered, these dimensions jointly elucidated 85.9% of the observed variance in SPs, as illustrated in Figure 3.

*4.2 Structural model*

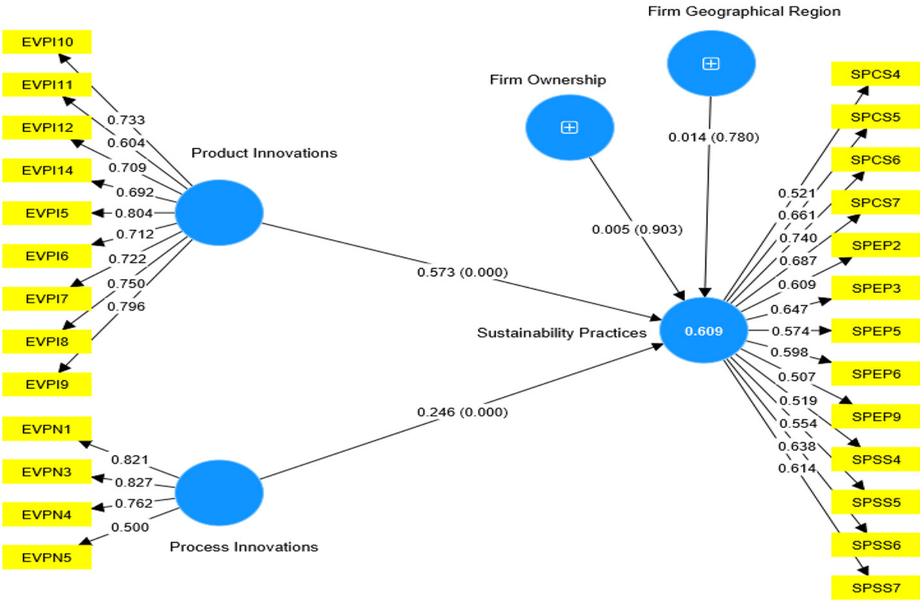
*4.2.1 Test of hypothesis.* To unveil the correlations among the constructs examined in this study, the bootstrapping procedure was employed, accompanied by pertinent *t*-statistics and path coefficients (Wong, 2013). The primary objective of using bootstrapping was to assess the significance of loading and path coefficients. The outcomes of this significance testing, relating to two specific hypotheses, are depicted in Figure 4, as well as detailed in Tables 8 and 9.

Based on the insights presented in Figure 4 and Table 8, EI elucidated approximately 60.9% of the variability observed in SPs. Among the individual variables, as depicted in Table 9, eco product innovation ($\beta$ = 0.573, $p < 0.05$) emerged as the most influential predictor, exhibiting significant predictive power. Process innovation also contributed to this relationship, albeit to a somewhat lesser extent.

Table 11 displays the structural model estimations for EI and the implementation of environmental SPs.

Based on the information conveyed in Figure 5 and Table 10, it is evident that EI accounted for around 43.7% of the variance in environmental SPs. Among the specific variables, eco product innovation ($\beta$ = 0.457, *t*-statistic 5.553, $p < 0.05$) stood out as the most substantial predictor, displaying a noteworthy level of predictive strength (Table 11). Although process innovation also contributed to this association, its impact was slightly less pronounced.

Table 13 presents the structural model estimations pertaining to EI and the integration of social SPs.




**Source:** Authors' estimation using SmartPLS 3

**Figure 4.**
Structural model estimates for EI and SPs

| Prediction for sustainability practices | $R$-square | $R$-square adjusted |
|---|---|---|
| Sustainability practices | 0.609 | 0.601 |

**Source:** Primary data

**Table 8.**
Prediction estimates for SPs

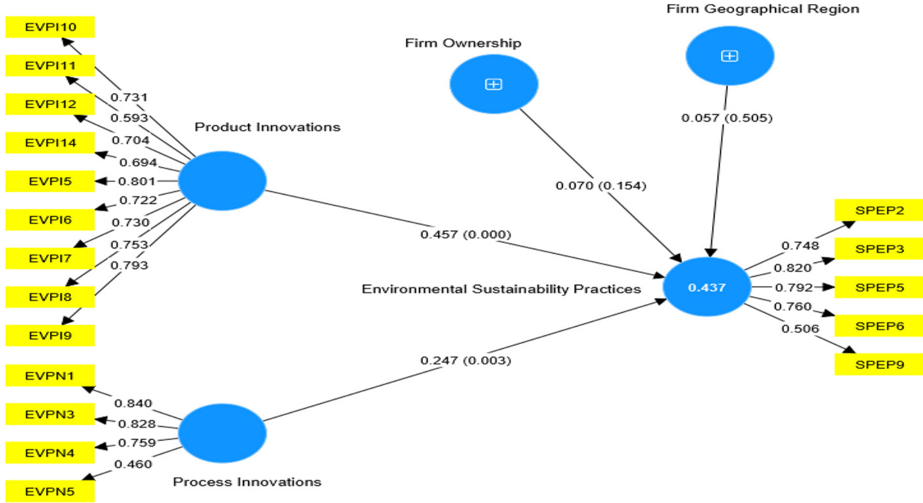
| Predictors | $\beta$ | Std. error | $t$ statistics | $p$ |
|---|---|---|---|---|
| Firm geographical region → SPs | 0.014 | 0.048 | 0.280 | 0.780 |
| Firm ownership → SPs | 0.005 | 0.041 | 0.122 | 0.903 |
| Product innovations → SPs | 0.573 | 0.074 | 7.710 | 0.000 |
| Process innovations → SPs | 0.246 | 0.069 | 3.589 | 0.000 |

**Source:** Primary data

**Table 9.**
Structural model estimates for prediction of SPs

Based on the insights presented in Figure 6 and Table 12, it is apparent that EI explained approximately 35.6% of the variability observed in social SPs. Among the individual variables, product Innovation ($\beta = 0.499$, $p < 0.05$) emerged as the most influential predictor, demonstrating a notable degree of predictive power (Table 13). Process innovation also played a role in this relationship, although its influence was slightly less prominent.

Table 14 presents the structural model estimations pertaining to EI and the integration of economic SPs.




**Source:** Authors' estimation using SmartPLS 3

**Figure 5.**
Structural model for environmental innovations and environmental SPs

**Table 10.**
Prediction estimates for environmental SPs

| Prediction for environmental sustainability practices | *R*-square | *R*-square adjusted |
|---|---|---|
| Environmental sustainability practices | 0.437 | 0.426 |

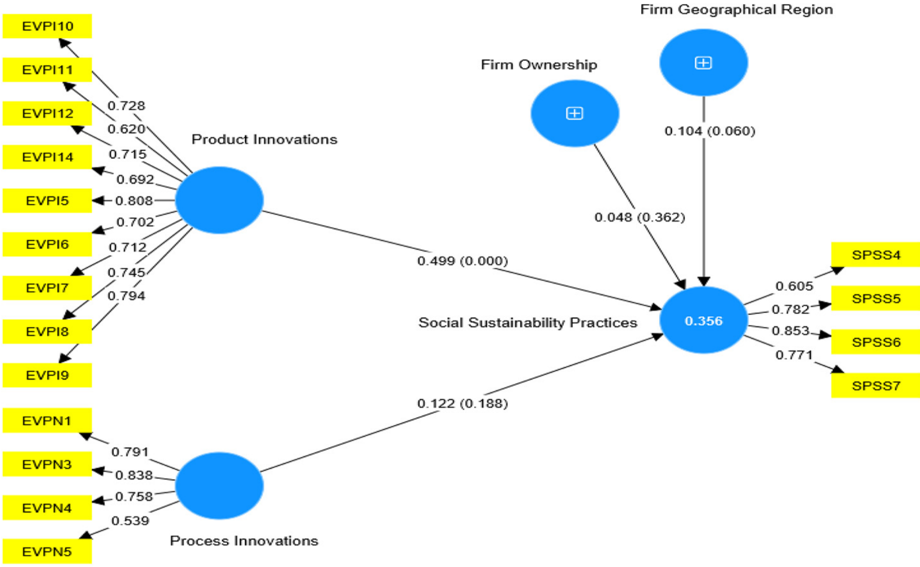
**Source:** Primary data

**Table 11.**
Structural model estimates for EIs and environmental SPs

| Predictors | $\beta$ | Std. error | t *statistics* | *p* |
|---|---|---|---|---|
| Firm geographical region → Environmental SPs | 0.057 | 0.086 | 0.666 | 0.505 |
| Firm ownership → Environmental SPs | 0.070 | 0.049 | 1.426 | 0.154 |
| Product innovations → Environmental SPs | 0.457 | 0.082 | 5.553 | 0.000 |
| Process innovations → Environmental SPs | 0.247 | 0.083 | 2.965 | 0.003 |

**Source:** Primary data

The insights derived from Figure 7 and Table 14 reveal that EI accounted for approximately 43% of the variability seen in economic SPs. Among the variables, eco product innovation ($\beta$ = 0.434, *t*-statistic 4.247, $p < 0.05$) emerged as the most influential predictor, demonstrating considerable predictive power (Table 15). Process innovation also contributed to this relationship, although to a slightly lesser extent. Furthermore, the findings in Table 9 support *H2*, demonstrating a significant relationship between eco product innovation and SPs within Uganda's manufacturing firms ($\beta = 0.573$, $t = 7.710$, $p < 0.05$). This emphasises the pivotal role of sustainability-focused eco product innovation in driving SPs within manufacturing firms. These innovative initiatives encompass sustainable product lines and design enhancements aimed at improving resource efficiency.




**Source:** Authors' estimation using SmartPLS 3

**Figure 6.** Structural model for environmental innovations and social sustainability practices

| Prediction for social sustainability practices | *R*-square | *R*-square adjusted |
|---|---|---|
| Social sustainability practices | 0.356 | 0.344 |

**Source:** Primary data

**Table 12.** Prediction estimates for social sustainability practices

| Predictors | $\beta$ | Std. error | *t* statistics | *p* |
|---|---|---|---|---|
| Firm geographical region → Social SPs | 0.104 | 0.055 | 1.880 | 0.060 |
| Firm ownership → Social SPs | 0.048 | 0.053 | 0.911 | 0.362 |
| Product innovations → Social SPs | 0.499 | 0.094 | 5.311 | 0.000 |
| Process innovations → Social SPs | 0.122 | 0.093 | 1.316 | 0.188 |

**Source:** Primary data

**Table 13.** Structural model estimates for environmental innovations and social sustainability practices

| Prediction for economic sustainability practices | *R*-square | *R*-square adjusted |
|---|---|---|
| Economic sustainability practices | 0.430 | 0.419 |

**Source:** Primary data

**Table 14.** Prediction values for economic sustainability practices

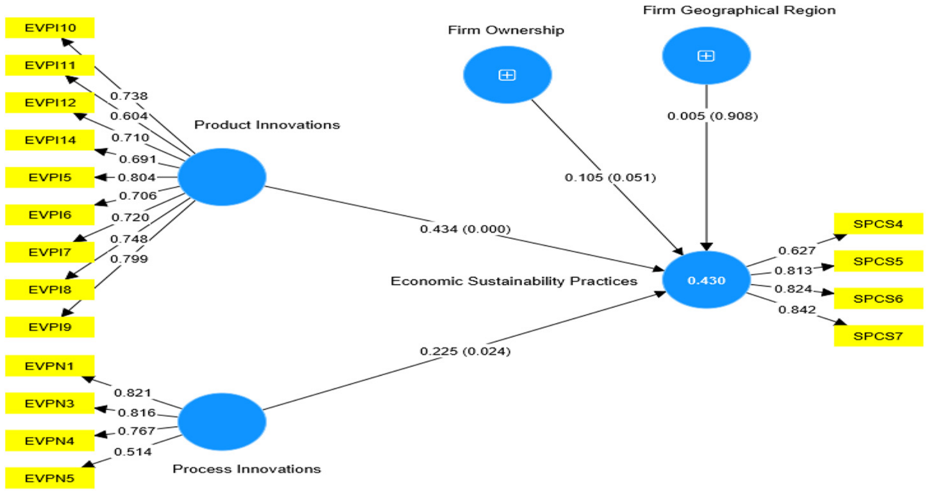



**Figure 7.** Structural model for environmental Innovations and economic sustainability practices

**Source:** Authors' estimation using SmartPLS 3

**Table 15.** Structural model estimates for environmental innovations and economic sustainability practices

| Predictors | $\beta$ | Std. error | *t* statistics | *p* |
|---|---|---|---|---|
| Firm geographical region → Economic SPs | 0.005 | 0.045 | 0.116 | 0.908 |
| Firm ownership → Economic SPs | 0.105 | 0.054 | 1.955 | 0.051 |
| Product innovations → Economic SPs | 0.434 | 0.102 | 4.247 | 0.000 |
| Process innovations → Economic SPs | 0.225 | 0.099 | 2.264 | 0.024 |

**Source:** Primary data

Based on the results presented in Table 9, the investigation of *H3* regarding the relationship between process innovation and the implementation of SPs among Ugandan manufacturing firms yielded a significant finding. The results indicate a statistically significant connection between process innovation and the integration of SPs ($\beta = 0.246$, $t = 3.589$, $p < 0.05$). This underscores the pivotal role of process innovation in driving the implementation of SPs within these firms. The analysis reveals that alterations and improvements in manufacturing processes, referred to as process innovation, profoundly impact the adoption of SPs. The significant coefficient ($\beta = 0.246$) implies that with each increment in process innovation, there is a corresponding rise in the incorporation of SPs. The positive coefficient underscores a direct and favourable link, suggesting that engagement in process innovation activities enhances firms' ability to integrate sustainability measures into their operations. This underscores the strategic significance of prioritising process innovation as a means of promoting SPs within Uganda's manufacturing sector.

## 5. Discussion

The findings presented in Table 8 provide compelling evidence demonstrating that the combined influence of EI dimensions (eco product and eco process innovations) accounts for a substantial 60.1% of the variance in SPs, thus supporting *H1*. This research outcome also establishes a significant positive relationship between eco product innovation and SPs within Uganda's manufacturing firms, thus confirming *H2*. Specific initiatives related to eco product innovation, such as eco-friendly product development, advanced production technologies and sustainability-focused product lines, play a pivotal role in driving the implementation of SPs. This attests to the strategic importance of aligning innovation efforts with environmental responsibility and consumer demand, ultimately fostering a corporate culture that embraces responsible business practices and contributes positively to the environment and society.

These findings align with research by Chen *et al.* (2019) and Lee and Lee (2022), who emphasise the role of eco product innovation in driving SPs within manufacturing firms. Similarly, Richardson *et al.* (2021) highlight that firms prioritising eco product innovation aligned with sustainability objectives enhance market competitiveness and environmental impact. Moreover, Rajagopal and Bernardes (2019) argue that firms often prioritise eco product innovation over SPs due to the immediate market benefits and competitive advantage it provides. They assert that this focus on eco product innovation may divert resources away from implementing SPs, potentially hindering overall sustainability efforts. On the other hand, Shafqat *et al.* (2020) contend that eco product innovation can actually drive sustainability by enabling the introduction of eco-friendly products or enhancing the environmental performance of existing products. They assert that sustainability-driven eco product innovation can lead to improvements in resource efficiency, reduced waste and lower environmental impact. The alignment with dynamic capability theory, as proposed by Barney (1991) and advanced by Teece *et al.* (1997), becomes evident. The positive relationship between eco product innovation and SPs in Ugandan manufacturing firms aligns with dynamic capability theory, emphasising firms' adaptability and innovation for competitive advantage. Prioritising eco product innovation aligned with sustainability enhances dynamic capabilities, enabling firms to respond to evolving demands and regulations. These endeavours present substantial implications for advancing sustainability policies and actions, yielding positive outcomes. For instance, the incorporation of eco-friendly packaging materials alongside incentives for effective waste management by employees underscores the organisation's unwavering commitment to environmental and social responsibility. Moreover, the organisation's focus on equity, safety and community well-being underscores its comprehensive sustainability approach. These combined endeavours underscore the catalytic function of eco product innovation in embracing sustainability and fostering responsible community engagement. They also highlight the necessity of cultivating an innovation-driven organisational culture and investing in robust research and development activities, which are crucial for manufacturing firms. These measures not only enhance competitiveness but also amplify the firm's ability to strengthen and elevate its SPs, thereby fostering lasting environmental and social stewardship.

The results from *H3* confirm the significant relationship between process innovation and SPs in Ugandan manufacturing firms, thus supporting *H3*. Process innovation efforts, such as upgrading manufacturing technology for environmental protection, energy-efficient technologies and sustainability-focused equipment replacement, directly translate into improved SPs. Equity, community safety, safety impact consideration and economic practices are also linked to process innovation frequency, indicating its role in driving SPs. These findings corroborate those of Johnson *et al.* (2018) and Smith *et al.* (2019), who support the positive influence of process innovation on SPs. Process innovation's impact on operational enhancements and sustainability outcomes aligns with Teece *et al.*'s (1997) dynamic capability theory, asserting that continuous adaptation and innovation enhance firm performance and SPs. Process innovation significantly correlates with implementing

SPs in Ugandan manufacturing firms, emphasising its potential to drive operational improvements and efficiency, thereby contributing to sustainability outcomes.

## 6. Conclusion, limitations and future research

This study's primary objective was to assess the influence of EI on the SP of M&L manufacturing firms in Uganda. Additionally, we aimed to explore the distinct significance of various dimensions of EI, as previously identified in the existing literature, in shaping SPs. To achieve these objectives, we conducted a questionnaire survey involving 208 manufacturing firms in Uganda, with key personnel, such as production managers, operations managers, environmental managers, human resource managers and chief finance managers participating. Our findings affirm a significant relationship between EI and SPs. Notably, among the dimensions of EI, eco product innovation emerged as the most potent predictor of SP, while process innovation exhibited the least predictive potential within M&L manufacturing firms in Uganda. This research contributes to the theoretical framework of dynamic capability theory and to the broader literature on SP. It underscores the strategic importance of both eco product and process innovations as resources and toolkits for advancing sustainability within Ugandan M&L manufacturing firms. These EI components have the potential to serve as sources of inspiration for further research in the field.

This research significantly enriches the theoretical understanding of the intricate relationship between EI and SP within M&L manufacturing firms in Uganda. It advances our comprehension by shedding light on the dynamic nature of this connection, emphasising that EI serves as a strategic resource and toolkit for fostering SPs. In particular, our study underscores the critical roles played by both eco product and eco process innovations in shaping sustainable outcomes. This theoretical contribution offers a nuanced perspective on how organisations can effectively drive SP through innovation-driven strategies, providing a solid foundation for future scholarly investigations into the intricate mechanisms governing this interplay.

From a managerial perspective, our findings offer actionable insights that can guide manufacturing managers in Uganda towards more informed and eco-conscious decision-making. Notably, our research identifies eco product innovation as a powerful driver of SPs, underscoring the practical importance of investing in innovative product development. Managers can use this knowledge to prioritise sustainability initiatives, thus steering their organisations towards environmentally responsible practices. Furthermore, the emergence of process innovation as a less potent factor highlights the significance of continuously enhancing internal processes to promote sustainable operations. This underscores the necessity for a comprehensive approach to environmental management that encompasses both eco product and process innovations.

The implications of this study also extend to policymakers, aligning closely with the United Nations' Sustainable Development Goals (SDGs), particularly SDG 12 (Sustainable Production and Consumption) and SDG 9 (Industry, Innovation and Infrastructure). Policymakers can leverage our findings to design more effective incentives and regulations aimed at promoting EI within the manufacturing sector. By doing so, they can actively facilitate the detachment of economic growth from environmental harm, fostering cleaner production and sustainable industrialisation. This aligns with global sustainability agendas and reinforces Uganda's commitment to addressing environmental challenges through innovation-driven policies.

Despite the valuable insights from this study, it is imperative to acknowledge its inherent limitations. The findings are primarily constrained by contextual specificity, focusing on a specific subset of manufacturing firms operating within designated districts and under the umbrella of the Uganda Manufacturers' Association. As a result, generalising these findings to the broader manufacturing landscape, both within Uganda and internationally, must be approached with caution, given the diversity of industry dynamics, resource availability and regulatory environments across various contexts. To address these limitations and further advance our understanding of SP, future research should adopt more comprehensive and nuanced methodologies encompassing qualitative and mixed-methods approaches to delve deeper into the multifaceted dimensions that underlie SP. These approaches can illuminate intricate interplays between EI and sustainability outcomes, providing a richer and more holistic understanding of the subject matter.

Moreover, research should explore the context-specific applications of EI in diverse manufacturing settings to identify tailored strategies and best practices for promoting sustainability within different industrial contexts, thereby enhancing the practical applicability of the findings. Additionally, future studies could delve into the economic implications of EI on SPs by examining its effects on financial performance, competitiveness and market positioning. Longitudinal research, tracking the evolution of SPs over time, would provide a temporal dimension, elucidating how EI contributes to sustainable outcomes and how organisations adapt to dynamic environmental and market conditions, guiding strategies for sustained sustainability and resilience building. Lastly, exploring the potential interplay between EI, government policies and industry standards would shed light on the regulatory dynamics influencing sustainability efforts within the manufacturing sector. In summary, while this study's limitations are acknowledged, they underscore the necessity for continued scholarly enquiry to comprehensively understand the complexities inherent in sustainability management within the manufacturing sector. Such insights have the potential to inform and guide organisations and policymakers towards more effective and informed strategies and initiatives.

## References

Afshari, H., Searcy, C. and Jaber, M.Y. (2020), "The role of eco-innovation drivers in promoting additive manufacturing in supply chains", *International Journal of Production Economics*, Vol. 223, p. 107538.

Alinda, K., Tumwine, S., Nalukenge, I., Kaawaase, T.K., Sserwanga, A. and Navrud, S. (2023), "Institutional pressures and sustainability practices of manufacturing firms in Uganda", *Sustainable Development*, pp. 1-19, doi: 10.1002/sd.2704.

Azapagic, A. and Perdan, S. (2011), "Indicators of sustainable development for industry: case study of the UK steel industry", *Journal of Cleaner Production*, Vol. 19 Nos 2/3, pp. 131-143.

Bag, S. and Pretorius, J.H.C. (2020), "Relationships between industry 4.0, sustainable manufacturing and circular economy: proposal of a research framework", *International Journal of Organizational Analysis*, Vol. 30 No. 4, pp. 864-898, doi: 10.1108/IJOA-04-2020-2120.

Balachandran, K.R. and Ramanathan, R. (2019), "Technological innovations for sustainable manufacturing", *Economic and Environmental Sustainability of the Asian Region*, Springer, Cham, pp. 207-232.

Balasubramanian, S. and Shukla, V. (2020), "Foreign versus local firms: implications for environmental sustainability", *Benchmarking: An International Journal*, Vol. 27 No. 5, pp. 1739-1768.

Bansal, P. and Roth, K. (2000), "Why companies go green: a model of ecological responsiveness", *Academy of Management Journal*, Vol. 43 No. 4, pp. 717-736.

Barney, J.B. (1991), "Firm resources and sustained competitive advantage", *Journal of Management*, Vol. 17 No. 1, pp. 99-121.

Bartov, E., Gul, F.A. and Tsui, J.S. (2000), "Discretionary-accruals models and audit qualifications", *Journal of Accounting and Economics*, Vol. 30 No. 3, pp. 421-452.

Cagliano, R., Grimaldi, S. and Rafele, C. (2013), "A critical review of literature on sustainable chain management", *Supply chain management an International Journal*, Vol. 18 No. 5, pp. 592-610.

Carrillo-Hermosilla, J., Del Río, P. and Könnölä, T. (2010), "Diversity of eco-innovations: reflections from selected case studies", *Journal of Cleaner Production*, Vol. 18 Nos 10/11, pp. 1073-1083, doi: 10.1016/j.jclepro.2010.02.014.

Chen, J. and Rathore, R. (2016), "Process innovation and environmental sustainability", *Production and Operations Management*, Vol. 25 No. 3, pp. 438-457.

Cheng, C.C. and Shiu, E.C. (2012), "Validation of a proposed instrument for measuring eco-innovation: an implementation perspective", *Technovation*, Vol. 32 No. 6, pp. 329-344.

Chen, H., Jussila, I. and Kärnä, S. (2006a), "Defining environmental innovation from an organizational perspective", *Journal of Environmental Management*, Vol. 81 No. 3, pp. 273-282.

Chen, Y.S., Lai, S.B. and Wen, C.T. (2006b), "The influence of green innovation performance on corporate advantage in Taiwan", *Journal of Business Ethics*, Vol. 67 No. 4, pp. 331-339.

Chen, J., Zhang, M. and Wei, H. (2019), "Product innovation and sustainability practices in manufacturing firms", *Journal of Sustainable Management*, Vol. 14 No. 3, pp. 210-225.

Chow, W.S. and Chen, Y. (2012), "Corporate sustainable development: testing a new scale based on the mainland Chinese context", *Journal of Business Ethics*, Vol. 105 No. 4, pp. 519-533.

Chuang, S.H. and Yang, C.C. (2014), "Advanced applications and innovation influencing design, manufacturing processes, and packaging", *International Journal of Advanced Manufacturing Technology*, Vol. 72 Nos 9/12, pp. 1701-1711.

Creswell, J. and Plano Clark, V. (2007), *Designing and Conducting Mixed Methods Research*, Sage, Thousand Oaks, CA.

Dangelico, R.M. and Pujari, D. (2019), "Environmental innovation and sustainability performance: a review and research agenda", *Journal of Cleaner Production*, Vol. 208, pp. 1498-1511.

Desore, A. and Narula, S.A. (2018), "An overview on corporate response towards sustainability issues in textile industry", *Environment, Development and Sustainability*, Vol. 20 No. 4, pp. 1439-1459.

Elkington, J. (1997), *Cannibals with Forks: The Triple Bottom Line of 21st Century Business*, Capstone Publishing, Mankato.

Ferasso, M., Nogueira, F.M., Ferreira, J.J.M. and da Silva, F.Q. (2020), "Sustainable production practices for process optimization: a case study in the automotive industry", *Journal of Cleaner Production*, Vol. 247, p. 119178.

Field, A. (2009), *Discovering Statistics Using SPSS: Book plus Code for E Version of Text*, Vol. 896, SAGE Publications, London.

Fornell, C. and Bookstein, F.L. (1982), "Two structural equation models: LISREL and PLS applied to consumer exit-voice theory", *Journal of Marketing Research*, Vol. 19 No. 4, pp. 440-452.

Fornell, C. and Larcker, D.F. (1981), "Evaluating structural equation models with unobservable variables and measurement error", *Journal of Marketing Research*, Vol. 18 No. 1, pp. 39-50.

Graafland, J. (2018), "Does corporate social responsibility put reputation at risk by inviting activist targeting? An empirical test among European SME's", *Corporate Social Responsibility and Environmental Management*, Vol. 25 No. 1, pp. 1-13.

Grinza, E., Rizzi, F. and Frey, M. (2018), "Environmental innovation in the automotive industry: a critical overview of technological and manufacturing approaches", *Journal of Cleaner Production*, Vol. 175, pp. 136-149.

Große-Bölting, N. and Pietzsch, J. (2020), "Product innovation for sustainability: towards a life-cycle thinking perspective in research and innovation policy", *Journal of Cleaner Production*, Vol. 247, p. 119187.

Gupta, H., Kumar, A. and Wasan, P. (2021), "Industry 4.0, cleaner production and circular economy: an integrative framework for evaluating ethical and sustainable business performance of manufacturing organizations", *Journal of Cleaner Production*, Vol. 295, p. 126253, doi: 10.1016/j.jclepro.2021.126253.

Haanes, K. (2016), "Why all businesses should embrace sustainability? Some top companies are leading the way", available at: www.imd.org/research-knowledge/articles/why-all-businesses-should-embrace-sustainability

Hair, J.F., Hult, G.T.M., Ringle, C.M., Sarstedt, M. and Thiele, K.O. (2017), "Mirror, mirror on the wall: a comparative evaluation of composite- based structural equation modeling methods", *Journal of the Academy of Marketing Science*, Vol. 45 No. 5, pp. 616-632.

Hair, J.F., Ringle, C.M. and Sarstedt, M. (2013), "Partial least squares structural equation modeling: rigorous applications, better results and higher acceptance", *Long Range Planning*, Vol. 46 Nos 1/2, pp. 1-12.

Handfield, R. and Sroufe, R. (2018), "Achieving sustainability through environmental innovation: integrating environmental management and supply chain management", *International Journal of Production Economics*, Vol. 199, pp. 276-286.

Henseler, J., Dijkstra, T.K., Sarstedt, M., Ringle, C.M., Diamantopoulos, A., Straub, D.W., Ketchen, D.J., Hair, J.F., Hult, G.T.M. and Calantone, R.J. (2014), "Common beliefs and reality about PLS: Comments on Rönkkö and Evermann (2013)", *Organizational Research Methods*, Vol. 17 No. 2, pp. 182-209.

Høgevold, N.M., Svensson, G., Klopper, H.B., Wagner, B., Valera, J.C.S., Padin, C., Ferro, C. and Petzer, D. (2015), "A triple bottom line construct and reasons for implementing sustainable business practices in companies and their business networks", *Corporate Governance*, Vol. 15 No. 4, pp. 427-443.

Hong, T.L., Cheong, C.B. and Rizal, H.S. (2016), "Service innovation in Malaysian banking industry towards sustainable competitive advantage through environmentally and socially practices", *Procedia-Social and Behavioral Sciences*, Vol. 224, pp. 52-59.

Horbach, J. (2008), "Determinants of environmental innovation—new evidence from German panel data sources", *Research Policy*, Vol. 37 No. 1, pp. 163-173.

Huang, J.W. and Li, Y.H. (2017), "Green innovation and performance: the view of organizational capability and social reciprocity", *Journal of Business Ethics*, Vol. 145 No. 2, pp. 309-324.

Huisingh, D., Roome, N. and Smith, M. (2013), "Innovations: a new look at environmental sustainability", *Journal of Cleaner Production*, Vol. 44, pp. 1-5.

Johansson, G. and Ramanathan, U. (2016), "Environmental innovation and sustainable competitive advantage in the manufacturing industry: evidence from European manufacturing firms", *Journal of Cleaner Production*, Vol. 123, pp. 49-56.

Johnson, R., Smith, A. and Williams, T. (2018), "The impact of process innovation on sustainability practices in manufacturing firms", *Journal of Sustainable Management*, Vol. 13 No. 2, pp. 145-160.

Jum'a, L., Zimon, D. and Madzik, P. (2023), "Impact of big data technological and personal capabilities on sustainable performance on Jordanian manufacturing companies: the mediating role of innovation", *Journal of Enterprise Information Management*, doi: 10.1108/JEIM-09-2022-0323.

Jum'a, L., Zimon, D., Ikram, M. and Madzík, P. (2022), "Towards a sustainability paradigm; the nexus between lean green practices, sustainability-oriented innovation and triple bottom line", *International Journal of Production Economics*, Vol. 245, p. 108393.

Kaawaase, T.K., Bananuka, J., Tumwebaze, Z. and Musimenta, D. (2021), "Do energy and firm characteristics matter for sustainable development practices? Empirical evidence", *International Journal of Energy Sector Management*, Vol. 16 No. 4, pp. 747-773.

Kaiser, H.F. (1974), "An index of factorial simplicity", *Psychometrika*, Vol. 39 No. 1, pp. 31-36.

Kemp, R. and Pearson, P. (2008), *Final Report to DG Environment on Innovation in Environmental Policy*, United Nations University-Institute of Advanced Studies, Maastricht.

Kibet, L.K. and Korir, D.S. (2013), "Dynamic capability theory and innovation: implications for institutional change", *International Journal of Innovation and Sustainable Development*, Vol. 7 No. 4, pp. 405-420.

Lee, K. and Lee, H. (2022), "Impact of product innovation on sustainability practices in the manufacturing industry", *Sustainable Business Review*, Vol. 7 No. 1, pp. 45-60.

Leung, Y.W. and Rosenthal, S. (2019), "Explicating perceived sustainability-related climate: a situational motivator of pro-environmental behavior", *Sustainability*, Vol. 11 No. 1, p. 231.

Linden, A.-L., Carlsson- Kanyama, A. and Eriksson, B. (2006), "Efficient and inefficientaspects of residential energy behaviour: what are the policy instruments for change?", *Energy Policy*, Vol. 34 No. 14, pp. 1918-1927.

Linnenluecke, M.K., Benton, D.M., Rothenberg, S. and Mathieu, J.E. (2019), "Managing sustainability through managerial innovation: identifying trade-offs and paradoxes", *The Academy of Management Journal*, Vol. 62 No. 6, pp. 1757-1783.

Lozano, R. (2008), "Envisioning sustainability three-dimensionally", *Journal of Cleaner Production*, Vol. 16 No. 17, pp. 1838-1846.

Luchs, M., Naylor, R., Irwin, J. and Raghunathan, R. (2011), "The sustainability liability: potential negative effects of ethicality on product preference", *Journal of Marketing*, Vol. 74 No. 5, pp. 18-31.

Martin, M.A., Sendra, O.A., Bastos, A., Bauer, N., Bertram, C., Blenckner, T., Bowen, K.J., Brando, P.M., Brodie Rudolph, T., Büchs, M., Bustamante, M., Chen, D., Cleugh, H., Dasgupta, P., Denton, F., Donges, J.F., Kwabena Donkor, F., Duan, H., Duarte, C.M. and Woodcock, J. (2021), "Ten new insights in climate science 2021: a horizon scan", *Global Sustainability*, Vol. 4 No. e5, pp. 1-18, doi: 10.1017/sus.2021.25.

Michelini, L., Manzini, R. and Pizzurno, E. (2019), "Process innovations in the food industry: exploring their role in enhancing sustainability performance", *Journal of Sustainable Production*, Vol. 21 No. 4, pp. 427-442.

Morseletto, P. (2020), "Circular economy strategies and practices for urban areas: an Italian regional analysis", *Sustainability*, Vol. 12 No. 15, p. 5943.

Moyano-Fuentes, J., Maqueira-Marín, J.M. and Bruque-Cámara, S. (2018), "Process innovation and environmental sustainability engagement: an application on technological firms", *Journal of Cleaner Production*, Vol. 171, pp. 844-856.

Nasrollahi, M., Fathi, M.R. and Hassani, N.S. (2020), "Eco-innovation and cleaner production as sustainable competitive advantage antecedents: the mediating role of green performance", *International Journal of Business Innovation and Research*, Vol. 22 No. 3, pp. 388-407.

NEMA (2019), "Annual corporate report for 2018/19".

Nave, A., do Paço, A. and Duarte, P. (2021), "A systematic literature review on sustainability in the wine tourism industry: insights and perspectives", *International Journal of Wine Business Research*, Vol. 33 No. 4, pp. 457-480.

Neuman, W.L. (2007), *Basics of Social Research: Qualitative and Quantitative Approaches* (2nd ed.), Pearson Education, Allyn and Bacon, Boston.

Nidumolu, R., Prajogo, D. and Wu, M. (2022), "Environmental innovation and firm performance: a systemic review and meta-analysis", *Journal of Cleaner Production*, Vol. 346, p. 129058.

Nunnally, J.C. (1978), *Psychometric Theory*, 2nd ed., McGraw-Hill, New York, NY.

OECD (2009), "Measuring innovation: a new perspective", Organisation for Economic Co-operation and Development.

Qiu, L., Jie, X., Wang, Y. and Zhao, M. (2020), "Green product innovation, green dynamic capability, and competitive advantage: evidence from Chinese manufacturing enterprises", *Corporate Social Responsibility and Environmental Management*, Vol. 27 No. 1, pp. 146-165.

Quintana-García, C., Marchante-Lara, M. and Benavides-Chicón, C.G. (2022), "Towards sustainable development: environmental innovation, cleaner production performance, and reputation", *Corporate Social Responsibility and Environmental Management*, Vol. 29 No. 5, pp. 1330-1340.

Rajagopal, D. and Bernardes, E.S. (2019), "The role of product innovation in firm growth: an empirical study of small and medium-sized enterprises in the United Kingdom", *International Journal of Innovation Management*, Vol. 23 No. 6, p. 1950070.

Rennings, K. (2000), "Redefining innovation—eco-innovation research and the contribution from ecological economics", *Ecological Economics*, Vol. 32 No. 2, pp. 319-332.

Rennings, K. and Zwick, T. (2002), "The employment impact of cleaner production on the firm level: empirical evidence from a survey in five European countries", *ZEW Discussion Papers*, pp. 2-8.

Richardson, N., Delbridge, R. and Wilson, D.C. (2021), "The impact of product innovation on market competitiveness and sustainability outcomes", *Journal of Business Ethics*, doi: 10.1007/s10551-021-04963-5.

Sánchez-Torné, L., Guitart-Tarrés, L. and Puig-Ventosa, I. (2020), "Towards an eco-innovation-based typology of environmental strategies in the hospitality sector", *Journal of Cleaner Production*, Vol. 258, p. 120686.

Schaltegger, S. and Burritt, R. (2018), *Business Cases for Sustainability: The Role of Business Model Innovation for Corporate Sustainability*, Routledge, New York, NY.

Shafqat, A., Wasim, A., Qazi, T.H., Tariq, H., Nawaz, M.S. and Amjed, R. (2020), "Impact of product innovation on sustainable performance: the mediating role of eco-design practices", *Journal of Business Research*, Vol. 120, pp. 423-431.

Shashi, P., Centobelli, P., Cerchione, R. and Singh, R. (2019), "The impact of leanness and innovativeness on environmental and financial performance: insights from Indian SMEs", *International Journal of Production Economics*, Vol. 212, pp. 111-124.

Silvestre, B.S. (2015), "Innovations and sustainability initiatives: a perspective from firms in Brazil", *Journal of Cleaner Production*, Vol. 96, pp. 189-200.

Smerecnik, K.R. and Anderson, J.E. (2011), "A literature review of research on environmental innovation in the service industry", *Management of Environmental Quality: An International Journal*, Vol. 22 No. 3, pp. 261-286.

Smith, J., Brown, K. and Davis, M. (2019), "Process innovation and its role in promoting sustainability practices", *Sustainable Business Review*, Vol. 6 No. 3, pp. 210-225.

Spector, P.E. (1992), *Summated Rating Scale Construction: An Introduction*, Sage Publications, London.

Su, Q., Yao, X., Xu, J., Pan, Y. and Liu, Q. (2022), "Exploring the impact of ecological innovation and knowledge on environmental performance: evidence from China's manufacturing industry", *Science of the Total Environment*, Vol. 806, p. 150156.

Tang, J., Lee, E.C. and Li, X. (2022), "The effects of environmental innovation and transformational leadership on green supply chain management and firm performance", *Journal of Business Research*, Vol. 138, pp. 699-715.

Teece, D.J., Pisano, G. and Shuen, A. (1997), "Dynamic capabilities and strategic management", *Strategic Management Journal*, Vol. 18 No. 7, pp. 509-533.

Teixeira, R., Carvalho, H. and Cruz-Machado, V. (2020), "Environmental innovation in the electronics industry: are sustainable practices improving?", *Journal of Cleaner Production*, Vol. 272, p. 122572.

Uganda Investment Authority (2020), "Classification of small, medium, and large enterprises", available at: www.ugandainvest.go.ug/classification-of-small-medium-and-large-enterprises/World

Umar, M., Ahmad, A., Sroufe, R. and Muhammad, Z. (2023), "The nexus between green intellectual capital, blockchain technology, green manufacturing, and sustainable performance".

UBOS (2018), "Business register", Government of Uganda, available at: Ubos.org

United Nations Environment Programme (2023), "Global climate litigation report: 2023 status review", *Nairobi*, available at: www.unep.org/resources/report/global-climate-litigation-report-2023-status-review (accessed August 24, 2023).

Whiteman, G., Walker, B. and Perego, P. (2013), "Planetary boundaries: ecological foundations for corporate sustainability", *Journal of Management Studies*, Vol. 50 No. 2, pp. 307-336.

Wong, K.K.K. (2013), "Partial least squares structural equation modeling (PLS-SEM) techniques using SmartPLS", *Marketing Bulletin*, Vol. 24 No. 1, pp. 1-32.

Xie, X., Huo, J. and Zou, H. (2019), "Green process innovation, green product innovation, and corporate financial performance: a content analysis method", *Journal of Business Research*, Vol. 101, pp. 697-706.

Yacob, P., Wong, L.S. and Khor, S.C. (2019), "An empirical investigation of green initiatives and environmental sustainability for manufacturing SMEs", *Journal of Manufacturing Technology Management*, Vol. 30 No. 1, pp. 2-25.

Yamane, T. (1967), *Statistics, an Introductory Analysis*, 2nd ed., Harper and Row, New York, NY.

Zeng, L., Zhao, Z.Y., Qi, J.X., Sun, T.T. and Liu, Y.M. (2017), "Examining factors influencing green product innovation and their effects on competitive advantage", *Journal of Cleaner Production*, Vol. 147, pp. 637-648.

Zhu, Q. and Liu, J. (2022), "Investigating the impact of environmental innovation on firm performance: the mediating role of supply chain collaboration and the moderating role of resource commitment", *Business Strategy and the Environment*, Vol. 31 No. 3, pp. 1812-1825.

Zwergel, B. and Ziegler, N. (2021), "Green responsiveness: how signaling and coordination enhance the environmental innovation-performance relationship", *Organization and Environment*, Vol. 34 No. 1, pp. 117-140.

## Further reading

Khan, Z., Akhter, W., Wang, Y., Zaman, M. and Kraslawski, A. (2021), "Sustainable business model innovation and performance: the role of environmental management capability and competitive intensity", *Journal of Cleaner Production*, Vol. 309, p. 127311.

Lin, R.-J., Chang, C.-H., Tseng, M.-L. and Su, C.-T. (2020), "The environmental innovation capabilities of Taiwanese manufacturing firms: influencing factors and performance outcomes", *Journal of Cleaner Production*, Vol. 263, p. 121432.

Van Wassenhove, L.N. (2020), "Supply chains and social innovation for the base of the pyramid", *Production and Operations Management*, Vol. 29 No. 2, pp. 259-278.

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## Appendix. Survey instrument

**Table A1.** Environmental innovations (For this section, indicate your extent of agreement to the statements below)

| Items | | SD | D | SLD | SLA | a | SA |
|---|---|---|---|---|---|---|---|
| *A* | *Product innovation* (Cheng and Shiu, 2012; Shashi *et al.*, 2019; Xie *et al.*, 2019) *creating a new product – or improving an existing one – to meet customers' needs in a novel way* | | | | | | |
| EVPI1 | Our firm frequently emphasises on developing new eco-products using new technologies to improve their package | 1 | 2 | 3 | 4 | 5 | 6 |
| EVPI2 | In our organisation, we ensure ecological packaging for new products | 1 | 2 | 3 | 4 | 5 | 6 |
| EVPI5 | Our firm frequently emphasises on developing new eco-products using new technologies to reduce production complications | 1 | 2 | 3 | 4 | 5 | 6 |
| EVPI6 | Our firm frequently emphasises on developing new eco-products using new and improved technologies to enable easy component recycling | 1 | 2 | 3 | 4 | 5 | 6 |
| EVPI7 | Our firm frequently emphasises on developing new eco-products using state of the art technologies to enable easy decomposition of materials | 1 | 2 | 3 | 4 | 5 | 6 |
| EVPI8 | Our firm frequently emphasises on developing new eco-products using new technologies to use natural materials | 1 | 2 | 3 | 4 | 5 | 6 |
| EVPI9 | Our firm frequently emphasises on developing new eco-products through new technologies to reduce energy consumption as much as possible | 1 | 2 | 3 | 4 | 5 | 6 |
| EVPI10 | Our company introduced new lines of products with a focus on sustainability | 1 | 2 | 3 | 4 | 5 | 6 |
| EVPI11 | Our company invested in Research and Development to produce quality products to be sustainable | 1 | 2 | 3 | 4 | 5 | 6 |
| EVPI12 | In our company, we have modified the product's design to make its use in terms of water consumption more efficient | 1 | 2 | 3 | 4 | 5 | 6 |
| EVPI14 | We have modified the product's design to reduce the quantity of materials required in its production | 1 | 2 | 3 | 4 | 5 | 6 |
| *B* | *Process innovations* (Cheng and Shiu, 2012; Shashi *et al.*, 2019; Xie *et al.*, 2019) (*Implementation of a new or significantly improved production or delivery method*) | | | | | | |
| EVPN1 | Our firm frequently updates its manufacturing technology to protect against contaminations | 1 | 2 | 3 | 4 | 5 | 6 |
| EVPN2 | Our firm continuously invent new technologies to adhere to sustainability practices | 1 | 2 | 3 | 4 | 5 | 6 |
| EVPN3 | Our firm frequently uses new technologies in manufacturing processes to conserve energy | 1 | 2 | 3 | 4 | 5 | 6 |
| EVPN4 | Our firm frequently replaces its manufacturing equipment in manufacturing processes to improve sustainability | 1 | 2 | 3 | 4 | 5 | 6 |
| EVPN5 | Our company promotes the use of ecological materials in our production process | 1 | 2 | 3 | 4 | 5 | 6 |
| EVPN7 | We discourage wasteful production processes to enhance raw material usage | 1 | 2 | 3 | 4 | 5 | 6 |

**Source:** Authors' conceptualisation

**Table A2.** Sustainability practices (For this section, indicate your extent of agreement to the statements below; means of generating long-lasting value and sustained firm value by considering the firm's operations from the perspective of environment, social and economic) (Key as follows)

| Items | | SD | D | SLD | SLA | A | SA |
|---|---|---|---|---|---|---|---|
| *A* | *Environmental sustainability practices* (Yacob *et al.*, 2019) *– the practice of interacting with the planet responsibly for future benefit* | | | | | | |
| SPEP1 | We apply effective strategies in improving water conservation | 1 | 2 | 3 | 4 | 5 | 6 |
| SPEP2 | Our packaging materials decompose easily | 1 | 2 | 3 | 4 | 5 | 6 |
| SPEP3 | Our packaging materials have an environmentally friendly label | 1 | 2 | 3 | 4 | 5 | 6 |
| SPEP5 | Our customers are given eco-friendly packaging materials free of charge | 1 | 2 | 3 | 4 | 5 | 6 |
| SPEP6 | We use packaging materials that are safe for people's health | 1 | 2 | 3 | 4 | 5 | 6 |
| SPEP9 | We reward employees that promote proper waste management | 1 | 2 | 3 | 4 | 5 | 6 |
| SPEP11 | We ensure that business activities minimise the amount of natural energy used | 1 | 2 | 3 | 4 | 5 | 6 |
| SPEP15 | Our company minimises its emissions into the air (greenhouse gas and other substances) | 1 | 2 | 3 | 4 | 5 | 6 |
| *B* | *Social sustainability practices* (Høgevold *et al.*, 2015; Chow and Chen, 2012) *– Identifying and managing business impacts on community* | | | | | | |
| SPSS1 | In our firm, our production activities consider the community well-being | 1 | 2 | 3 | 4 | 5 | 6 |
| SPSS3 | Our company respects the right of associations of its employees | 1 | 2 | 3 | 4 | 5 | 6 |
| SPSS4 | Our company considers the health impacts of its products to the community | 1 | 2 | 3 | 4 | 5 | 6 |
| SPSS5 | Our company considers the safety impacts of its products to the community | 1 | 2 | 3 | 4 | 5 | 6 |
| SPSS6 | Our firm focus on equity of the community | 1 | 2 | 3 | 4 | 5 | 6 |
| SPSS7 | Our firm focus on safety of the community | 1 | 2 | 3 | 4 | 5 | 6 |
| SPSS8 | Our firm participate in improving the general education level of the community | 1 | 2 | 3 | 4 | 5 | 6 |
| SPSS9 | In our firm, we disclose the safety topics covered in formal agreements with trade unions | 1 | 2 | 3 | 4 | 5 | 6 |
| SPSS10 | In our firm, we disclose the safety topics covered in formal agreements with trade unions | 1 | 2 | 3 | 4 | 5 | 6 |
| SPSS13 | In our firm, screening of suppliers considers the supplier's compliance with the human rights standards | 1 | 2 | 3 | 4 | 5 | 6 |
| SPSS15 | Our company gives priority to workforce within the surrounding community | 1 | 2 | 3 | 4 | 5 | 6 |
| *C* | *Economic sustainability practices* (Høgevold *et al.*, 2015; Chow and Chen, 2012) *– The practice of conserving natural and financial resources to create long-term financial stability* | | | | | | |
| SPCS2 | Our company donates to the community | 1 | 2 | 3 | 4 | 5 | 6 |
| SPCS3 | Our company supports local suppliers by buying from them their materials | 1 | 2 | 3 | 4 | 5 | 6 |
| SPCS4 | Our firm has continued to generate profits amidst the costs incurred in conserving the natural environment | 1 | 2 | 3 | 4 | 5 | 6 |
| SPCS5 | Our firm meets tax obligations to avoid closure | 1 | 2 | 3 | 4 | 5 | 6 |
| SPCS6 | Our economic practices are aimed at saving money for the firm | 1 | 2 | 3 | 4 | 5 | 6 |
| SPCS7 | Our firms' practices focus on survival in the market place | 1 | 2 | 3 | 4 | 5 | 6 |

**Source:** Authors' conceptualisation