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Digitalisation and environmental management activities: The effects of family ownership`

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Abstract

While digitalisation has significant implications for environmental management activities, this nexus has received minimal attention in research. Given this backdrop, this study uses a unique survey dataset of 386 micro and small enterprises (MSEs) and conducts an OLS regression analysis to examine the impact of digitalisation on environmental management activities. The study also investigates how family ownership moderates this relationship. The study finds that digitalisation supports environmental management activities as an important strategic mechanism, and that family ownership has a negative moderating effect on the relationship between digitalisation and environmental management activities. This study contributes to 'institutional theory' by highlighting its applicability to the new context of MSEs in emerging markets. Further, the study provides managerial insights into how to ensure environmental management practices in the digital age.

KEYWORDS
digitalisation, environmental management activities, family ownership, MSEs

1 | INTRODUCTION

Digitalisation "describes how IT or digital technologies can be used to alter existing business processes" (Verhoef et al., 2021, p. 891). Firms around the world are changing their business models via the digitalisation of value creation or production processes aimed that increasing efficiency and financial performance (Anwar et al., 2022; Heider et al., 2022). Apart from improving performance, the growing digitalisation of production processes is aimed at reducing the environmental pollution caused by business activities (Li et al., 2023). The digitalisation of the production process is broadly aimed at improving waste management and ensuring sustainable production. The literature underscores the potential of digitalisation as an instrument for climate change adaptation (Balogun et al., 2020). In view of this, recent research has focused on exploring the relationship between digitalisation and environmental management[1] activities (ENVMGT) (Brenner & Hartl, 2021; Luo et al., 2022). Prior research has also focused on the increasing pressure on large corporations to reduce

Abbreviations: AI, artificial intelligence; DT, digital technology; ENVMGT, environmental management activities; ESG, environmental, social, and governance; GSN, Ghana Startup Network; IT, information technology; KCAP, knowledge exploitation capabilities; MSEs, micro and small enterprises; OECD, The Organization for Economic Cooperation and Development; SEW, socioemotional wealth; WEF, World Economic Forum.

[1]We use the terms 'environmental management activities' and 'environmental management practices' interchangeably.

the environmental impact of business activities (George & Schillebeeckx, 2022). Meanwhile, research has also focused on the effect of digital technology (DT) adoption on the ENVMGT of small firms (e.g., Pangarso et al., 2022). This highlights the potential of digitalisation in fostering ENVMGT in business models (Acciarini et al., 2021). Additionally, the pressure on corporations to adopt ENVMGT is of concern because non-compliant firms are likely to suffer damage to their image and reputation (Berrone et al., 2013).

We note that family firms, defined as firms that that are owned and managed by business families (Block, 2010) are particularly sensitive to their corporate image and reputation (Cruz et al., 2019). This is because the firm is often considered as an extension of the family identity, which is part of their socioemotional wealth (SEW) (Miller & Le Breton-Miller, 2014). SEW refers to the non-economic and affect-related benefits that firm owners derive from firms as result of their controlling stake (Gómez-Mejía et al., 2007). In view of this, family firms are inclined to avoid practices that put their image and reputation in danger (Dyer & Whetten, 2006). Research shows that family firms are increasingly adopting ENVMGT (Chadwick & Dawson, 2018). This behaviour is reflective of the 'normative' and 'mimetic' pressures, as postulated by the institutional theory (DiMaggio & Powell, 1983). Normative pressure arises when an organisation adopts a certain behaviour or practice for fear of been locked out, or excluded from certain relationships and resources (Dubey et al. (2019). Mimetic pressure refers to organisations' tendency to imitate the good practices and behaviours of others, either voluntarily or consciously, in order to gain similar results (DiMaggio & Powell, 1983; Fauzi & Sheng, 2022). Despite this, very little is known about how digitalisation by micro and small enterprises (MSEs), the most ubiquitous form of businesses in emerging markets, impacts ENVMGT. Furthermore, given the widespread nature of family-controlled firms (Botero et al., 2015), and their contribution to employment and global gross domestic product (GDP) (Basco, 2015), it is surprising that there is yet no focus of research on how family ownership influences the effect of digitalisation on ENVMGT. This is an interesting and important research gap, which we intend to fill in this paper. Therefore, we address the question: *To what extent does digitalisation impact ENVMGT in emerging markets? And how does family influence affect this relationship?* Addressing this is important because MSEs are the most dominant forms of businesses in emerging markets. Studying this allows us to examine the extent to which firms in emerging markets are contributing to sustainable development through eco-friendly business practices. As many of these firms are family-owned, it is important to explore the dynamics of digitalisation and ENVMGT in the presence of family influence. We also examine the effect of knowledge capabilities – the ability to recognise and internalise new knowledge (Soluk et al., 2021) – on ENVMGT. This is because knowledge capabilities have been shown to be important antecedence of firm level activities and outcomes for MSEs in emerging markets (Anwar et al., 2022) and family firms (Issah et al., 2023; Soluk et al., 2021).

Using a unique dataset of 386 firms in Ghana, we find empirical support for the hypothesis that digitalisation is positively associated with ENVMGT. The empirical results also support the prediction that family influence attenuates the relationship between digitalisation and ENVMGT. However, we did not find support for the postulation that knowledge exploitation capabilities (KCAP) are positively associated with ENVMGT.

Our study contributes to the literature in several ways. First, we contribute to institutional theory (DiMaggio & Powell, 1983) by highlighting its applicability to the new context MSEs in emerging markets. Second, we contribute to the ENVMGT literature by showing the importance of digitalisation towards promoting corporate environmental activities. Our findings are in line with what Bendig et al. (2023) and Yang et al. (2023) found: firm's digital orientation and digitalisation have significant and positive impact on environmental practices. Third, we propose the moderating effect of family influence on the relationships between digitalisation and ENVMGT, thus establishing a mechanism explaining how family firm impact on digitalisation relates to ENVMGT. Fourth, we provide new insights and add to the literature on the digitalisation–environmental management nexus from new and relatively unexplored context of contemporary emerging economies such as Ghana.

The remainder of this paper is organised as follows. Section 2 reviews the relevant literature. We present the research design and methods in Section 3 and the results and discussion in Section 4. Finally, the conclusion is presented in Section 5.

2 | LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

2.1 | Digitalisation

Conceptually, 'digitalisation' is a complex phenomenon and its definitions are still incongruent (Brenner & Hartl, 2021). Matthess and Kunkel (2020) and Verhoef et al. (2021) explained digitalisation as the process of enhanced applications of information and/or DTs to alter existing business processes in an economy. Legner et al. (2017) discussed digitalisation using two different aspects, namely social and technical, indicating its adoption and use through DTs in a broader individual, organisational and societal context. Other researchers (e.g., Li et al., 2018; Ramaswamy & Ozcan, 2016) viewed digitalisation through the lens of the information and communications technology (ICT) and provided evidence of how its implications improve an organisation's business model. In this study, we describe digitalisation as how emerging IT and DTs can be used to alter existing business processes into environmentally sustainable business models. It is evident in the extant literature that cutting edge technologies and advance digital tools have profound effects on the various aspects of business and society. For instance, Matthess and Kunkel (2020) find evidence of positive effect of digitalisation on sectoral productivity. Other researchers posit that digitalisation is a major driving force of economic, agricultural and social change (OECD, 2017; Brenner & Hartl, 2021; Shen et al., 2022).

2.2 | Environmental management activities

The recent development in organisational practices relating to managing environmental activities and organisational proactive response to

stakeholders' expectations of protecting ecology has drawn researchers' interest in studying organisational environmental management activities (Amoako, 2020; Hofer et al., 2012; Nishitani et al., 2012, 2021; Wagner, 2011). Researchers define environmental management as a process of minimising the adverse effects of different organisational activities on the natural environment. For instance, according to Klassen and McLaughlin (1996), environmental management is a process by which a company's efforts are aimed at minimising harmful effects of goods as well as manufacturing activities in the natural atmosphere, while Betts et al. (2015) define it as a process by which management responds to stakeholders' concerns as well as observe organisations' activities in order to reduce/minimise its effect on people (Amoako, 2020). Accordingly, in this study, we define environmental management activities as the activities/efforts that organisations undertake to minimise the harmful effects of their products and manufacturing, marketing and other activities in the natural environment. Organisations' efforts to adopt measures to design ecological products or services and to package to be reused, repaired or recycled; comply voluntarily and proactively with environmental regulations; investing money in saving energy could be some examples of organisational environmental management practices. Given the World Economic Forum's (WEF) anticipation that the adoption and implications of digitalised approaches will be more pervasive in businesses across the world by 2025 (Acciarini et al., 2021), this study finds it crucial to investigate the impact of the application of digitalisation towards promoting organisational environmental management practices.

2.3 | Digitalisation and environmental management practices

Although limited, a growing number of researchers have investigated the nexus between digitalisation and environmental management practices and observed a positive role that digitalisation plays towards enhancing environmental management practices (Bendig et al., 2023; Chen et al., 2020; Gouvea et al., 2018; OECD, 2017; Shen et al., 2022; United Nations, 2015; Yang et al., 2023). For example, Balogun et al. (2020) highlighted the importance of digitalisation towards cities' sustainable development with potentials to foster climate-friendly urban environments and societies. Bendig et al. (2023) used the panel data from the U.S. Standard and Poor's 500 companies and found evidence of significant and positive effect of firm's digital orientation on environmental management activities. Likewise, Yang et al. (2023) observed a U-shaped relationship, implying that a low level (high level) of digitalisation hinders (enhances) firm's environmental management activities.

In this study, we emphasise that digitalisation can be a useful option to promote environmental management practices for a number of reasons. First, I4.0 technologies including AI, big data and cloud computing can address the problems of resource shortages, traffic congestion, and air pollution (Lu et al., 2016; Wu et al., 2021). For example, based on virtual communications, managers can reduce number of physical travels for corporate meetings, services and transactions while ensuring efficiency of scarce resources and reducing air pollution and traffic congestion (Brenner & Hartl, 2021). Second, such technologies can also address environmental issues including solid waste, e-waste, food waste and agricultural waste (Hung & Nham, 2023). Given the importance of digitalisation towards promoting environmental management practices, empirical evidence of the effects of digitalisation transformation on environmental sustainability is primarily discussed in isolation in top-tier journals (Bansal, 2019) and also remain uncertain. We, however, view digitalisation as a driving force and positively associate this with corporate environmental management practices and pay attention to study further on what enables organisations, especially family firms, to promote environmental activities and enhance environmental management practices. Accordingly, we propose the following hypothesis:

H1. There is an association between digitalisation and firms' environmental management practices.

2.4 | Institutional theory

To extend the discussion further on the association between digitalisation and environmental management activities, this study relies on the notion of Institutional Theory (DiMaggio & Powell, 1983). Institutional theory has been widely used in understanding of the association between organisations' wider social environment and their subsequent actions (Bhuiyan et al., 2023; Hussain & Hoque, 2002; Risi et al., 2023). In particular, this theory recognises the role of the social environment in maintaining rules and practices that can subsequently trigger specific actions in organisations (Risi et al., 2023). Furthermore, the theory highlights the process of gaining stakeholder legitimacy in any social environment (Fauzi & Sheng, 2022). More specifically, this theory explains the pressure exerted on organisations by stakeholders to act or behave in a way, which is similar to other organisations in forms or in practices (DiMaggio & Powell, 1983; Risi et al., 2023).

The literature identifies three types of institutional isomorphic mechanisms, namely, coercive, mimetic and normative (DiMaggio & Powell, 1983). Coercive pressure refers to the informal and formal pressures on organisations to behave in a certain way via adopting new practices or attitudes. This pressure may emanate from government regulations (Dubey et al., 2019). This may also arise because of the competitive dynamics in an industry (DiMaggio & Powell, 1983). Mimetic pressure explains the tendency for organisations to imitate the good practices and behaviours of others either voluntarily or consciously in order to gain similar results (DiMaggio & Powell, 1983; Fauzi & Sheng, 2022). Dubey et al. (2019) observe that normative pressure arises when an organisation adopts a certain behaviour or practice for fear of been locked out or excluded from certain relationships and resources. This implies that organisations tend to adopt certain practices if most organisations within the focal firms' environment or community are engaged in such practices (Fauzi & Sheng, 2022).

Prior studies have relied on this theory (DiMaggio & Powell, 1983) to explain the sustainable environmental management

activities of firms in general (e.g., Aguinis & Glavas, 2012; Bansal & Song, 2017) and family firms in particular (Bammens & Hünermund, 2020; Berrone et al., 2010). The following section has now extended the discussion on the environmental management practices of family firms in the lens of Institutional Theory.

2.5 | The moderating effect of family firms

Extant literature on the nexus between environmental management practices and family firms documents mixed outcomes. We discussed the outcomes below, categorising them into two strands of research.

In the first strand of research, from the institutional theory perspective, it is widely accepted that family firms care about their reputation as the business is often considered an extension of the family identity (Gomez-Mejia et al., 2014; Greve & Teh, 2018). Moreover, as firm reputation and image is part of the SEW of family firms (Gómez-Mejía et al., 2007; Miller & Le Breton-Miller, 2014), they seek to preserve their SEW by improving firm reputation via environmental management practices (Cruz et al., 2014; Dyer & Whetten, 2006). Furthermore, family firms tend to be deeply embedded in local communities (Bammens & Hünermund, 2020; Berrone et al., 2010) that intensify the pressure on them to display good citizenship behaviour. Thus, local communities can sanction firms that fail to live up to good environmental expectations. Besides local civil societies, local authorities can equally pressurise family firms into compliance via campaigns and citizen lawsuits that may damage firm reputation (Dyer & Whetten, 2006). This implies that family firms who care more about their corporate reputation (as part of their SEW) is more likely to engage in environmental management practices (Bammens & Hünermund, 2020; Cruz et al., 2019). In addition, favourable firm reputation enhances firms' ability to access resources, attract or maintain customers and secure stakeholder support, all towards ensuring firms' ultimate survival (Bansal & Clelland, 2004; Meyer & Rowan, 1977).

Furthermore, an increasing number of studies indicate that family firms are more socially responsible when it comes to external dimensions such as the environment (Cruz et al., 2014; Dyer & Whetten, 2006). Family firms tend to display environmentally responsible behaviour and cause less environmental pollution (Berrone et al., 2010). Also, the proclivity of family firms to engage in environmentally sustainable or eco-innovation decisions tends to be rising more than those of the non-family firms, as noted by Bammens and Hünermund (2020). Moreover, institutional pressures have led to enhancing environmental management activities performance by family-owned firms (Bammens & Hünermund, 2020; Berrone et al., 2013).

On the contrary, the other strand of research underscores that family firms are less likely to demonstrate environmentally responsible behaviour (Miroshnychenko et al., 2022). In this study, we corroborate this viewpoint for a number of reasons. First, environmental management practices as well as digitalisation are both costly to implement as they require both human and financial resources to succeed (Clark et al., 2018). Indeed, 'green investments' often cannot be financially justified, at least in the short term (Berrone et al., 2013, p. 893) as implementing ecological policies may not be economically efficient. Second, digitalisation, which often involves significant changes within an organisation and the acquisition of digital capabilities (Anwar et al., 2022), is equally expensive and requires high capital investments (Zoppelletto et al., 2023). Third, family firms at large are financially constrained (Hussinger & Issah, 2019), and unable to attract external financial capital because of concerns over losing control to external financial providers such as institutional investors (De Massis et al., 2018; Gomez-Mejia et al., 2014; Hussinger & Issah, 2022). Fourth, family firms may lack adequate in-house human resources to plan and execute environmental policies (Miroshnychenko et al., 2022). All these resource constraints imply that family firms are less likely to simultaneously pursue both digitalisation and sustainable environmental policies, which are considered as competing growth paths (Denicolai et al., 2021). Therefore, in pursuing the most salient strategic choice – digitalisation – there may not be any resources left to invest in other crucial areas such as environmental management activities.

In view of the above review of literature, we concur with the second strand of research, implying that in the event of increasing digitalisation, family ownership will weaken digitalisation performance and, consequently, its effect on environmental management practices. Accordingly, we propose the following hypothesis for testing:

> **H2.** Family ownership influences the association between digitalisation and environmental management practices.

2.6 | The moderating effect of knowledge exploitation capabilities

Companies value knowledge as their most important strategic asset (Zack et al., 2009). Integrating corporate environmental management practices into a strategic implementation programme requires an effective knowledge exploitation process. In the innovation management literature, it is emphasised that short-term innovation performance can be enhanced by leveraging existing knowledge and technologies, while long-term innovation performance can be enhanced by exploring new knowledge and technologies (Benner & Tushman, 2015; González-Ramos et al., 2023; Mathias et al., 2018). In view of this, KCAP can be developed to gain competitive advantage in two ways, that is, by nurturing firms' valuable knowledge, culture, and structure (Gold et al., 2001), and/or acquiring new external knowledge, assimilating it and applying it to create new value (Hock-Doepgen et al., 2021; Ozer & Vogel, 2015). KCAP is considered a critical component of any firm, since it determines how and what knowledge is valued, shared and stored for potential innovation within the organisation (Janz & Prasarnphanich, 2003; Joshi et al., 2010). Literature, therefore, highlights the role of KCAP as an enabler to improve

corporate environmental management practices and promoting environmental performance management activities of an organisation (Borland et al., 2016; Cooper & Molla, 2017; Dzhengiz & Niesten, 2020; Melissen et al., 2016). von Weltzien Hoivik (2011) emphasised the capability of KCAP to interlink and interlock business goals with environment management objectives in order to foster a financial and socially responsible business.

Given the importance of organisational KCAP towards promoting environmental management practices, I4.0 DTs such as AI, big data and machine learning technology can be used to develop organisation's environmental knowledge through acquiring environment related data and use such data for integrating environmental approaches into organisation's operational strategies (Yang et al., 2023). Similarly, radio frequency identification (RFID) technology can be used to obtain real time information on environmental conditions, while blockchain technology could be employed to better monitor the entire process of recycling and reuse, ensuring the transparency and authenticity of environmental governance procedures (Huang et al., 2022; Yang et al., 2023). Although empirical investigations on the role of developing KCAP towards environmental management practices is sparse in literature, the above discussion highlights the importance of developing KCAP for improving environmental management activities of organisations. We acknowledge the significance and assume that a positive nexus between digitalisation and environmental management activities will be stronger (weaker) if organisation's KCAPs are higher (lower), hence devise the following hypothesis:

> **H3.** Ceteris paribus, the association between digitalisation and environmental management practices is influenced by organisation's knowledge capabilities.

2.7 | Conceptual framework

Based on the review of the literature and the subsequent development of the hypotheses above, a conceptual model of this study is developed (see Figure 1).

3 | RESEARCH DESIGN AND METHODS

3.1 | Data and sample

Globally, MSEs are recognised for their significant contributions to GDP and employment (Ayalu et al., 2023) as well as for their role in managing socioeconomic issues and accomplishing growth targets in both the advanced and developing countries (Bai et al., 2021; OECD, 2017a). MSEs therefore are of importance in this study. Moreover, given that most businesses in Ghana are grouped under the MSEs category of industry, and the MSEs that have made remarkable contribution to job creation and technological development in Ghana are managed by owners and relations (Adomako & Ahsan, 2022; Oppong et al., 2014), we tested our hypotheses in the context of Ghana. However, because of the lack of existing environmental management practices and digitalisation data of the MSEs, we use unique survey data from Ghanaian companies for the testing. The paper classifies MSEs as firms with one to five employees, six to nine employees, and 10 to 29 employees (Adomako & Ahsan, 2022; Osei et al., 1993). In view of this, the survey was conducted in Ghana within MSEs with fewer than 30 employees, as described in Osei et al. (1993).

A convenience sampling technique was used to obtain contact information for 6000 owners and managers of MSEs from the Ghana Startup Network (GSN) (Acquaah & Agyapong, 2015). Because of the pandemic and ease of technology access among individuals and small businesses in Ghana, we preferred online surveys for collecting data from April to May 2021. This approach was also supportive to minimise costs, space and time (Troise et al., 2022). As a survey instrument, Qualtrics software was used. The survey questionnaire was emailed in English along with a cover letter explaining the purpose of the research and a guarantee to keep privacy and confidentiality of their personal and business data. Given that managers and owners of MSEs are directly involved in the implementation of business strategies (Hock-Doepgen et al., 2021), we selected owners and managers who are well acquainted with the details of business operations and actively participate in decision-making. In order to conduct the survey, we contacted GSN and discussed the survey objectives as well as

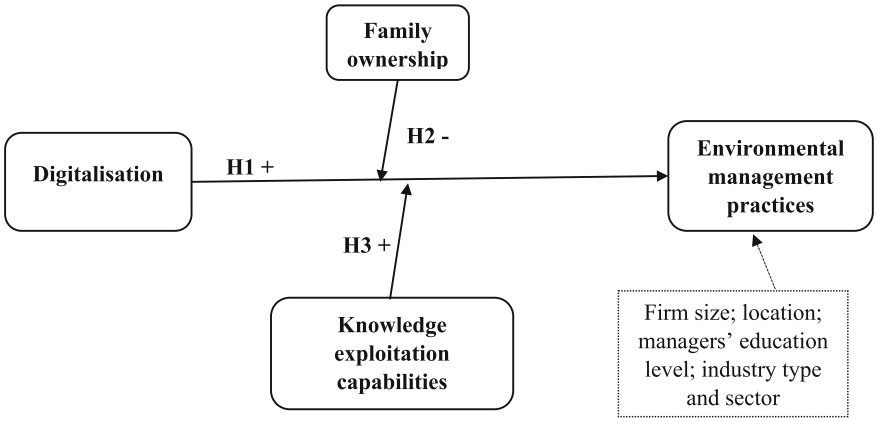

FIGURE 1 Conceptual framework.
Source: Authors' own work.

targeted MSE owners and managers for the survey. We then emailed the URL link to the survey to owners and managers participating in the study. We finally selected 386 complete responses from participants representing family-owned firms only, accounting for a response rate of 6.43%. In view of the experiment of Amaya et al. (2018) in Ghana that managed to secure only 1.8% response rate after sending SMS reminder to the respondents, we consider 6.43% a reasonably high response rate in the context of the small businesses in Ghana.

Table 1 presents a detailed description of the MSE firms in the sample. Therefore, the total sample data used for this study consists of survey data of 386 MSE the prominent sample is involved in a service industry (50%), the second largest industry is primary industries (30%), followed by manufacturing (8%), wholesale and retail industries (7%) and construction industry (5%), which we used as the baseline of analysis in our regression model. From an ownership perspective, 262 or 67.88% of firms are family-owned out of 386 firms.

3.2 | Research method and model

We estimate the OLS regression model to examine the relationship between digitalisation and environmental management activities using the equation:

TABLE 1 Distribution of sample.

Description	N.	%
Type of firm		
Non-family firms	124	32.12
Family firms	262	67.88
Industries		
Services	192	49.74
Wholesale	27	6.99
Manufacturing	32	8.29
Primary industries	116	30.05
Construction	19	4.92
Education		
Senior high school or lower	35	9.07
Bachelor's degree	229	59.33
Master's degree	104	26.94
PhD	18	4.66
Firm age		
1–4 years	207	53.63
5–10 years	118	30.57
More than 10 years	61	15.80
Firm size		
1–5 employees	262	67.88
6–9 employees	34	8.81
10–29 employees	90	23.32
Total	386	100

$$ENVMGT = \beta_0 + \beta_1 DIGI + \beta_2 KCAP + \beta_3 FAMFIRMS + \beta_4 DBMI + \beta_5 DIGITOOLS + + \beta_6 ENDYNA + \beta_7 FIRM\ SIZE + \beta_8 FAGE + \beta_9 LOCATION + \beta_{10} FINPERF + \beta_{11} NFAILURE + \beta_{12} MEDU + IND + \varepsilon \quad (1)$$

The following regression model tests whether a family firm moderates the association between digitalisation and environmental management activities.

$$ENVMGT = \beta_0 + \beta_1 DIGI + \beta_2 KCAP + \beta_3 FAMFIRMS + \beta_4 FAMFIRMS \times DIGI + \beta_5\ DBMI + \beta_6 DIGITOOLS + + \beta_7 ENDYNA + \beta_8 FIRM\ SIZE + \beta_9 FAGE + \beta_{10} LOCATION + \beta_{11} FINPERF + \beta_{12} NFAILURE + \beta_{13} MEDU + IND + \varepsilon \quad (1.1)$$

The following regression model tests whether KCAP moderate the association between digitalisation and environmental management activities in the equation

$$ENVMGT = \beta_0 + \beta_1 DIGI + \beta_2 KCAP + \beta_3 FAMFIRMS + \beta_4 KCAP \times DIGI + \beta_5\ DBMI + \beta_6 DIGITOOLS + + \beta_7 ENDYNA + \beta_8 FIRM\ SIZE + \beta_9 FAGE + \beta_{10} LOCATION + \beta_{11} FINPERF + \beta_{12} NFAILURE + \beta_{13} MEDU + IND + \varepsilon \quad (1.2)$$

We have provided a detailed description of the variables in Table 2.

3.3 | Selection of variables

We used validated constructs during the development of the questionnaire that have been previously tested and proven reliable. We carefully selected the measures based on their effectiveness and relevance to our research topic. For a comprehensive understanding of the measures used, please refer to Table 2, which provides an overview of each construct and its corresponding measurement.

3.3.1 | Dependent variable

To assess environmental management practices, we employed the *ENVMGT* measures previously utilised in research (Memon et al., 2019). Following Memon et al. (2019), we measured environmental management activities (*ENVMGT*) using five items. We collected data by asking respondents to rate their environmental performance on a five-point Likert scale, which ranged from 1 ('strongly disagree') to 5 ('strongly agree'). This allowed us to capture a range of responses and opinions, which we then analysed using a rigorous methodology. We conducted a factor analysis on the five items, where composite reliability reports as .80 (Cronbach's $\alpha = .88$). This allowed us to identify the interrelationships between

TABLE 2 Description of the main variables.

Variables		Properties
Response scales range from 1 (strongly disagree) to 5 (strongly agree)		
Environmental performance		CA = 0.88; VE = 68%
1	Designs products and packaging to be reused, repaired, or recycled	
2	Exceeds voluntarily environmental regulations	
3	Invests in saving energy	
4	Adopts measures to design ecological products or services	
5	Performs environmental audits periodically	
Digitalisation		CA = 0.77; VE = 69%
1	Assessment of your own digitalization compared with the industry	
2	Assessment of ICT use	
3	Evaluate how extensive your own ICT use is	
Digital tools		CA = 0.77; VE = 61%
1	Social media and collaborative technologies (e.g., chat or discussion forums, file or document management or document sharing software etc.)	
2	Mobile technologies, e.g., smart phone, iPad, tablets, laptop etc.	
3	Data and analytics	
4	Cloud computing services, e.g., Dropbox, Googledrive, iCloud etc.	
DBMI		CA = 0.69; VE = 90%
In the context of digital technology, our business model:		
1	We frequently introduce new ideas and innovations in our business	
2	We frequently introduce new processes, routines, and norms in our business model.	
3	We are pioneers with our business model	
4	All in all, our business model is novel or new	
5	Attracts a lot of new customers	
6	Attracts a lot of new suppliers and other business partners	
7	Brings together internal and external participants in novel ways	
8	Is revolutionising the way business deals are made.	
9	Offers new combinations of processes, products, services, and information	
Response scales range from 1 (strongly disagree) to 5 (strongly agree)		
Knowledge capabilities		CA = 0.84; VE = 76%
Our company has the capabilities to:		
1	Recognize relevant knowledge	
2	Internalize new external knowledge	
3	Exploit new knowledge for innovations	
Financial performance		CA = 0.91; VE = 70%
1	Sales growth	
2	Return on sales	
3	Gross profit	
4	Net profit	
5	Return on equity	
6	Return on investment	
Environmental dynamism: Response scales range from 1 (very stable) to 5 (very volatile)		

(Continues)

TABLE 2 (Continued)

Variables	Properties
	CA = 0.82; VE = 65%
What is the rate of change (volatility) in your business unit's competitive environment relative to change in other industries? The degree of change	
1 Where a change in the processes, products, services, and business models for our customers is needed.	
2 Where the knowledge and capabilities of our suppliers change.	
3 Where a change in the processes, products, services, and business models of our competitors occur.	
4 Where the processes, products, services, and business models of our own company change	

Abbreviations: CA, Cronbach's alpha; DBMI, digital business model innovation; ICT, information and communications technology; VE, variance explained.

the items and reduce them into a unifying variable (Soluk et al., 2021).

3.3.2 | Independent variables

The variable digitalisation (*DIGI*) is an independent variable that represents the assessment of companies' digitalisation capability. To measure digitalisation, we used three items based on the studies of Bley et al. (2016) and Eller et al. (2020). These items were designed to evaluate the extent to which a company has adopted DTs and processes. The managers of the firms were asked to rank the digitalisation level of their respective firms on a 5-point Likert scale, ranging from 1 'very low' to 5 'very high'. This ranking was based on their perception of the company's digitalisation capability, including assessment of their own digitalisation compared with the industry assessment of ICT use assessment, evaluate how extensive their own ICT is. The composite reliability was reported as .57, and Cronbach's α was calculated to be .77, which is considered acceptable for a research instrument. Overall, the *DIGI* variable offers a valuable metric for assessing a company's digitalisation capability, a crucial factor in today's digital economy.

3.3.3 | Moderating variables

Family ownership

Following Gomez-Mejia et al. (2014), we captured family ownership *(FAMFIRMS)* using a dummy variable. This is a self-reported measure where firm managers were asked to indicate if the firm is a family firm or not. Le Breton-Miller and Miller (2016) suggested that family firms possess the capacity to implement corporate sustainability practices that prioritise the well-being of stakeholders and the larger community through responsible economic, social and environmental behaviour. In light of this theoretical connection, we are incorporating family firms as moderating variables.

Knowledge exploitation capabilities

We measured the independent variable, KCAP, using three items that were adapted from Soluk et al. (2021). Firm owners and managers were asked to rate their respective firms using a 5-point Likert scale, where 1 indicated 'strongly disagree' and 5 indicated 'strongly agree'. We subsequently divided the sample according to KCAP for the purpose of conducting a sub-sample[2] analysis. A recent study by Shahzad et al. (2020) shows that knowledge absorption capacity significantly impacts firms' environmental practices and corporate environmental performance.

3.3.4 | Control variables

We controlled for firm-level characteristics and managerial skills in our regression model to ensure a more comprehensive analysis. George et al. (2022) argued that DTs and innovations play a crucial role in addressing significant global challenges, particularly in mitigating climate change and fostering sustainable development. Following this finding, we control digital tools and digital business model innovation into our research model. We controlled for digital business model innovation (*DBMI*) with variable constructed from nine items in a five-point Likert scale of 1 = 'strongly disagree' to 5 = 'strongly agree' (Soluk et al., 2021). Digital tools *(DIGITOOLS)* using four items from Kane et al. (2015) and Eller et al. (2020) measured on a five-point Likert scale, ranging from 1 'strongly disagree' to 5 'strongly agree'. To control for environmental dynamism (*ENDYNA)* or volatility, we used five items measured on a five-point Likert scale, ranging from 1 'strongly disagree' to 5 'strongly agree' (Chen et al., 2015). Financial performance (*FINPERF)* is measured using six items on a five-point Likert scale ranging from 1 'strongly disagree' to 5 'strongly agree' (Eller et al., 2020).

We controlled for the number of business failures (*NFAILURE*) experienced by using a continuous variable. The experience gained from business failure can act as a valuable resource, contributing to the managerial ability to transform the knowledge acquired through failure into innovative actions within a new business context (Boso et al., 2019). The measurement of the number of business failure experiences is based on self-reported measures from past business

[2]Using the *KCAP* split sample, our study conducted a sub-sample analysis. High values refer to those above the mean, whereas low values indicate those below the mean.

TABLE 3 Factor analysis.

Items	Factor	Average	Composite reliability
Environmental management activities			
entmgt1	0.5791	0.34	0.80
entmgt2	0.6964	0.48	
entmgt3	0.7266	0.53	
entmgt4	0.6705	0.45	
entmgt5	0.6488	0.42	
Financial performance			
perf1	0.7859	0.62	0.88
perf2	0.7258	0.53	
perf3	0.7202	0.52	
perf4	0.836	0.70	
perf5	0.6424	0.41	
perf6	0.7671	0.59	
Knowledge capabilities			
Kc1	0.5365	0.29	0.59
Kc2	0.5738	0.33	
Kc3	0.5939	0.35	
Digitalisation			
digi1	0.5928	0.35	0.57
digi2	0.5408	0.29	
digi3	0.5166	0.27	
Environmental dynamism			
entdy1	0.7782	0.61	0.85
entdy2	0.7282	0.53	
entdy3	0.7739	0.60	
entdy4	0.7905	0.62	

failures (Boso et al., 2019). This variable indicates how many times a manager has experienced business failures. This approach allows us to accurately measure the effect of *NFAILURE* on the outcome.

In our analysis, we incorporated control variables for both firm size (*FIRM SIZE*) and firm age (*FAGE*) to ensure that their respective impacts are considered. We measured Firm size as the natural logarithm of the total number of employees to account for the skewed nature of the variable. We measured this by taking the natural logarithm of the total number of employees to accommodate the skewed nature of the variable, and age (*FAGE*) is controlled for using a natural logarithm of the number of employees and the number of years the business has been in operation, respectively (Issah et al., 2023). This approach was chosen to address the skewed nature of the variable and provide a more accurate representation of the relationship between firm size and firm age and the environmental management activities variable.

We considered the geographic location of the firms in our sample by categorising them into two main regions within Ghana. The Location *(LOCATION)* variable indicates whether the firm is located in economically prosperous Southern Ghana (assigned a dummy value of 1) or economically disadvantaged Northern Ghana (assigned a dummy value of 0) (Abdulai et al., 2018).

We also control for the level of education of managers *(MEDU)*. Egri and Herman (2000) emphasise the significance of assessing certain demographic characteristics[3] of managers responsible for environmental aspects, such as age, gender and education, warranting special attention. Given the importance of this variable's impact on environmental management practices within firms, we included a control for the educational level of managers (*MEDU*). We control the industrial affiliation of firms. These include Manufacturing (*MANUIND*), services (*SERIND*), primary sector (*PRIIND*) and construction (*WSIND*). Construction is used as the benchmark of comparison in the analysis (Issah et al., 2023).

[3]The impact of managerial demographic and personality characteristics, as well as leadership capabilities, influences the outcomes resulting from their environmental behaviour.

TABLE 4 Convergent and discriminant validity assessment.

Panel A:					
Squared correlation (SC) among latent variables					
Environmental management activities	**1**				
Financial performance	*0.025*	1			
Knowledge capabilities	*0.036*	0.059	1		
Digitalisation	*0.009*	0.034	0.012	1	
Environmental dynamism	*0.001*	0.000	0.005	0.000	1
Panel B:					
Average variance extracted (AVE) by latent variable					
Environmental management activities	**0.604**	**No problem with discriminant and convergent validity**			
Financial performance	0.637	No problem with discriminant and convergent validity			
Knowledge capabilities	0.644	No problem with discriminant and convergent validity			
Digitalisation	0.550	No problem with discriminant and convergent validity			
Environmental dynamism	0.529	No problem with discriminant and convergent validity			

Note that when AVE value> = SC value, there is no problem with discriminant validity and when AVE > = 0.5, there is no problem with convergent validity.

TABLE 5 Descriptive statistics.

Variable	OBS	MEAN	SD	MIN	Q1	Q2	Q3	MAX
ENVMGT	386	3.10	0.88	1.00	2.60	3.20	3.80	5.00
DIGI	386	4.50	1.50	1.00	3.70	4.70	5.70	8.00
KCAP	386	4.10	0.58	1.00	4.00	4.00	4.30	5.00
FAMFIRMS	386	0.66	0.48	0.00	0.00	1.00	1.00	1.00
DBMI	386	3.50	0.71	1.40	3.20	3.60	4.00	5.00
DIGITOOLS	386	3.90	0.75	1.00	3.50	4.00	4.30	5.00
ENDYNA	386	2.90	0.74	1.00	2.30	3.00	3.30	5.00
FIRM SIZE	386	0.32	0.47	0.00	0.00	0.00	0.69	1.10
FAGE	386	0.39	0.44	0.00	0.00	0.00	0.69	1.10
LOCATION	386	0.67	0.47	0.00	0.00	1.00	1.00	1.00
FINPERF	386	3.40	0.70	1.00	3.00	3.50	4.00	5.00
NFAILURE	386	1.60	1.70	0.00	0.00	1.00	2.00	11.00
MEDU	386	2.30	0.69	1.00	2.00	2.00	3.00	4.00
SERIND	386	0.50	0.50	0.00	0.00	0.00	1.00	1.00
WSIND	386	0.07	0.26	0.00	0.00	0.00	0.00	1.00
MANUIND	386	0.08	0.28	0.00	0.00	0.00	0.00	1.00
PRIIND	386	0.30	0.46	0.00	0.00	0.00	1.00	1.00

Abbreviations: DBMI, digital business model innovation; DIGI, digitalisation; DIGITOOLS, digital tools; ENDYNA, environmental dynamism; ENVMGT, environmental management activities; FAGE, firm age; FAMFIRMS, family ownership; FINPERF, financial performance; FIRM SIZE, firm size; KCAP, knowledge exploitation capabilities; MANUIND, manufacturing; MEDU, education of managers; NFAILURE, number of business failures; PRIIND, primary sector; SERIND, services; WSIND, construction.

TABLE 6 Panel A. Pairwise correlations.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) ENVMGT	1.000												
(2) DIGI	0.063	1.000											
(3) KCAP	0.169*	0.095	1.000										
(4) FAMFIRMS	0.034	−0.154*	−0.036	1.000									
(5) DBMI	0.056	0.225*	0.424*	−0.108*	1.000								
(6) DIGI TOOLS	0.000	0.388*	0.320*	−0.093	0.508*	1.000							
(7) ENDYNA	−0.028	0.006	0.054	−0.041	−0.048	−0.025	1.000						
(8) FIRM SIZE	0.070	−0.027	0.146*	0.014	0.245*	0.144*	−0.067	1.000					
(9) FAGE	0.012	−0.135*	0.009	0.051	−0.019	−0.023	−0.124*	0.297*	1.000				
(10) LOCATION	−0.037	0.141*	0.116*	−0.144*	0.093	0.115*	−0.001	0.020	−0.142*	1.000			
(11) FINPERF	0.139*	−0.140*	0.200*	−0.037	0.342*	0.093	0.017	0.189*	0.115*	0.042	1.000		
(12) NFAILURE	−0.012	−0.049	0.002	0.006	0.010	−0.065	0.099	0.052	−0.015	−0.104*	−0.081	1.000	
(13) MEDU	−0.036	0.094	0.042	−0.054	0.129*	0.157*	0.041	0.116*	0.047	−0.006	0.062	−0.098	1.000

Abbreviations: DBMI, digital business model innovation; DIGI, digitalisation; DIGITOOLS, digital tools; ENDYNA, environmental dynamism; ENVMGT, environmental management activities; FAGE, firm age; FAMFIRMS, family ownership; FINPERF, financial performance; FIRM SIZE, firm size; KCAP, knowledge exploitation capabilities; MEDU, education of managers; NFAILURE, number of business failures.
***$p < .01$.**$p < .05$.*$p < .1$.

4 | RESULTS

Factor analysis

We conducted factor loadings to further assess the validity and reliability of the constructs. The items display moderately desirable factor loading; no instances of cross-loading were found in the data analysis, as indicated in Table 3. The table also presents the composite reliability for all constructs, which are all above the threshold of 0.70 (Nunnally & Bernstein, 1994), except KCAP and digitalisation, which are also within acceptable reasonable level of 0.60 (Netemeyer et al., 2003). The low composite reliability value for the two constructs can be attributed to the small number of items in the scales. This is because small number of items tend to yield lower reliability levels while scales with high number of items lead to high levels of reliability (Netemeyer et al., 2003).

Convergent and discriminant validity assessment

Using a Stata package known as '*condisc*' that offers an alternative to test discriminant and convergent validity, Table 4 presents results of the tests. Panel A of Table 4 (pertains to discriminant validity) illustrates the relationships between the constructs. The results indicate a positive correlation between *ENVMGT* and financial performance (*FINPERF*) (r = 0.025), *KCAP* (r = 0.036), digitalisation (*DIGI*) (r = 0.009) and environmental dynamism (*ENDYA*) (r = 0.001). Moreover, the analysis reveals a positive correlation between digitalisation (*DIGI*) and *KCAP*.

We evaluated convergent and discriminant validity by examining squared correlations (SC) among latent variables and average variance extracted (AVE) by these variables. In our results (refer to Panel B of Table 4, discriminant validity), all AVE values surpass SC values, meeting the criteria for acceptable discriminant validity. The discriminant validity satisfied the condition, indicating that the items do not significantly overlap with each other when loaded onto their respective constructs (Anwar et al., 2022)

Additionally, an AVE value greater than 0.5 indicates no issues with convergent validity. Our analysis demonstrates that the AVE for our key variables exceeds 0.5, affirming that our analysis does not encounter any problems with convergent validity (Anwar et al., 2022). Our regression model confirmed convergent validity as all constructs demonstrating satisfactory values (above 0.50), indicating that the items adequately explained variance within their respective constructs.

4.1 | Descriptive statistics and correlations

The descriptive analysis presented in Table 5 reveals insights from our analysis. The mean value of 3.10 for environmental management activities *(ENVMGT)* indicates that, on average, the firms within our sample exhibit a relatively high level of engagement in environmental management activities. Moreover, the mean value of 4.50 for Digitalisation (*DIGI*) suggests an even greater involvement of these firms in digitalisation efforts. Our analysis also indicates that the firms in our sample possess relatively high knowledge capabilities *(KCAP)*, with a mean value of 4.10. Interestingly, we observed that 66% of the firms in our sample hold family-owned (*FAMFIRMS*), while the utilisation of digital tools averages at 3.90. Furthermore, the average for digital business model innovation is at 3.50 among these MSEs in their business operations. While the firms in our sample are relatively young, with an average firm age (*FAGE*) of 0.39 and their managerial education (*MEDU*) is impressive, with an average mean value of 2.3.

Table 6 shows the correlations analysis. The correlation analysis indicates that *ENVMGT* exhibit a positive correlation with both *DIGI* at 0.063 and *KCAP* at 0.169.

An important observation is the strong correlation between the utilisation of *DIGI* and *DBMI*, also at a coefficient of 0.508. This is because the mean variance inflation factor is 1.93, which is well below the established threshold of 10 (Clauss et al., 2022). Conversely, there is a negative correlation of −0.154 between *FAMFIRM* and *DIGI*. There was no multicollinearity threat in the dataset as the variance inflation factor of all constructs towards *ENVMGT* and *DIGI* was below 4 (Anwar et al., 2022).

4.2 | Common method bias

It is widely accepted that reliability and validity of estimations from cross-sectional survey data may be undermined by common method

TABLE 6 Panel B variance inflation factor (VIF).

Variable	VIF	1/VIF
DIGI	1.31	0.761435
KCAP	1.28	0.780128
FAMFIRMS	1.08	0.928978
DBMI	1.77	0.565753
DIGI TOOLS	1.57	0.637206
ENDYNA	1.05	0.951387
FIRM SIZE	1.23	0.810312
FAGE	1.18	0.844991
LOCATION	1.1	0.907251
FINPERF	1.28	0.782682
NFAILURE	1.09	0.921099
MEDU	1.07	0.933882
Mean VIF	1.93	

Abbreviations: DBMI, digital business model innovation; DIGI, digitalisation; DIGITOOLS, digital tools; ENDYNA, environmental dynamism; ENVMGT, environmental management activities; FAGE, firm age; FAMFIRMS, family ownership; FINPERF, financial performance; FIRM SIZE, firm size; KCAP, knowledge exploitation capabilities; MEDU, education of managers; NFAILURE, number of business failures.

bias (CMB) (MacKenzie & Podsakoff, 2012). We estimated a Harman's single factor test on all the survey items using an unrotated principal component factor analysis (Fuller et al., 2016). The test indicates that the items have an eigenvalue of more than 1 and explain 76% of the variance. The first factor explains 20% of the variance, which is lower than the widely accepted 50% rule of the thump (Anwar et al., 2022). Thus, our data does not suffer from CMB concerns.

4.3 | Empirical results

The results of our analysis based on multiple linear models are presented in Table 7. Our Hypothesis 1 is supported by the empirical results. Our Hypothesis 1 predicts an association between digitalisation and environmental management activities and our result that digitalisation plays a crucial role in the advancement of environmental

TABLE 7 Relationship between digitalization and environmental management activities and moderating effect of family influence and knowledge capabilities.

	(1)	(2)	(3)	(4)
Variables	ENVMGT	ENVMGT	ENVMGT	ENVMGT
DIGI	0.090***	0.182***	0.264	0.358*
	(2.654)	(3.171)	(1.359)	(1.799)
KCAP	0.272***	0.261***	0.473**	0.464**
	(3.191)	(3.061)	(1.997)	(1.967)
FAMFIRMS		0.683**		0.681**
		(2.070)		(2.061)
FAMFIRMS × *DIGI*		−0.133**		−0.133**
		(−1.980)		(−1.985)
KCAP × *DIGI*			−0.044	−0.044
			(−0.908)	(−0.923)
DBMI	−0.076	−0.072	−0.072	−0.068
	(−0.940)	(−0.899)	(−0.887)	(−0.845)
DIGI TOOLS	−0.099	−0.094	−0.095	−0.090
	(−1.359)	(−1.290)	(−1.303)	(−1.234)
ENDYNA	−0.052	−0.043	−0.051	−0.041
	(−0.866)	(−0.707)	(−0.846)	(−0.686)
FIRM SIZE	0.085	0.084	0.085	0.084
	(0.834)	(0.830)	(0.830)	(0.825)
FAGE	−0.014	0.003	−0.008	0.008
	(−0.125)	(0.023)	(−0.074)	(0.074)
LOCATION	−0.154	−0.141	−0.158	−0.145
	(−1.580)	(−1.448)	(−1.622)	(−1.490)
FINPERF	0.187***	0.193***	0.184***	0.190***
	(2.686)	(2.776)	(2.640)	(2.731)
NFAILURE	−0.010	−0.012	−0.010	−0.012
	(−0.364)	(−0.439)	(−0.377)	(−0.452)
MEDU	−0.066	−0.056	−0.069	−0.059
	(−1.009)	(−0.858)	(−1.047)	(−0.897)
IND	Included	Included	Included	Included
Constant	1.862***	1.301**	1.049	0.476
	(3.803)	(2.306)	(1.027)	(0.450)
Observations	386	386	386	386
Adjusted R-squared	0.053	0.061	0.053	0.060

Abbreviations: DBMI, digital business model innovation; DIGI, digitalisation; DIGITOOLS, digital tools; ENDYNA, environmental dynamism; ENVMGT, environmental management activities; FAGE, firm age; FAMFIRMS, family ownership; FINPERF, financial performance; FIRM SIZE, firm size; IND, industry; KCAP, knowledge exploitation capabilities; MEDU, education of managers; NFAILURE, number of business failures.

t-Statistics in parentheses.

***$p < .01$.**$p < .05$.*$p < .1$.

management activities plays a pivotal role in the progress of environmental management activities. Result suggests that there is a direct and positive relationship between the level of digitalisation and the effectiveness of environmental management practices. This is supported by the results of Model 1 in Table 7 ($\beta = .090$, $p < .01$), which is statistically significant at the 1% level. Our study supports the notion that digitalisation facilitates environmental management activities and emphasising its significance as a crucial component within firm-level strategies (Denicolai et al., 2021; Queiroz et al., 2022). This finding has important implications for organisations seeking to enhance their environmental management practices and environmental sustainability initiatives through digitalisation performances. With the integration of DTs, companies can optimise their operations and processes, leading to significant reductions in resource consumption, reduce waste, and environmental impact. Additionally, digitalisation can enable companies to track their carbon footprint and other environmental performances, leading to greater transparency and accountability.

4.3.1 | Moderation effect of family ownership

Hypothesis 2 proposes that family ownership influences the relationship between digitalisation and environmental management practices. Our study suggests that the positive relationship between digitalisation and environmental management practices is reduced for family-owned firms, indicating a negative moderating effect. This suggests that family-owned companies might experience additional challenges in implementing environmentally sustainable practices as they digitise their operations.

We find support for this hypothesis as indicated by Model 2 of Table 7 ($\beta = -.132$, $p < .05$), and the result is statistically significant at the 5% significance level.

Figure 2 presents the negative moderating effect of family ownership on the relationship between digitalisation and environmental management activities.

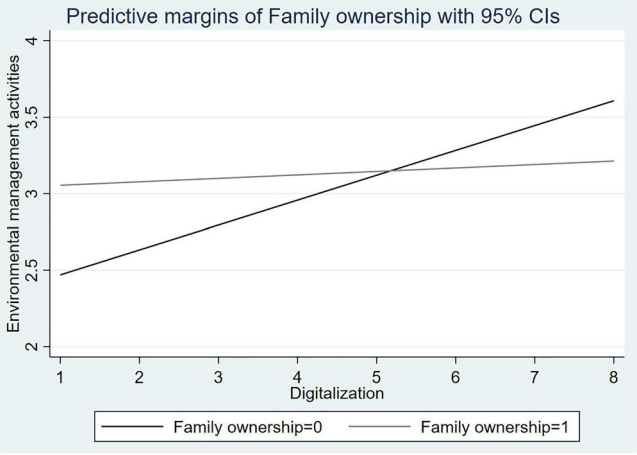

FIGURE 2 The moderation of family ownership on the relationship between digitalisation and environmental management activities.

4.3.2 | Moderation effect of knowledge capabilities

Our Hypothesis 3 predicts that the relationship between digitalisation and environmental management practices would be influenced by the organisational knowledge capabilities. However, the analysis does not support this prediction, as the positive association between digitalisation and environmental management activities is not significantly moderated by KCAP.

4.4 | Robustness tests

The results as presented in Table 8 are consistent with results of Table 7.

4.5 | Self-selection bias

Innovation and family business scholars are concerned about endogeneity issues (Issah et al., 2023). To control for potential self-selection based endogeneity bias (Heckman, 1979), we applied an econometric technique is conducted in two steps. First, we estimated a probit model that captures environmental management practices for all firms in our sample. We then created a variable known as the inverse mills ratio (Titus et al., 2017). The second step involves adding this variable to the model as an additional control variable to reduce the potential effects of self-selection bias (He & Wong, 2004). The results of this analysis as presented in Table 8 are consistent with our prior results. Selection based endogeneity biased is not a major concern for our results. This is because the additional control variable, inverse mill ratio is not statistically significant in any model (He & Wong, 2004; Issah et al., 2023).

4.6 | Sub-sample analysis

We conducted a sub-sample analysis that differentiated between firms with high and low knowledge capabilities. This analysis aimed to test how high and low KCAP influence the positive relationship between environmental management activities and digitisation.[4] Our analysis suggests that the positive association between digitalisation and organisational environmental management activities is more pronounced for organisations with higher KCAP. Model 1 of Table A1 ($\beta = .166$, $p < .05$) shows that digitalisation is positively associated with environmental management activities only for firms with high knowledge capabilities.

Our study further aims to investigate the influence of several factors impact on digitalisation and environmental management activities within our sample. Particularly, our focus lies in how the dynamic nature of the environment (*ENDYNA*), the utilisation of digital tools

[4]Based on the split sample, our study conducted a sub-sample analysis. The high values are those that are above the mean, while the low values are those that are below the mean.

TABLE 8 Relationship between digitalization and environmental management and moderating effect of family influence and knowledge capabilities: Heckman selection model.

	(1)	(2)	(3)	(4)
Variables	ENVMGT	ENVMGT	ENVMGT	ENVMGT
DIGI	0.086**	0.181***	0.215	0.341*
	(2.522)	(3.152)	(1.087)	(1.700)
KCAP	0.286***	0.274***	0.433*	0.426*
	(3.332)	(3.209)	(1.815)	(1.790)
FAMFIRMS	0.103	0.753**	0.096	0.732**
	(1.032)	(2.266)	(0.960)	(2.198)
FAMFIRMS × DIGI		−0.138**		−0.138**
		(−2.050)		(−2.046)
KCAP × DIGI			−0.032	−0.041
			(−0.661)	(−0.850)
DBMI	−0.137	−0.137	−0.130	−0.131
	(−1.520)	(−1.525)	(−1.422)	(−1.434)
DIGI TOOLS	−0.302**	−0.308**	−0.284*	−0.233
	(−1.976)	(−2.024)	(−1.826)	(−1.556)
ENDYNA	−0.023	−0.011	−0.024	−0.019
	(−0.364)	(−0.180)	(−0.385)	(−0.300)
FIRM SIZE	0.152	0.155	0.147	0.101
	(1.368)	(1.401)	(1.315)	(0.952)
FAGE	0.033	0.052	0.033	0.046
	(0.289)	(0.460)	(0.293)	(0.405)
LOCATION	−0.237**	−0.228**	−0.234**	−0.186*
	(−2.122)	(−2.050)	(−2.090)	(−1.722)
FINPERF	0.221***	0.229***	0.217***	0.181***
	(3.024)	(3.140)	(2.943)	(2.708)
NFAILURE	−0.014	−0.017	−0.014	−0.017
	(−0.520)	(−0.607)	(−0.518)	(−0.630)
MEDU	−0.083	−0.073	−0.083	−0.070
	(−1.248)	(−1.110)	(−1.256)	(−1.065)
INVMILLS	−0.780	−0.825	−0.721	−0.422
	(−1.510)	(−1.602)	(−1.374)	(−0.908)
Constant	3.242***	2.740**	2.537*	1.280
	(3.128)	(2.584)	(1.705)	(0.911)
Observations	386	386	386	386
Adjusted R-squared	0.056	0.065	0.055	0.060

Abbreviations: DBMI, digital business model innovation; DIGI, digitalisation; DIGITOOLS, digital tools; ENDYNA, environmental dynamism; ENVMGT, environmental management activities; FAGE, firm age; FAMFIRMS, family ownership; FINPERF, financial performance; FIRM SIZE, firm size; IND, industry; KCAP, knowledge exploitation capabilities; MEDU, education of managers; NFAILURE, number of business failures.
t-Statistics in parentheses.
***$p < .01$.**$p < .05$.*$p < .1$.

(*DIGITOOLS*), the educational background of managers (*MEDU*) and the geographic location of firms (*LOCATION*) on these activities. In order to investigate these factors further, we performed a sub-sample[5] analysis.

[5]The high values are those that are above the mean, while the low values are those that are below the mean.

The results presented in Panel B of Table A1 indicate that the positive relationship between digital and environmental management practices becomes stronger with an increase in the level of environmental dynamism ($\beta = .078$, $p < .05$). This finding highlights the importance of considering the dynamic nature of the environment and the potential of digitalisation in developing environmental management practices.

Our research shows that companies that have adopted high-level DT tools ($\beta = .115$, $p < .0$), possess well-educated managerial staff ($\beta = .105$, $p < .01$), and are located in the Northern region of Ghana ($\beta = .115$, $p < .10$) end to exhibit positive and significant association between digitisation and engaging in environmental management activities. This finding highlights the potential benefits of digitalisation in encouraging environmental management practices.

Our research explored how digitalisation affects environmental management practices across various firm characteristics in our sample. We found that the effect of digitalisation is more pronounced among small firms, as indicated in Panel F of Table A1 ($\beta = .103$, $p < .05$). Similarly, our analysis revealed that young firms are more likely to be positively influenced by digitalisation on their environmental management practices (refer to Panel F of Table A1: $\beta = .161$, $p < .0$).

Furthermore, we also examined the association between digitalisation and financial performance. Our findings showed that the relationship between digitalisation and environmental management practices is more significant among high-performing firms, as captured in Panel F of Table A1 ($\beta = .124$, $p < .01$).

Finally, we have summarised and highlighted the main findings of our study in respect to each of the hypothesised relationship in Table 9.

4.7 | Discussion

In comparison to the previous studies that investigate predominantly the drivers of environmental management performance (Poltronieri et al., 2019), this study endures the ongoing debate of the researchers on corporate environmental management activities (e.g., Dobler et al., 2014; Heras-Saizarbitoria et al., 2020; Lu et al., 2021; Lu & Herremans, 2019; Yadav et al., 2017). As a first result, the empirical outcomes of this study reveal a positive nexus between digitalisation and environmental management activities, corroborating the finding of Bendig et al. (2023), which used the natural resource-based view in a developed country context, proxied by the US Standard and Poor's 500 companies, and pinpointed a significant and positive impact of the digital orientation and digitalisation on firms' environmental management activities.

Our study adds to the growing literature that have brought to the fore, the role of digitalisation in the quest for environmental management practices or eco-innovation, as emphasised by Li et al. (2023). Li et al. (2023), however, used the perspective of the affordance theory, and revealed a positive correlation of process reengineering and DT-led eco-innovation with sustainable performance in the manufacturing and the ICT industries in China. Further, our result is in partial concurrence with the findings of Yang et al. (2023) that investigated the textile and apparel sector, and recorded evidence of a U-shaped nexus between digitalisation and environmental performance in China as a proxy of the emerging economies. On the contrary, the finding of this study opposes Haq and Huo (2023) that used the contingency theory in a developing country context, proxied by the SMEs in Pakistan, and found negative influence of digital strategy on environmental performance.

In order to elaborate the nexus between digitalisation and environmental management activities, we have considered it vital to examine the moderating effect of family ownership, and influence of two vital contextual factors, that is, knowledge exploitation and risk management capabilities. Our finding indicated the attenuating impact of family ownership on the said nexus and made an important contribution to institutional theory (DiMaggio & Powell, 1983), emphasising its pertinence in the new context of family-owned MSEs in an emerging and developing market setting. This finding shows resemblance with an earlier investigation conducted by Denicolai et al. (2021) that used a balanced sample of MSEs from the North-West Province of Italy and employed Artificial Intelligence (AI) as a proxy of digitalisation. Unlike our selection of family ownership, Denicolai et al. incorporated internationalisation as the moderating variable and documented evidence of its influence on the digitalisation-environment nexus. On the contrary to the use of the intuitional theory by the previous studies to analyse how intuitional logics affect the behaviour of large firms (e.g., Berrone et al., 2013) or firms in advanced economies (e.g., Bammens & Hünermund, 2020), the finding of this study reaffirms the applicability of the theory towards enhancing environmental practices of the MSEs in the emerging markets. In connection with the influence of two vital contextual factors, our finding of a positive association between digitalisation and environmental management practices is in partial consonance with the study of Wu et al. (2022) that has established the nexus using the notion of 'digitalisation capabilities'. Wu et al. (2022) investigated the digital transformation in both the large firms and the MSEs in the manufacturing industry in China, indicating close links of the digitalisation capabilities to internal and external factors. The nature of the inner mechanism of the digitalisation capabilities of the Chinese manufacturing MSEs shows great resemblance to the knowledge exploitation management capabilities of MSEs, as postulated in our study.

TABLE 9 Summary of the main findings of the study.

Hypothesis	Our findings
H1. *There is an association between digitalisation and firms' environmental management practices.*	There is a direct and positive relationship between the level of digitalisation and the effectiveness of environmental management practices.
H2. *Family ownership influences the association between digitalisation and environmental management practices.*	The positive relationship between digitalisation and environmental management practices is reduced for family-owned firms, indicating a negative moderating effect.
H3. Ceteris paribus, *the association between digitalisation and environmental management practices is influenced by organisation's knowledge capabilities.*	No evidence found on the influence of organisation's knowledge capabilities on the positive association between digitalisation and environmental management activities.

In corroboration with the findings of Denicolai et al. (2021), Bendig et al. (2023), Li et al. (2023) and so on, the empirical results of this study lend credence to the fact that digitalisation is an enabler of environmental performance which should be included in the firm level strategies to "foster performance measurement systems, improvements, and value chain integration" (Queiroz et al., 2022, p.1). Moreover, our findings reiterate the significance of firms' digitalisation footprints in sustainability and hence contribute to the environmental management practices literature related not only to the context of the developing world but also countries in general, ranging from the largest developing economy (China) to the largest developed economy (USA). We, however, argue that despite the widespread global presence of family-owned MSEs, there is dearth of focus in research on the nexus between their digitalisation capabilities and resulting performance in environmental management activities.

5 | CONCLUSION

The aim of this paper was to investigate the association between digitalisation and environmental management activities. The study also investigated the moderating role of family influence on the relationship between digitalisation and environmental management activities. Corresponding to the objectives of this study, we formulated four hypotheses in the context of Ghana, the third largest US export market for goods in Sub-Saharan Africa with a rapidly growing young and internationally connected population through digital means (ITA, 2022). For testing the hypotheses, we adopted a combination of the methodological approaches of Osei et al. (1993), Acquaah and Agyapong (2015), Hock-Doepgen et al. (2021), Adomako and Ahsan (2022), Troise et al. (2022), and employed a convenience sampling technique to survey online the owners and managers of MSEs with fewer than 29 employees from the Ghana Startup Network (GSN). Benchmarking the experiment of Amaya et al. (2018) in Ghana, we are convinced of receiving a reasonably high response rate in the context of the MSEs in Ghana.

Using a unique dataset of 386 family firms in Ghana, we found empirical support for our hypotheses that digitalisation is positively associated with environmental management activities. We also find that this relationship is attenuated by family influence, thus adding to the existing growing studies that show that family ownership is associated with environmental management activities (e.g., Bammens & Hünermund, 2020; Cruz et al., 2019). However, while our finding of negative moderating effect of family influence on digitalisation and environmental management activities is surprising, it raises an important issue about competing strategies between digitalisation and environmental management activities. This implies that digitalisation and environmental management activities may compete over limited resources (Denicolai et al., 2021) when the firm under consideration is a family-owned business. However, given the successful Chinese strategy of compelling businesses to adopt the DTs as part of the accomplishments of the "30–60 development goals of digital China" (Li et al., 2023), it is logical to expect that a contemporary emerging economy like Ghana can pursue a sustainable growth path by designing supportive regulations and incentivising adoption of environmentally friendly DTs by the family-owned firms.

5.1 | Contributions

The key contributions of this study are to the institutional theory and firms' environmental management practices literature. Regarding theoretical contribution, given that prior studies have often used intuitional theory to analyse how intuitional logics influence the behaviour of large firms (e.g., Berrone et al., 2013) or firms in advanced economies (e.g., Bammens & Hünermund, 2020), our study reconfirms the suitability of the application of the institutional theory towards promoting MSEs environmental practices in the context of emerging markets. Our context driven contribution shows that MSEs in Ghana such as those contained in our sample are even more amenable to institutional theory. We reason these firms are more embedded in local communities in terms of both their operations and customer base (Berrone et al., 2010), and can therefore suffer significant consequences of local collective action and intuitional pressure relative to their reputations.

Regarding the contribution to the literature, given that bulk of the previous studies have been conducted in the context of a diverse range of industries in China, followed by USA, and there has been a dearth of studies in the context of MSEs in the contemporary emerging economies, this study makes a vital contribution to the environmental management literature by looking into the experience of Ghana, a wonderful proxy of the emerging economies that have achieved significant economic and social development over the last two decades (USAID, 2022) by showing the importance of digitalisation towards promoting environmental management practices amongst MSEs, and corroborates the findings of Bendig et al. (2023) and Yang et al. (2023). Specifically, the use of DTs can improve the firms' environmental management practices, and the application of digital innovations can promote social advancement. Furthermore, we propose the moderating effect of family influence on the relationships between digitalisation and firms' environmental management practices, thus establishing a mechanism explaining how family firm impact on digitalisation relate to firms' environmental management practices. Moreover, we identify contextual factors which are knowledge capabilities and risk management abilities to determine the effectiveness of the nexus between digitalisation and environmental management practices. We acknowledge that a number of contemporary research (e.g., Forés et al., 2023; Gómez-Mejía et al., 2007; Le Breton-Miller & Miller, 2016; Miroshnychenko et al., 2022; Molly et al., 2010; Rees & Rodionova, 2015) have committed to investigating the role of family involvement in a firm's top management and revealed symptoms of hindering the allocation of funds for green innovation (Heider et al., 2022; Matzler et al., 2015), and undermining the benefits of dynamic capabilities on environmental performance (Forés et al., 2023; Heider et al., 2022; Matzler et al., 2015), reflective of a conservative or risk averting behaviour of the family/business

(Abeysekera & Fernando, 2020; Comino-Jurado et al., 2021; Ernst et al., 2022) towards making economically rational investments. Given this background, our propositions of considering the moderating effect of family influence on the nexus between digitalisation and firms' environmental management practices, and the influence of knowledge capabilities and risk management abilities in determining the effectiveness of the nexus appear to be another contribution to the extant literature.

5.2 | Implications

Our study has managerial and policy implications. Our study indicates that digitalisation is not only aimed towards improving financial performance of firms but can also be an enabler of environmental, social and governance (ESG) performance. In consideration of the contemporary age of digitalisation, we emphasise incorporating state of the art technologies into the business model processes to improve the environmental footprint of the production processes and, as a consequence, conserve sustainable environment. It is widely known that small firms from the developing countries have not been in a favourable socioeconomic position to get actively involved in the fight against climate change. Therefore, our findings are of significance to encourage firms' engagement in ESG practices to boosts financial performance, led by the formulation of long-term strategic plans (DasGupta & Roy, 2023; Eccles et al., 2014; Lo & Sheu, 2007; Wang & Sarkis, 2017). Given the impact of digitalisation on environmental performance among the local MSEs, we recommend provisioning of public institutional support schemes including financial resources to enable these firms to invest more in digital equipment or assets to strengthen the digitalisation process. We also recommend sector-specific training programmes to enhance ability to minimise the risks and cost involved in digitalisation, and also to improve the knowledge capabilities of the resource constrained firms.

5.3 | Limitation and future study

Although this study provides theoretical and managerial insights for researchers and practitioners, it has been subjected to several limitations that require further investigation. This study does not examine causal relationships (Bascle, 2008; Soluk et al., 2021). However, sensitivity analyses and an assessment of the potential endogeneity problem were conducted so as to rule out alternative judgments and provide robust evidence. In future research, we can explore digitalisation and environmental management practices longitudinally to confirm the validity and reliability of our outcome. In the wake of the COVID-19,[6] we chose to employ an online survey research method, which prevented us from observing the details of the digitalisation process. Therefore, future research may use qualitative methods such as face-to-face in-depth interviews to improve our understanding of factors influencing digitalisation. It is also possible to adapt case studies for the purpose of examining the causal time-difference effects of implementing digitalisation in MSEs (Soluk et al., 2021). Furthermore, we encourage future scholarly works to explore how MSEs develop digitalisation beyond environmental management activities. Given that we concentrate on environmental management activities, that is, widely regarded as one of the most important dimensions of environmental management activities, we suggest examining the relationship between DTs and environmental management activities through both the environmental and social dimensions of sustainability, in line with the findings of previous studies, for example, Li et al. (2020), that suggested reflecting sustainability by a triple bottom line perspective and an economic and environmental performance perspective. As this study focused on emerging economies among Ghanaian firms, its results may not be applicable to companies in other countries with dissimilar socioeconomic contexts. The scope of future research can be extended to countries with different institutional and legal environments, such as those in emerging Asian markets (Autio et al., 2014; Soluk et al., 2021). Future research may examine the role of these different constructs in emerging economies because of their different digital cultures, heterogeneity of knowledge exploitation (Cui et al., 2020).

[6]This study followed a survey process during the COVID-19 period.

CONFLICT OF INTEREST STATEMENT

We (the authors) declare that we do not have any conflict (financial or non-financial) of interest.

DATA AVAILABILITY STATEMENT

Dataset is available and will be provided if required.

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APPENDIX A

TABLE A1 Sub-sample analysis.

Panel A: relationship between digitalisation and environmental management: high vs. low knowledge capabilities (KCAP).		
	(1) **High KCAP**	**(2)** **Low KCAP**
VARIABLES	**ENVMGT**	**ENVMGT**
DIGI	0.166**	0.045
	(2.259)	(1.185)
Controls	Included	Included
IND	Included	Included
Constant	3.943***	1.899***
	(5.206)	(3.277)
Observations	127	259
Adjusted R-squared	0.152	0.017
Panel B: relationship between digitalisation and environmental management: environmental dynamism		
	(1) **High ENDYNA**	**(2)** **Low ENDYNA**
VARIABLES	**ENVMGT**	**ENVMGT**
DIGI	0.078**	0.088
	(2.171)	(1.649)
Controls	Included	Included
IND	Included	Included
Constant	0.876	2.930***
	(1.638)	(4.082)
Observations	216	170
Adjusted R-squared	0.066	0.069
Panel C: relationship between digitalisation and environmental management: digital tools adoption		
	(1) **High DIGI TOOLS**	**(2)** **Low DIGI TOOLS**
VARIABLES	**ENVMGT**	**ENVMGT**
DIGI	0.115***	0.085
	(2.833)	(1.570)
Controls	Included	Included
IND	Included	Included
Constant	2.076***	0.405
	(2.966)	(0.577)
Observations	210	176
Adjusted R-squared	0.119	0.142
Panel D: relationship between digitalisation and environmental management: managerial education		
	(1) **High MEDU**	**(2)** **Low MEDU**
VARIABLES	**ENVMGT**	**ENVMGT**
DIGI	0.105***	−0.015
	(2.646)	(−0.219)
Controls	Included	Included
IND	Included	Included
Constant	2.125***	0.719
	(3.479)	(0.890)

(Continues)

TABLE A1 (Continued)

Panel D: relationship between digitalisation and environmental management: managerial education	(1) High MEDU	(2) Low MEDU
Observations	264	122
Adjusted R-squared	0.080	0.089

Panel E: relationship between digitalisation and environmental management: based on location difference	(1) Northern Ghana	(2) Southern Ghana
VARIABLES	ENVMGT	ENVMGT
DIGI	0.114*	0.070
	(1.933)	(1.639)
Controls	Included	Included
IND	Included	Included
Constant	0.448	2.137***
	(0.495)	(3.373)
Observations	126	260
Adjusted R-squared	0.071	0.050

Panel F: relationship between digitalisation and environmental management: firm characteristics	(1) Small firm	(2) Big firm	(3) Young firm	(4) Old firm	(5) High perf	(6) Low perf
VARIABLES	ENVMGT	ENVMGT	ENVMGT	ENVMGT	ENVMGT	ENVMGT
DIGI	0.102**	−0.016	0.161***	−0.004	0.124***	0.055
	(2.568)	(−0.205)	(3.561)	(−0.065)	(3.224)	(0.954)
Controls	Included	Included	Included	Included	Included	Included
IND	Included	Included	Included	Included	Included	Included
Constant	2.375***	0.150	1.502**	2.126***	2.413***	−0.654
	(3.942)	(0.161)	(2.161)	(2.859)	(3.536)	(−0.677)
Observations	262	124	207	179	181	205
Adjusted R-squared	0.059	0.052	0.096	−0.007	0.166	0.095

t-Statistics in parentheses.
***$p < .01$.**$p < .05$.*$p < .1$.