

## Postformation alliance capabilities and environmental innovation

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## RESEARCH ARTICLE



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# Postformation alliance capabilities and environmental innovation: The roles of environmental in-learning and relation-specific investments

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## Abstract

This paper draws insights from the relational view perspective to examine the effects of two postformation alliance capabilities—interorganizational coordination and communication, and relation-specific investments on small- and medium-sized enterprises' (SMEs') environmental innovation. Analysis of time-lagged survey data from a sample of 223 SMEs from the United Arab Emirates (UAE) shows a positive interactive effect of interorganizational coordination and communication on environmental innovation, and this relationship is mediated by environmental in-learning. The results further indicate that relation-specific investment moderates the indirect relationship between the complementary effect of interorganizational coordination and communication and environmental innovation. These findings extend the environmental innovation literature by exploring the interactive effect of interorganizational coordination and communication on environmental innovation.

## KEYWORDS

environmental in-learning, environmental innovation, interorganizational communication, interorganizational coordination, SMEs, UAE

## 1 | INTRODUCTION

In recent times, the concept of environmental innovation has gained increasing scholarly and practitioner attention (Adomako et al., 2021; Chang & Gotcher, 2020; De Marchi, 2012; Melander, 2018) due to its impact on business performance and sustainability (Costantini et al., 2017; Wijethilake, 2017). To produce restorative resolution in an effort to enhance sustainability and profitability, firms are required to proactively seek environmental innovation (Liao, 2018b; Yu et al., 2017). According to Kemp and Pearson (2007, p. 7), environmental innovation is defined as “the production, assimilation or exploitation of a product, production process, service or management or business method that is novel to the organization (developing or

adopting it) and which results, throughout its life cycle, in a reduction of environmental risk, pollution and other negative impacts of resource use (including energy use) compared to relevant alternatives.” Thus, environmental innovation displays a low environmental footprint during the process of manufacturing (i.e., process environmental innovation) or when a product is used over its life cycle (Costantini et al., 2017; Hofman et al., 2020).

To foster environmental innovation in the dynamic and technological landscape, firms increasingly rely on strategic alliances as a strategic tool and resource that concerns mutual agreements between two or more partners to exchange resources or co-develop knowledge (Dangelico & Pontrandolfo, 2015; Rizzi et al., 2013). Such strategic alliances help firms to overcome ecosystem and sustainability issues

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because of the exploitation of partners' skills and knowledge in managing uncertainties (Stadtler & Lin, 2017), for example, concerning environmental issues. Thus, through allying with external partners, firms can gain access to environmental knowledge that promotes understanding of sustainability issues and enhances environmental innovation (Adams et al., 2016; Wassmer et al., 2012). In a similar vein, some scholars contend that environmental in-learning helps firms to develop environmental innovation (Neutzling et al., 2018; Valkering et al., 2013). Environmental in-learning captures the ability of alliance partners to combine the partners' knowledge and create a new knowledge base about environmental and sustainability issues (Kim et al., 2018). Environmental in-learning also allows firms to generate new knowledge and promote mutual behavior in associations to promote environmental innovation (Watson et al., 2018). However, the transfer of knowledge and promotion of learning among alliance partners is a risky and complex process due to the multifaceted nature of partnering organizations and exchange processes (Kim et al., 2018). The environmental in-learning process can also prove difficult in certain interorganizational relationships where firms possess a strong brand reputation and have a powerful presence in markets (Wang, 2011).

This notion is linked to the perspective that some firms are better able to attend to complexities of interorganizational relationships than others (Kohtamäki et al., 2018). In this regard, scholars argue that some firms possess alliance management capability through which a firm can develop and manage alliance relationships (Wang & Rajagopalan, 2014). As evident from the alliance management literature, alliance management capability is conceptualized as a unidimensional construct (Gammoh Bashar & Voss Kevin, 2013), a multidimensional construct (Lambe et al., 2002), or a higher order construct with different dimensions (Schilke & Goerzen, 2010). Further, a plethora of studies consider preformation alliance capabilities before a relationship is formed, to achieve performance gains (Leischnig & Geigenmüller, 2018; Yang & Meyer, 2019). Meanwhile, others focus on postformation aspects (e.g., Schreiner et al., 2009) and argue that firms need postformation alliance capabilities to manage an interorganizational relationship when it is formed and running (Kohtamäki et al., 2018). A critical look at the literature indicates a paucity of knowledge on the performance implications of firms' postformation capabilities. Specifically, less attention has been paid to the potential differing effects of various postformation alliance capabilities (Schreiner et al., 2009), thereby limiting understanding of their complementary roles in environmental in-learning and environmental innovation (Helfat & Raubitschek, 2018; Wang & Rajagopalan, 2014).

Our study attempts to address these knowledge gaps by examining how different postformation alliance capabilities interact to drive environmental in-learning and how environmental in-learning enhance environmental innovation. We conceptualize postformation alliance capabilities in terms of two fundamental abilities: *interorganizational coordination* wherein a firm synchronizes relational activities and handles joint tasks, and *interorganizational communication* wherein a firm ensures the frequent and timely exchange of information

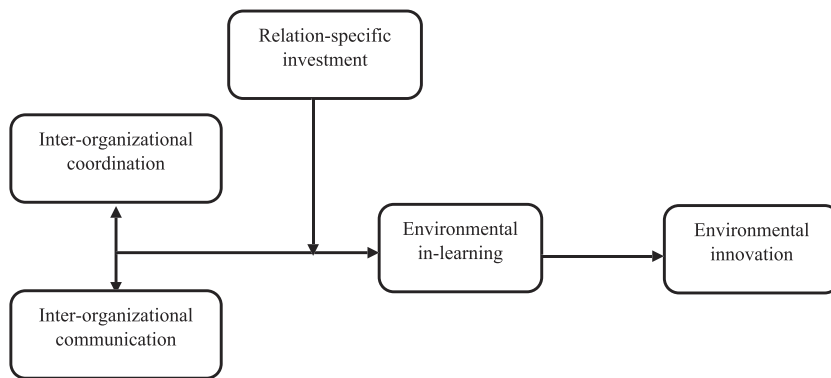
(Schreiner et al., 2009). Using survey data from 258 small- and medium-sized enterprises (SMEs) in the United Arab Emirates (UAE), the study contributes to a strategic alliance and environmental management literature in three main ways. First, researchers have highlighted the role of alliance management capability to enhance synergies among partners (Schilke & Goerzen, 2010; Watson et al., 2018). However, the contribution of previous studies is limited to the higher order conceptualization of alliance management capability (Kauppila, 2015; Schreiner et al., 2009) that potentially inhibits understanding of how individual capability components interact and work together to support the accumulation of external resources (Kohtamäki et al., 2018; Niesten & Jolink, 2015). Our study is novel in disintegrating postformation alliance capabilities into two components: interorganizational coordination and communication (Wang & Rajagopalan, 2014), and employing complementary logic to understand the interplay between both capabilities for environmental innovation (Song et al., 2005). Second, our study is the first to show how a set of postformation alliance capabilities interact to facilitate alliance management to promote environmental innovation. Specifically, our study shows that environmental in-learning acts as a mediating mechanism to leverage the interplay of postformation alliance capabilities for environmental innovation. The interplay between interorganizational coordination and interorganizational communication allows a firm to pool environmental resources in a cooperative way that enhances environmental in-learning. Subsequently, environmental in-learning promotes the knowledge accumulation and supports the development of environmental innovation. Third, we focus on the moderating role of relation-specific investments on the link between the interplay of postformation alliance capabilities and environmental innovation through environmental in-learning. Relation-specific investments act as resource commitments to support specific alliance relationships (Wagner & Bode, 2014), facilitate the interplay of effective deployment of postformation alliance capabilities for environmental in-learning and, hence, improve environmental innovation.

In the following section, the theoretical background and study's hypotheses, as shown in Figure 1, are discussed. Next, the study context, data collection approach, and study measures are described. This is followed by analytical procedures and the reporting of study findings. We then conclude the study with a discussion of theoretical contributions and practical implications.

## 2 | THEORETICAL BACKGROUND

### 2.1 | Alliance management capability

The alliance literature suggests that merely having strategic alliances is not sufficient; instead, firms need to manage and utilize alliance relationships (Kale et al., 2002). Alliance management capability, "to purposefully create, extend, or modify the firm's resource base, augmented to include the resources of its alliance partners" (Helfat et al., 2007, p. 66), allows firms to better identify and take advantage of strategic alliances (Kale & Singh, 2007).



**FIGURE 1** Conceptual framework of the study

Prior research conceptualizes alliance management capability as a multidimensional construct consisting of several routines, such as alliance transformation, alliance proactiveness, interorganizational communication, alliance bonding, interorganizational coordination, and interorganizational learning (Schilke & Goerzen, 2010; Schreiner et al., 2009). Although researchers directly conceptualize alliance management capability, they seldom consider the constituent elements at different stages of an alliance life cycle (for review, see Wang & Rajagopalan, 2014). Specifically, an alliance goes through different stages in its life cycle (Gulati, 1998), such as (1) the preformation stage, wherein a firm searches for an appropriate partner and decides to form an alliance, (2) the postformation stage, wherein a firm has to manage an alliance once it is established and running. Therefore, firms need capabilities to effectively manage an alliance during each of its phases. For example, preformation alliance capabilities can allow a firm to actively search for partners and form relationships ahead of competitors (Sarkar et al., 2009). In contrast, postformation alliance capabilities enable the effective running of relationships and the creation of values from the partnerships (Al-Tabbaa et al., 2019).

The postformation stage is particularly critical because firms have the “opportunity to create value by leveraging complementary assets and learning from each other” (Wang & Rajagopalan, 2014, p. 251). Accordingly, postformation alliance capabilities can help firms expand existing relationships (Al-Tabbaa et al., 2019). Indeed, prior research (Robson et al., 2019) suggests that firms use postformation alliance capabilities to coordinate behaviors and build trusting bonds with partners for mutual gains. The alliance literature identifies two distinct postformation alliance capabilities: interorganizational coordination and interorganizational communication (Sarkar et al., 2009; Wang & Rajagopalan, 2014). First, interorganizational coordination captures the ability of a firm to govern and manage activities with alliance partners (Gulati et al., 2005). Over the course of an alliance, partners can understand the relational requirements and comprehend the joint tasks. Accordingly, interorganizational coordination allows a firm to alter and adapt alliance-related arrangements in order to improve its efficiency and effectiveness (Gulati et al., 2012). Second, interorganizational communication relates to the ability of a firm to transfer meaningful and timely information between alliance partners (Schreiner et al., 2009). To maintain value-enhancing relationships,

open and frequent communication is essential among partners. Such communication can enhance knowledge acquisition, promote learning, and foster greater understanding of complex issues among partners (Grant, 1996; Kogut & Zander, 1992).

## 2.2 | Environmental in-learning

Learning is instrumental for a firm to identify and exploit environmental threats and opportunities (Newton et al., 2015) and generate long-term advantage over competitors (Brown & Eisenhardt, 1997). Prior studies concentrate on firm learning occurring through interaction with the environment, observing the consequences of the interaction and modifying their beliefs (Lee et al., 1992). For instance, Fraj et al. (2015) argued that internal orientation can stimulate a firm to assimilate knowledge and learn about the environment and cultural changes. However, it is difficult for resource-constrained SMEs to merely rely on internal learning related to the environment. In this vein, extant literature has shown that strategic alliances are important for SMEs to access partners' knowledge and share tacit resources embedded within organizations that lie at the core of a firm's competitive advantage (Barney, 1991; Inkpen, 1997). Studies have proposed that strategic alliances can provide solid knowledge bases and promote learning about environmental threats and opportunities (Mirvis et al., 2016; Quist & Tukker, 2013).

In this study, we used the term *environmental in-learning*, which refers to a dynamic process of accumulating and leveraging environmental know-how via alliance partners (Bouncken & Fredrich, 2016; Newton et al., 2015). Environmental in-learning encompasses both vicarious learning that occurs by imitating the supposedly successful practices of other partnering firms (Denrell, 2003), as well as the transfer of environmental knowledge through frequent interactions between partners (Lane & Lubatkin, 1998). This study specifically focuses on environmental in-learning occurring through relationships with key partners that are our customers, suppliers, investors, and research institutions. Prior research suggests that these relationships are vital in a firm's environmental in-learning because they involve a high level of communication and coordination to exchange valuable knowledge (Dyer & Singh, 1998; Yli-Renko et al., 2001).

### 2.3 | Interplay of postformation alliance capabilities, environmental in-learning, and eco-innovation

The implications of interorganizational coordination and interorganizational communication are known in the alliance literature (Chen et al., 2013; Oliveira & Lumineau, 2017; Paulraj et al., 2008), although the literature is less clear about how the joint presence of both capabilities shapes eco-innovation. For instance, Kohtamäki et al. (2018) point out that there is a significant gap in our understanding of the interaction between different postformation alliance capabilities. Moreover, Robson et al. (2019, p. 151) highlight the crucial question of “how do different capability components work together in augmenting key partnership attributes?” which is yet to be answered. Thus, in an attempt to respond to these calls, we consider the interaction between postformation alliance capabilities (i.e., interorganizational coordination and interorganizational communication) and link these capabilities with SMEs' environmental innovation.

We propose that the interplay of postformation alliance capabilities provides a necessary but insufficient condition for environmental innovation. It is environmental in-learning that transforms the benefits of the interplay of postformation alliance capabilities into successful environmental innovation development. The relational view suggests that the relational rents generated through collaborative relationships and joint efforts can provide a competitive advantage (Dyer et al., 2018; Dyer & Singh, 1998). As highlighted by Dyer and Singh (1998), a strategic alliance can generate superior performance once “partners combine, exchange, or invest in idiosyncratic assets, knowledge, and resources/capabilities, and/or they employ effective governance mechanisms” (p. 662). The interplay of postformation alliance capabilities acts as a governance mechanism that may improve relational rent such as environmental in-learning (Dyer et al., 2018; Dyer & Singh, 1998). This environmental in-learning can offer a solid foundation through which an SME can develop better environmental innovation by assimilating valuable and complex knowledge (Lin et al., 2013).

## 3 | HYPOTHESES DEVELOPMENT

### 3.1 | Interplay of postformation alliance capabilities and environmental in-learning

An SME's interorganizational coordination and interorganizational communication are vital postformation alliance capabilities (Wang & Rajagopalan, 2014) that are critical in promoting environmental in-learning (Dyer & Singh, 1998). Interorganizational coordination is vital to develop harmony about alliance task requirements, the nature of interdependence, and the specification of working procedures (Schreiner et al., 2009). Interorganizational communication describes the ability to share information among partners in a timely, accurate, and complete manner (Paulraj et al., 2008). Interorganizational coordination promotes efficient joint working despite the divided operating systems and the physical and cultural distances among the partners. Interorganizational communication is fundamental for SMEs to

overcome postformation challenges by understanding the partner's differences and developing cohesive relationships (Owens et al., 2018). The configuration of interorganizational coordination and interorganizational communication promotes the flow of information about environmental technologies and market demands across organizational boundaries (Davis, 2016), thereby stimulating environmental in-learning. Interorganizational coordination may provide a good platform for environmental in-learning due to the alignment of partners' activities. The efficiency of this platform can be improved by interorganizational communication, in that frequent communication allows an SME to effectively exploit the coordination mechanisms in enhancing environmental in-learning. For example, interorganizational coordination can be better leveraged when an SME regularly interacts and applies interorganizational communication to exchange information and enhance environmental in-learning. Additionally, frequent and timely information exchange due to alliance communication helps SMEs to coordinate and align their activities more effectively (Choi & Contractor, 2019), thus generating more environmental in-learning.

Thus, we take a cue from the principle of combinative capabilities (Kogut & Zander, 1992) and argue that the combination of firms' ability to coordinate and communicate will strongly impact on environmental in-learning than when they are deployed individually. Further, recent studies highlight the advantages of complementarities between different activities in strategic decision making and actions (e.g., Acebo et al., 2021; García-Marco et al., 2020); hence, rather than adopting a singular activity, exploiting complementarities between the two capabilities of coordination and communication will enhance environmental in-learning. In effect, we expect that aligning interorganizational coordination and communication will have a synergistic effect on environmental in-learning. In line with these arguments, we state that

**H1 :** The interactive effect of interorganizational coordination and interorganizational communication is positively related to environmental in-learning.

### 3.2 | Environmental in-learning and environmental innovation

Although a relationship between in-learning and innovation of SMEs is established by previous studies (Bouncken et al., 2015; Nielsen & Nielsen, 2009), scholars have overlooked the role of environmental in-learning in promoting environmental innovation. In this study, we argue that when an SME is equipped with environmental in-learning, it is endowed with the ability to generate novel and potentially useful ideas, which can, in turn, enhance environmental innovation. First, environmental in-learning can help SMEs access their partners' broad, codified, and tacit knowledge, which may promote the level of existing knowledge base of a firm (Ahuja, 2000; Dyer & Singh, 1998). The increased level of knowledge can facilitate an SME to understand new information, detect market and environmental opportunities, and reduce innovation expenditures, thereby leading to environmental innovation (Das & Teng, 2001). Second,

environmental in-learning contains the flow of extensive knowledge from alliance partners (Ma & Huang, 2016). The acquired knowledge from outside can improve an SME's thinking and enhance flexibility to consider different alternatives and adapt to unpredictable environmental changes. Also, it allows SMEs to expand the sustainability-related knowledge pools and advance innovative ideas (Liao & Tsai, 2019), which can have an impact on environmental innovation. Third, external knowledge acquisition and learning can increase the speed of processing, which, in turn, shortens the life cycle of environmental innovation development (Dyer & Singh, 1998). Finally, environmental in-learning provides the basis for the development of firm routines that support existing and reinforce the building of new capabilities to brace environmentally friendly ideas (Nielsen & Nielsen, 2009), consequently promoting the readiness and competency of SMEs to support the development of environmental innovation. Thus, we argue that

**H2 :** Environmental in-learning is positively related to SMEs' environmental innovation.

### 3.3 | The mediating role of environmental in-learning

We argue that environmental in-learning can serve as an intermediate process through which the interplay of postformation capabilities affects SMEs' environmental innovation. More specifically, postformation alliance capabilities provide a solid base for the environment in-learning due to efficient governance of external relationships (Dyer et al., 2018). In turn, the environment in-learning lays a fundamental knowledge base to develop and launch environmental innovation. In this regard, the simultaneous alignment of interorganizational coordination and interorganizational communication capabilities may—through the principles of combinative capabilities and the benefits complementarities—facilitate knowledge flows for environmental innovation (Kohtamäki et al., 2018). However, knowledge can become obsolete quickly due to a dynamic environment and increasing sustainability concerns. Thus, to enhance the potential benefits of interorganizational coordination and interorganizational communication interplay to environmental innovation, an SME needs environmental in-learning to realize opportunities before they become eroded. Environmental in-learning enables an SME to utilize knowledge from different alliance partners and leverage postformation alliance capabilities, thereby achieving environmental innovation. Thus, we posit that the environmental innovation of SMEs may depend on high levels of environmental in-learning to continuously identify market opportunities, select new alternatives, upgrade competencies, and take advantage of postformation alliance capabilities (Fredrich et al., 2019; Niesten & Jolink, 2015). Accordingly, we posit that

**H3 :** Environmental in-learning mediates the relationships between the interactive effect of interorganizational coordination and communication on environmental innovation.

### 3.4 | The moderating role of relation-specific investments

Relation-specific investments comprise the tangible or intangible expenditures a firm makes to support a specific alliance relationship with another firm (Anderson & Weitz, 1992; Williamson, 1985). Relation-specific investments play a significant role in value creation and relational rent because they act as a substitute for trust and enticements for partners to act nonopportunisticly (Dyer et al., 2018; Dyer & Singh, 1998). Research has long established that relation-specific investments, such as a dedicated alliance function, can help to structure in-learning (Kale & Singh, 2007) and develop alliance management capability (Kale et al., 2002). In this study, we integrate the relation view with contingency philosophy to explain that, under a high level of relation-specific investments, the effect of the interplay of postformation alliance capabilities on environmental learning would be enabled, which will, in turn, translate into a greater level of environmental innovation. First, because relation-specific investments lose their value outside of the specific relationship, partners become trapped or locked in their existing relationship (Levinthal & Fichman, 1988). As the relation-specific investment increases, an SME makes greater efforts to maintain this relationship (Williamson, 1985). Due to this reasoning, relation-specific investment promotes postformation alliance capabilities to maintain an identical relationship and form new relationships, while effectively monitoring this relationship and intervening in their operations (Dyer et al., 2001). Second, in the presence of a high level of relation-specific investments, an SME can effectively manage an alliance for the learning of specialized environmental knowledge to remain unique and ahead of its competitors (Findikoglu & Lavie, 2019). Thus, relation-specific investments enable an SME to adopt a proactive approach to work closely with alliance partners while facilitating the implementation of interorganizational coordination and interorganizational communication to govern the alliance relationship, thereby promoting environmental in-learning. Subsequently, environmental in-learning could enable an SME to acquire superior new knowledge in order to facilitate environmental innovation. Based on the above arguments, we propose that

**H4 :** Relation-specific investments moderate the relationship between the interactive effect of interorganizational coordination and communication on environmental in-learning, such that the indirect effect, via environmental in-learning, is stronger at higher levels of relation-specific investments.

## 4 | METHODOLOGY

### 4.1 | The study context

The context of this study is SMEs in Dubai-UAE, an emerging Middle Eastern market. We used Dubai as our research context for several reasons. First, Dubai is the second largest emirate of the UAE after



Abu Dhabi. Particularly, SMEs make around 95% of the business in Dubai and contribute approximately 40% of Dubai's economic growth (Muhammad Siddique, 2015). Second, the landscape of Dubai is a global business hub with eye-catching setups and emerging start-ups (Singh et al., 2020). The strategic location of Dubai, noticeable by the Gulf countries, North Africa, and the Indian subcontinent, has offered business opportunities across different industrial sectors including manufacturing and services. Third, Dubai and other Emirates have set a model for policy progress and economic development. Although the nonoil sector is growing due to an increased focus toward the knowledge-based economy, the majority of gross domestic product is still sourced from the oil sector (Parcero & Ryan, 2017). In this regard, the government has launched an initiative for, long-term, building a green economy in the UAE (EmiratesGBC, 2020). Therefore, Dubai serves as a useful context to show how postformation alliance capabilities have supported SMEs' environmental response and driven them to engage in environmental innovations.

## 4.2 | Sample and data collection

Following the definition provided by the Government of Dubai (Dubai-SME, 2014), we define an SME as a business with 250 or fewer employees. The sampling frame of the study was the Dubai Chamber of Commerce and Industry (DCCI, 2013). Consistent with prior studies of SMEs, and relative to the study context (e.g., Avlonitis & Salavou, 2007; Brik et al., 2011), we used the following criteria to select the firms: (1) independent firms that are not part of any group or chain, (2) firms employing less than 250 employees, (3) manufacturers and/or service providers that engaged in innovative business activities, and (4) firms with complete contact information on the chief executive officers (CEOs). In addition to these criteria, we added a screening question that requires only SMEs that engage in strategic alliance activities (i.e., within the last 3 years) to be part of the study sample. Based on these criteria, we randomly selected 876 SMEs listed on the Dubai Chamber of Commerce and Industry. We contacted these SMEs by email and telephone to elicit participation in our study. Accordingly, 290 SMEs agreed to take part in the study.

Considering the relatively complex nature of the hypothesized relationships (i.e., interactive and causal paths), the data were collected in two waves with a time lag of 1 year using both email and hand delivery approaches. In the first wave (T1), the CEOs of the 290 SMEs were approached by trained research assistants with a questionnaire to gather information on postformation alliance capabilities, environmental in-learning, and relation-specific investments. After, many months of reminders and follow-ups, we received a total of 258 useable responses, yielding a response rate of 28.69%.

After a 12-month period, we conducted a follow-up study (T2) with R&D managers and new products/process development managers of 229 SMEs to capture the environmental innovation measures. It is instructive to note that in this second wave of the survey, 36 SMEs were dropped from the original list of 258 SMEs (i.e., from the first wave). The principal reason for the follow-up survey with these specific respondents

was to (1) apprehend the translation of postformation alliance capabilities and environmental in-learning into environmental innovation and (2) evade the issue of common method bias (Babalola et al., 2019; Podsakoff et al., 2012). Again, like wave one, the survey was administered using emails and a hand delivery approach. After removing the responses with missing values, we used 223 questionnaires, suggesting an effective response rate of 22.75%, for the final analysis.

## 4.3 | Measures

We relied on prior literature for items to measure the focal constructs of the study. More specifically, the items were adapted by making changes to the wording to enhance understanding in the Dubai context. All the items were measured using a 7-point Likert scale, as shown in Table 1.

### 4.3.1 | Interorganizational coordination

Using four items developed by Schreiner et al. (2009), interorganizational coordination was measured. The items represent the coordination of alliance-related activities and working processes of SMEs with external partners.

### 4.3.2 | Interorganizational communication

We used three items from prior studies (e.g., Paulraj et al., 2008; Schreiner et al., 2009) to capture interorganizational communication. This was operationalized in terms of the extent to which partners share critical information in a timely and frequent manner.

### 4.3.3 | Relation-specific investments

We adapted four items measuring relation-specific investments from Hånell et al. (2018) and Wang et al. (2014). Respondents were asked to report on the extent to which they invested in an alliance relationship.

### 4.3.4 | Environmental in-learning

The items to measure environmental in-learning were adapted from Bouncken et al. (2015) and Graham (2018). This was conceptualized as the environment-related knowledge accumulation and learning from alliance partners.

### 4.3.5 | Environmental innovation

We measured environmental innovation with six items adapted from prior research (e.g., Konadu et al., 2020; Li, 2014). The items captured the development of environmental products and processes in SMEs.

**TABLE 1** Reliability and validity of measurement model

Constructs and item description	Factor loading
Interorganizational coordination (CA = .87; CR = .86; AVE = .61)	
We have established internal processes (e.g., for marketing, project coordination) to coordinate partner-related activities.	.71
We have established interorganizational processes for cooperation with partners.	.74
We meet regularly within our company to adapt our working procedures to partners.	.76
We have adjusted our incentive systems (bonus, goal agreement) to serve the goals of the alliance with partners.	.87
Interorganizational communication (CA = .89; CR = .89; AVE = .74)	
We can explain the win-win situation of the alliance to partners on any given occasion.	.90
We make an effort to let partners know exactly our market positioning.	.88
We always inform partners about the new contact persons in our company in case of organizational changes.	.79
Environmental in-learning (CA = .82; CR = .84; AVE = .63)	
We acquired knowledge/learned from our partners to tackle environmental challenges more quickly.	.81
We gained strong expertise with the latest environmental technologies from our partners.	.82
We learnt pollution prevention skills from our partners.	.74
Environmental innovation (CA = .95; CR = .94; AVE = .82)	
We are the first that offer environmental-friendly products/services in the marketplace.	.94
Our competitors consider us as a leading company in the field of sustainability.	.96
We develop new products/services that are regarded as sustainable for society and the environment.	.90
We improve existing products/services that are regarded as sustainable for society and the environment.	.88
Our reputation in terms of sustainability is better than the sustainability reputation of our competitors.	.89
Compared to our competitors, we more thoroughly respond to societal and ethical demands.	.77
Relation-specific investments (CA = .86; CR = .86; AVE = .61)	
We have made investments in the alliance partner regarding time.	.71
We have made investments in the alliance partner regarding adaptations.	.73
We have made investments in the alliance partners in the form of capital.	.85
We have made investments in alliance partners in the form of personnel development.	.81

Note: Fit indices:  $\chi^2/df = 1.27$ ; RMSEA = .04; CFI = .98; NNFI = .95, .98; SRMR = .03.

Abbreviations: AVE, average variance extracted; CA, Cronbach alpha; CR, composite reliability.

#### 4.3.6 | Controls

We included several control variables to determine their influence on our study's model, comprising: firm size, firm age, industry type, and alliance experience. These variables were used as controls because previous studies have revealed that they have a significant influence on environmental innovation (Adomako, 2020; Konadu et al., 2020). First, firm size was measured using the number of full-time employees. Second, firm age was measured using the number of operational years of an SME. Third, we measured alliance experience as the number of alliances formed during the last 3 years. Finally, industry type was used as a dummy variable: 1 = manufacturing and 2 = services.

### 5 | ANALYSES

#### 5.1 | Reliability and validity of the measurement model

We conducted confirmatory factor analysis (CFA) to examine the validity and reliability of the multi-item measures. Following

previous research (Bagozzi & Yi, 2012; Kline, 2015), we used approximate fit heuristics such as non-normed fit index (NNFI), comparative fit index (CFI), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR) to evaluate the fitness of our measurement model. Accordingly, we found acceptable fit statistics for our CFA estimation,  $\chi^2/df = 1.27$ ; RMSEA = .04; CFI = .98; NNFI = .95, .98; SRMR = .03. Consistent with previous suggestions (e.g., Hair et al., 2014, 2017), the Cronbach alpha and composite reliability score for each construct exceed the recommended benchmarks of .70 and .60, respectively. Finally, we examined discriminant validity of the variables using the suggested test by Fornell and Larcker (1981). From Tables 1 and 2, the average variance extracted (AVE) for each construct exceeds the highest shared variance (HSV) of each pair of constructs—this confirms evidence of discriminant validity among the multi-item constructs. Table 1 presents details of the measurement model such as standardized factor loadings for all measurement items and the relevant model fit indicators. Table 2, on the other hand, shows descriptive statistics and correlations of the study variables.



**TABLE 2** Correlations and descriptive statistics of study variables

Variables	M	SD	1	2	3	4	5	6	7	8	9
Firm age <sup>a</sup>	2.81	0.35	1								
Firm size <sup>a</sup>	4.17	1.08	.03	1							
Alliance experience <sup>b</sup>	-----	-----	-.10*	-.03	1						
Industry type <sup>b</sup>	-----	-----	.02	.10*	-.13*	1					
Interorganizational coordination	5.30	1.07	-.09	.03	.02	.11*	<b>.78</b>				
Interorganizational communication	5.15	1.22	-.10*	.11*	.09	.03	.38**	<b>.86</b>			
Environmental innovation	5.45	1.57	-.08	-.10*	-.15*	.00	-.05	.05	<b>.90</b>		
Relation-specific investment	4.74	1.05	.05	-.07	-.06	.02	.01	.02	-.01	<b>.78</b>	
Environmental in-learning	4.50	1.17	-.07	.02	-.04	.02	.09	.25**	.36**	.13*	<b>.79</b>

Note: Square root of AVEs in bold on diagonal.

Abbreviations: M, mean; SD, standard deviation.

<sup>a</sup>Natural logarithm transformation of the original values.

<sup>b</sup>Dummy variable.

\* $p < .05$ . \*\* $p < .01$ .

## 5.2 | Common method bias

Although data on study variables were collected from multiple sources and with time interval, the problem common method bias (CMB) could characterize our dataset. As such, we followed several ex-ante procedural and ex-post statistical tests to assess the CMB threat. First, ex-ante procedures were followed in the questionnaire design: (1) counterbalancing the order of question, (2) use of diverse rating scales, (3) inclusion of reverse-coded items, and (4) assurance of confidentiality to informants (Podsakoff et al., 2003). Second, in terms of ex-post statistical tests, we followed previous studies (e.g., Boso et al., 2013; Chang et al., 2010) and assessed three competing CFA models: method-only model (Model 1) where all items were loaded on a single latent construct:  $\chi^2/df = 9.13$ ; RMSEA = .19; CFI = .66; NNFI = .64; SRMR = .20; trait-only model (Model 2) where each item was loaded on its respective latent construct:  $\chi^2/df = 1.27$ ; RMSEA = .04; CFI = .98; NNFI = .95, .98; SRMR = .03; and method-trait model, which combines both Model 1 and Model 2:  $\chi^2/df = 1.15$ ; RMSEA = .03; CFI = .99; NNFI = .96; SRMR = .03. A comparison of three models suggests that Model 2 and Model 3 are superior to Model 1—suggesting that CMB is not a threat for our study.

## 5.3 | Testing of hypotheses

Consistent with previous studies (Lee et al., 2018; Zhang & Wu, 2017), the proposed hypotheses and possible mediation effect were tested using regression and PROCESS macro analysis. To avoid the occurrence of multicollinearity, we mean-centered interorganizational coordination, interorganizational communication, and relational-specific investments before calculating their respective product terms. Indeed, from Table 3, the highest VIF is 1.46, which means that multicollinearity is not a serious concern to the current analysis and estimations. Table 3 presents the standardized regression

coefficients and their respective significant levels as well as fit indices for each model estimated.

Consistent with H1, the analysis revealed that the interactive effect of interorganizational coordination and interorganizational communication is positively related to environmental in-learning ( $\beta = .26$ ,  $p < .01$ ), as confirmed by Model 5. H2 posits that environmental in-learning positively drives SEMs' environmental innovation. From Model 3, we find support for H2 ( $\beta = .33$ ,  $p < .01$ ). Further, the empirical analysis is consistent with H3, that environmental in-learning mediates the relationship between the interactive effect of interorganizational coordination and communication and environmental innovation. Specifically, we find support for our mediation effect such that the interaction between interorganizational coordination and interorganizational communication positively relates to environmental innovation ( $\beta = .20$ ,  $p < .01$ ) (shown by Model 2); the interactive effect of interorganizational coordination and interorganizational communication is positively related to environmental in-learning ( $\beta = .26$ ,  $p < .01$ ); environmental in-learning positively relates to SMEs' environmental innovation ( $\beta = .33$ ,  $p < .01$ ). It is instructive to note that the significant association between the interactive effect of interorganizational coordination and interorganizational communication and environmental innovation diminishes when environmental in-learning is introduced as a mediator—confirming a full mediation effect. To validate the proposed mediation effect, we conducted a further test using PROCESS macro (Hayes & Preacher, 2013). The PROCESS macro results (Table 4) show significant direct, indirect, and total effects.

Finally, we find empirical support (as shown by Model 6) for H4 that relation-specific investments positively moderate the impact of the interaction between interorganizational coordination and communication on environmental in-learning ( $\beta = .20$ ,  $p < .01$ ). We used PROCESS macro to confirm the regression results for H4—significant conditional indirect effect of the focal predictor (interactive effect of interorganizational coordination and communication) to the

**TABLE 3** Standardized regression estimates

Variables	Model 1 environmental innovation	Model 2 environmental innovation	Model 3 environmental innovation	Model 4 environmental in-learning	Model 5 environmental in-learning	Model 6 environmental in-learning
<b>Controls</b>						
Firm age <sup>a</sup>	−.09	−.11	−.09	−.05	−.08	−.08
Firm size <sup>a</sup>	−.11	−.12*	−.12*	−.10	−.03	−.01
Industry type <sup>b</sup>	−.00	.01	.00	.01	.02	.03
Alliance experience <sup>a</sup>	−.17*	−.18**	−.15*	−.07	−.08	−.09
Interorganizational coordination (ICD)	.12*	.17*	.06	.26**	.34**	.33**
Interorganizational communication (ICM)	−.10	−.06	−.08	−.02	.02	.01
<b>Complementary main effect</b>						
ICD × ICM		.20**	.11		.26**	.35**
<b>Mediating effect</b>						
Environmental in- learning			.33**			
<b>Three-way moderating effect</b>						
Relation-specific investments (RSI)						.12
RSI × ICD						−.16*
RSI × ICM						.21**
ICD × ICM × RSI						.20**
<b>Model fitness</b>						
F value	2.08*	2.92**	5.93**	2.69*	4.32**	4.86**
R <sup>2</sup>	.08	.12	.22	.09	.13	.24
ΔR <sup>2</sup>	-----	.04	.10	-----	.04	.11
Highest VIF	1.26	1.35	1.48	1.24	1.36	1.46

Note: Standardized coefficients are reported.

<sup>a</sup>Natural logarithm transformation of the original values.

<sup>b</sup>Dummy variable.

\* $p < .05$ . \*\* $p < .01$ .

independent variable (environmental innovation) via the mediator (environmental in-learning) at different values of the moderator (relation-specific investments). Table 4 presents these findings.

## 6 | DISCUSSION AND IMPLICATIONS

This study aimed to examine how different components of alliance management capabilities (i.e., interorganizational coordination and interorganizational communication) and postformation alliance capabilities interact to drive environmental in-learning and the effect of the latter on environmental innovation at different levels of relation-specific investments. Our findings reveal a unique complementary positive effect of postformation alliance capabilities on environmental in-learning, on the one hand, and a positive impact of environmental in-learning on environmental innovation. Additionally, we find that the effects of the interaction between postformation alliance

capabilities on environmental innovation is channeled through environmental in-learning. Relatedly, the study finds a contingency role of the relation-specific investments, such that the positive complementary effect of postformation alliance capabilities on environmental innovation is enhanced when a relation-specific investment is high. These findings present significant research contribution to the alliance management and environmental innovation literature and venture management lessons for SMEs, particularly within emerging economies.

First, our study contributes to the extant literature by pioneering the effect of a fine grain analysis of lower order alliance management capabilities on SMEs' environmental innovation. Specifically, we extend the previous research (e.g., Hofman et al., 2020; Huang & Li, 2017) on strategic alliances and environmental innovation by highlighting the unique complementarity role of interorganizational coordination and interorganizational communication in driving environmental in-learning and environmental innovation. Our findings

**TABLE 4** Results of PROCESS macro

	Estimates	LL 95% CI	UL 95% CI
Direct effects			
Interactive effect of interorganizational coordination and communication → environmental innovation	.16*	.05	.27
Interactive effect of interorganizational coordination and communication → environmental in-learning	.15*	.07	.23
Environmental in-learning → environmental innovation	.43*	.26	.61
Indirect effects			
Indirect effect	.07*	.03	.13
Total effect	.16*	.04	.27
Conditional indirect effects			
−1 SD of the moderator	.05*	.02	.10
Mean of the moderator	.09*	.04	.15
+1 SD of the moderator	.12*	.05	.20

Abbreviation: SD, standard deviation.

\*Nonzero within the boundaries (significant).

depart from existing studies (Albino et al., 2012; Huang & Li, 2017) by introducing environmental in-learning as a significant mechanism through which postformation alliance capabilities impact the environmental innovation of SMEs. Second, extant research posits the relevance of relational investments in promoting interorganizational collaborations and relationships (Dyer et al., 2018; Li et al., 2017), yet such a relationship is less understood, especially for SMEs that engage in strategic alliances with the purpose of enhancing their environmental activities and success. The current findings advance our knowledge concerning when postformation alliance capabilities can successfully influence environmental in-learning. Thus, the alliance management literature often limits the concept of relation-specific investments to performance outcomes (Chiang et al., 2018; Nie et al., 2011), thereby neglecting the significant boundary condition effects this may have on intervening processes and capabilities. Accordingly, the study extends this field of research by demonstrating how relation-specific investments interact with postformation alliance capabilities to drive environmental in-learning among SMEs. Collectively put, the findings from this study make a significant contribution to the literature of interorganizational collaboration and environmental innovation by highlighting when and how interorganizational coordination and interorganizational communication impact on SMEs' environmental innovation—thereby unraveling the complex and dynamic social and organizational processes that characterize environmental innovation (see, Huang et al., 2010; Liao, 2018a).

Our research has implications for SME owners and managers. With businesses striving to engage in innovations that are environmentally friendly and sustainable, it is refreshing to know that SMEs can be environmentally innovative while forming alliances and collaborating with partners. Specifically, the findings provide valuable venture management lessons to SMEs that engaging with partners (through interorganizational coordination and interorganizational

communication) can be an effective means to gain knowledge about relevant environmental issues that can potentially enhance environmental innovation. It is also instructive to note that, for SMEs to maximize the environmental learning outcomes from these interorganizational collaborations, managers ought to invest time and personal and other resources into improving existing alliances while seeking new partners. In a nutshell, our findings demonstrate that the ideal pathways for SME owners and managers to be environmentally innovative is to (1) increase their coordination and communication activities with partners who are environmentally oriented, (2) absorb relevant learnings from these postformation alliance capabilities, and (3) continue to invest in the relationships.

## 7 | LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

Like many other research studies, our study is characterized by several limitations—some of which provide avenues for future research. First, the driving and conditioning forces of SMEs' environmental innovation was limited to resources and capabilities that are derived from strategic alliances. However, recent studies enable understanding of the significant role of firms' internal routines and policies—such as organizational culture and orientations in driving environmental innovation (Liao, 2018a, 2018b). It may be the case that congruence (or otherwise) between alliance relationships and the focal firm's organizational culture might have significant implications on the propensity to engage in environmental innovation. Thus, the literature will benefit from future research that attempts to investigate the role of organizational culture in our current framework. Second, an extension of our study is to examine whether the gender of owner-managers of SMEs would have any significant impact. Specifically, the tenets

gender socialization theory explains how men and women differ in certain qualities. For example, women are more in favor of environmental and ethical issues and likely to engage in activities that protect the environment (e.g., Ibrahim et al., 2009; Jain & Zaman, 2020). Therefore, future research can incorporate entrepreneurial gender as a useful moderating factor. Third, the study relies on self-reported measures of environmental innovation. Future research might unearth additional insights and nuances if objective measures of environmental innovation are used.

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