

# Adaptability culture fosters SMEs' climate change proactive adaptation in Vietnam

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## ARTICLE INFO

DOI:10.46223/HCMCOUJS.  
econ.en.16.2.3632.2026

Received: August 08<sup>th</sup>, 2024

Revised: October 26<sup>th</sup>, 2024

Accepted: November 05<sup>th</sup>, 2024

JEL classification code:

D20; M14; O13

*Keywords:*

adaptability culture;  
awareness of climate change;  
climate change proactive  
adaptation; SMEs

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## ABSTRACT

This study aims to explore the influence of Adaptability Culture (AC) on Climate Change Adaptation (CCA) among Vietnamese Small and Medium-sized Enterprises (SMEs). Further, this study examines the mediating role of Awareness of climate change Adaptation (AWA) in this relationship. Employing the Model of Private Proactive Adaptation to Climate Change (MPPACC), this study examines Vietnamese SMEs' climate change adaptation measures. Utilizing a survey approach, data from 314 SMEs in Vietnam were analyzed via the SEM linear structural model, employing SmartPLS4 software. The findings reveal a significantly positive impact of adaptability culture on SMEs' climate change adaptation activities. The study underscores the importance of adaptability culture in fostering proactive responses to climate change among SMEs in Vietnam. The study also highlights the magnitude of enhancing an adaptability culture within SMEs to magnify their resilience to climate change. Managers and policymakers can leverage such findings to develop strategies that promote adaptability culture and climate change awareness among SMEs, thereby progressing their adaptive capacity.

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## 1. Introduction

Climate change has become a major factor contributing to unpredictability, resulting in significant financial burdens across various industries, particularly for businesses (Abbasi & Nawaz, 2020; Kundzewicz et al., 2018; Winn et al., 2011). Developing economies in tropical regions face an "eco-development trap" because of global shocks. To break free, such countries need early adoption of low-carbon tech during structural change, guided by innovative policies to avoid high-emission patterns and technological lock-in (United Nations Conference on Trade and Development [UNCTAD], 2020).

Engaging in low-carbon solutions early prevents environmental harm and provides economic opportunities. This allows developing countries to build assets in activities aligned with international production standards, catering to markets with high ecological standards or consumers willing to pay a premium for environmentally sustainable products. Such an approach fosters resilience, sustainability, and a competitive edge in international markets (UNCTAD, 2020).

In the case of Vietnam, a Southeast Asian country with a diverse climate and an extensive coastline, rising sea levels pose a notable threat to low-lying coastal and river deltas. Without effective CCA, 06 - 12 million people may face coastal flooding by 2070 - 2100. The projected temperature increases in Vietnam, ranging between 1.0°C and 3.4°C by 2080 - 2099 compared to the 1986 - 2005 baseline, pose significant economic and social risks (The World Bank Group and the Asian Development Bank, 2020). While the country has committed to combating climate change through policies like the National Climate Change Strategy (Government of Vietnam, 2011) and ratified the Paris Agreement in 2016, challenges persist (United Nations Framework Convention on Climate Change, 2016). Ongoing collaboration and the execution of adaptation measures are indispensable for minimizing potential impacts on multidimensional poverty and inequality (World Bank and Asian Development Bank, 2020).

Researchers have recognized SMEs as catalysts for economic growth, local employment, and innovation (Mendy et al., 2020). Yet, despite the innovative potential, SMEs can significantly contribute to greenhouse gas emissions (Puppim de Oliveira & Jabbour, 2017; Schaefer et al., 2011). Additionally, experts deem SMEs more vulnerable to climate change effects than other sectors due to restrictions on resources, liquidity, skilled labor, management capabilities, and technical capacity (Crick et al., 2018; Fernández-Olmos & Ramírez Aleson, 2017).

This study focuses on incremental adaptation through diversification strategies. Responsive adaptation diversification strategy involves developing actions and behaviors that minimize the harm or enhance the benefits of natural changes in climate and extreme events (Kates et al., 2012) and is characterized by continuous proactive responses to climate hazards, viewing climate change as a chance to be seized (Kump & Schweiger, 2022; Organisation for Economic Co-operation and Development [OECD], 2023; Wouterse et al., 2022). Regardless of the belief that vulnerability encourages innovation, the contemporary literature overlooks how SMEs implement diverse adaptation strategies. To address this gap, providing small businesses with climate change awareness and an adaptive culture is crucial for accelerating their responses and policy adaptations to climate change.

This study aims to achieve two primary objectives: (1) identify factors influencing climate change adaptation through diversification strategies in Vietnamese SMEs; (2) examine how climate change awareness mediates the relationship between adaptability culture and adaptation to climate change in Vietnamese SMEs.

This study possesses both theoretical and practical contributions. First, it pioneers quantitative research on the CCA capabilities of 314 SMEs in Vietnam, marking the first attempt to measure their potential in exploiting opportunities arising from climate change. Second, the study affirms the substantial influence of adaptive culture on the diversification adaptation of SMEs to climate change, providing valuable insights into the crucial role of fostering a resilient cultural environment for SMEs in Vietnam. Third, the study establishes that an adaptive culture could promote diversification adaptation to climate change through enhancing climate change awareness. Additionally, the research integrates in-depth interviews with climate change experts in Vietnam and SME owners to generate a scale for assessing the diversification adaptation behavior of SMEs in addressing challenges and seizing opportunities presented by climate change.

## **2. Literature review and hypothesis development**

### **2.1. Proactive adaptation**

Many theories have studied adaptive behavior as a factor influenced by cognitive factors. Through mental and social cognitive processes, behavioral theories identify relevant determinants of behavior. Behavioral theories pinpoint factors influencing adaptive action related to cognitive processes, such as the theory of planned behavior proposed by Ajzen (1985). The theory of planned behavior developed by Ajzen (1985) was formed from three previous theories, including the theory of reasoned action by Ajzen and Fishbein (1975), the protection motivation theory of Rogers (1975), and the value-belief-norm theory (Stern et al., 1999). Adaptation-related studies have utilized the above theories in many different aspects (Arunrat et al., 2017; Bagagnan et al., 2019; Luu et al., 2019; Mitter et al., 2019). Le et al. (2018) examine standard components of adaptive capacity in climate change adaptation and natural resource management, including activities that build human, social, financial, political, and physical capital.

On the other hand, another more comprehensive and practical approach to determining adaptive capacity is related to the Private Proactive Adaptation to Climate Change (MPPACC) Model. Grothmann and Patt (2005) used the Protection Motivation Theory (Rogers, 1983) to propose the Model of Private Proactive Adaptation to Climate Change (MPPACC); Grothmann and Patt (2005) assert that perceived risk (risk assessment) and perceived adaptive capacity (adaptive appraisal) determine the understanding of smallholders' adaptive capacity. One's self-assessment of one's ability to cope with these risks and the associated costs is addressed when evaluating adaptive capacity. Meanwhile, risk assessment involves an individual viewing a chosen action based on probability and potential harm criteria. According to Grothmann and Patt (2005), MPPACC explains how maladaptive thinking can negatively impact an individual's intention to engage in adaptive behavior, in this case, a business manager. Insights into the perceptions of individuals, especially business managers, regarding climate impacts are explained through the MPPACC model (Zobeidi et al., 2022). From there, it can help determine the ability to adapt to climate change based on SMEs' proactive adaptation plans.

Climate change is a primary driver of natural disasters, posing significant risks to SMEs. These events can lead to substantial economic losses, including workforce and capital reduction, production disruptions, and supply chain challenges (Iqbal et al., 2023; Ngcamu, 2023; Sheller, 2021; Sloggy et al., 2021; Sun et al., 2023; Wu et al., 2020). To mitigate these risks and promote resilience, it is imperative to support SMEs in their efforts to adapt to and address climate change (Ali et al., 2023; Swatdikun et al., 2024). SMEs can play a vital role in addressing climate change by adopting sustainable practices, such as greening operations, innovating green solutions, and creating environmentally-focused businesses (Organisation for Economic Co-operation and Development [OECD], 2021). The Covid-19 pandemic demonstrated SMEs' capacity for innovation; however, they face similar challenges in digitization and green transition. To overcome these hurdles, enhancing awareness of climate change and providing SMEs with the necessary resources, including finance and skills, are crucial (OECD, 2023).

While smaller firms may have fewer communication channels and decision-making processes compared to larger ones, their agility can be a significant advantage in responding

to market emergencies, such as the pandemic, and implementing new business strategies (OECD, 2023). As defined by Isip (2022), organizational adaptability is the ability to adjust internal structures and processes in response to external shifts. Wouterse et al. (2022) underscore this as a proactive response to minimize risks or capitalize on opportunities. Algarni et al. (2022) further connect adaptability to flexibility, highlighting the alignment of internal resources with external demands. In the context of global transformations, adaptability is crucial for sustained organizational success (Yin, 2023). The debate on firms' adaptability to digital-era opportunities, such as diversification, continues (Kump & Schweiger, 2022). Diverse economies demonstrate resilience to shocks, fostering growth (Organisation for Economic Co-operation and Development/World Trade Organization [OECD/WTO], 2019). Integrating diversity aids businesses in navigating disruptive changes (Odeh et al., 2023). Adaptation studies categorize strategies into incremental and transformative types (Zobeidi et al., 2022). Incremental adaptation involves proactive responses to climate hazards, viewing climate change as an opportunity (Kump & Schweiger, 2022; OECD, 2023; Wouterse et al., 2022). Transformational adaptation entails altering system components (Park et al., 2012). Research primarily focuses on incremental adaptation through gradual changes in production decisions (Alam, 2015; Läderach et al., 2017; Nielsen & Reenberg, 2010) and product diversification as a core climate change adaptation strategy (Shaffril et al., 2018). A proactive approach to climate change adaptation involves planning and policy implementation to address anticipated impacts (Ash et al., 2012). Unlike reactive adaptation, which occurs in response to existing impacts, proactive adaptation is triggered by long-term changes or planning activities (Basu et al., 2022; Berrang-Ford et al., 2011). Building adaptive capacity through proactive action can lead to adaptation and sustenance in challenging environments (Rijal et al., 2022). Proactive adaptation strategies include preparing for expected impacts, monitoring, raising awareness, building partnerships, and enhancing learning or research (Berrang-Ford et al., 2011). Diversification and innovation can promote a firm's ability to proactively recognize emerging market changes and gain a competitive advantage (Statsenko & de Zubielqui, 2020). In agriculture, diversification boosts stability and resilience to shocks (Rotz & Fraser, 2015) and aligns with global social and climate goals (Díaz et al., 2018; McElwee et al., 2020).

## ***2.2. Adaptability culture***

Organizational culture is crucial for adaptability and agility (Carvalho et al., 2023). AC values flexibility (Deal & Prince, 2003), aiding firms in adapting to their environment (Denison & Mishra, 1995; Sabuhari et al., 2020). Adaptability culture helps anticipate and adjust to environmental changes (Kotter & Heskett, 1992), shaping crisis response (Martinez et al., 2023). Cultural factors promote responsibility and coordination in crisis management (Passetti et al., 2021; Zamoum & Gorpe, 2018). Trust-based cultures enhance crisis management through decentralized decision-making (Monternel et al., 2023). Culture, knowledge sharing, and innovation positively affect competitive advantage (Azeem et al., 2021). AC facilitates innovative crisis management, including employee empowerment (Hughes et al., 2020; Martinez et al., 2023). During crises like climate change, transparent communication fosters trust and lessens insecurity (MacKay et al., 2022), aiding quick decision-making (Martinez et al., 2023). Leaders emphasizing adaptability adopt dynamic crisis response approaches (Martinez et al., 2023).

## ***2.3. Awareness of climate change adaptation***

AWA comprises knowledge, experience, and attention related to CCA (Litke et al., 2024). Employees' perceptions of organizational culture significantly influence their behaviors, work environments, and the overall organizational climate (Shanker, 2015). Their insights and awareness within the organization reflect their understanding of cultural and climate expectations (Govan, 2019).

Perceived sensitivity to climate change risks is a critical factor influencing adaptive behavior (Dang et al., 2014; Zobeidi et al., 2022). Employee awareness of environmental issues, including ethical values and specific policies, is essential for effective adaptation (Markey & Townsend, 2013). Organizational culture and human resources practices foster employee awareness (Meyer et al., 2004). Well-informed employees are better equipped to respond to climate-related challenges (Franken et al., 2022; Moşteanu, 2024; Weick & Sutcliffe, 2006). Training programs focused on environmental responsibility can enhance employee awareness and promote adaptive behavior (Farooq et al., 2023; Pham et al., 2018; Usman et al., 2023).

Individuals' perceptions and responses to climate change are deeply influenced by their social context, particularly through discourse (Zobeidi et al., 2022). As Grothmann and Patt (2003, 2005) argue, exposure to climate-related information, often within the workplace, shapes risk awareness and adaptation capacity. Participation in training programs can enhance climate change understanding and vulnerability reduction (Mitter et al., 2019; Ricart et al., 2023; Zobeidi et al., 2022). Understanding environmental constraints and adaptive strategies is crucial for effective risk management and climate change adaptation (Galaz, 2005; Sohail, 2023). Research indicates that heightened awareness of climate change correlates with increased adaptation efforts, suggesting a positive relationship between knowledge and resilience (Gebre, 2023; Jamshidi et al., 2020).

#### **2.4. Theoretical framework**

This study employs the Model of Private Proactive Adaptation to Climate Change (MPPACC) developed by Grothmann and Patt (2005) as a conceptual framework. The MPPACC, which focuses on cognitive factors influencing individual adaptation choices (Yang et al., 2024), posits that subjective factors are as crucial as objective ones. Perceived adaptive capacity is shaped by perceived effectiveness, self-efficacy, and costs. Individuals assess potential benefits and costs before deciding to adapt or not. The MPPACC will help elucidate the role of climate change awareness in the relationship between adaptive culture and adaptation capacity. We hypothesize that adaptive culture fosters an understanding of adaptation's value, leading to individual evaluations of benefits and costs. While perceived self-efficacy is considered, the primary focus is on climate change awareness and the perception of adaptation costs and potential damages.

This study extends Abbasi and Nawaz's (2020) model to examine the relationship between climate change awareness and adaptation. A resource-based perspective posits that adaptable cultures, characterized by personnel flexibility, are essential for navigating rapid environmental change (Barney, 1991). To explain the mediating role of climate change awareness in this relationship, the study draws on the Resource-Based View theory (RBV) (Barney, 1991; Costanza et al., 2016). According to RBV, organizational resources confer a sustainable competitive advantage when valuable, rare, inimitable, and non-substitutable (Barney, 1991). The study applies RBV to emphasize the role of human resources, particularly adaptive organizational culture, as a strategic asset for organizational resilience in

the face of environmental change (Barney, 1991).

## ***2.5. Hypothesis development***

### ***2.5.1. Adaptability Culture (AC) and Climate Change Adaptation (CCA)***

Löbbe et al. (2019) promote an energy efficiency culture for cutting emissions, while Isensee et al. (2023) highlight corporate culture's role in emissions reduction. Isensee et al. (2020) identify SMEs' sustainable development dimensions, integrating corporate culture. Kiesnere and Baumgartner (2019, 2020) stress openness and top-management support for sustainable development. Cultural perspectives include Hofstede's (1980) and Cameron and Quinn's (2011) frameworks. According to Hofstede (1980), organizational culture is a collective mental programming that is often difficult to change; if it does change, it is slow because the culture exists in the minds of people or has become crystallized in the institutions that these people build together if many people share the culture. In their study, Cameron and Quinn (2011) found that organizations may fare worse if change strategies are not tried because modifying organizational culture is key to successfully implementing major improvement strategies and adapting to increasingly turbulent environments. The Belief-Action-Outcome theory, adapted by Isensee et al. (2020), integrates corporate culture into sustainable digital development. A related dimension of organizational culture is norms (Isensee et al., 2020), which have been identified as critical additional factors in explaining adaptive behavior (Van Valkengoed & Steg, 2019) and are considered contextual factors and influence climate change risk assessment (Mitter et al., 2024).

Adaptive culture is adapting to one's environment to thrive in the marketplace (Denison, 1990; Sabuhari et al., 2020). Cultural organization plays a vital role in organizational resilience and performance, helping employees adapt effectively to environmental changes (Suryaningtyas et al., 2019; Woo & Kang, 2021). The concept of cultural application, in which ethical leaders and employees view the initiative as an opportunity, is essential in determining organizational resilience (McManus et al., 2008). Lengnick-Hall et al. (2011) argue that organizational resilience is a resource of employee expertise, competence, knowledge, and established processes and procedures to guide the organization forward. An organization that thrives on diversity and inclusion can overcome and benefit from disruptive surprises (Odeh et al., 2023). Organizations with a clear vision, enthusiastic and committed employees, and a culture that grants autonomy allowing members to make independent decisions, innovate, and develop opportunities to understand better how to handle unexpected challenges such as climate change (Southwick et al., 2017). According to Barney (1991), to promote the value of human resources, it is necessary to exploit opportunities and build capabilities to counter threats. Climate change is both an opportunity and a challenge (Albitar et al., 2023), so if businesses ignore building a culture and equipping members of the organization with climate knowledge, strengthening the organization's adaptive capacity will help companies take advantage of opportunities and limit risks based on human resources (Barney, 1991).

Construction and manufacturing studies show cultural impacts on sustainability (Bulinska-Stangrecka & Bagienska, 2021; Caldera et al., 2019). Corporate culture shapes resilience, with adaptable cultures enhancing it (McManus et al., 2008). Diversification and integration help navigate surprises (Odeh et al., 2023), backed by Sharma et al. (2021), for adaptability in textiles. Integration positively influences reactive and proactive flexibility, allowing businesses to adjust to the changes in the external environment (Tsai & Lasminar,

2021). According to Statsenko and de Zubielqui (2020), firms might proactively promote their adaptive ability to identify external change and uncertainty through diversification and innovation. Besides, clear visions, employee enthusiasm, and autonomy aid in facing business challenges (Southwick et al., 2017). Human capital accumulation is crucial for climate change and sustainability (Aftab & Veneziani, 2024; Angrist et al., 2024). Hence, the following research hypotheses are derived:

*H1: AC has a positive impact on CCA*

#### *2.5.2. Adaptability Culture (AC) and awareness of climate change adaptation (AWA)*

Adaptability culture drives organizational innovation through flexible human resource practices that encourage risk-taking and skill development (Woodman et al., 1993), aiding in understanding business issues like CCA. This flexibility, supported by an open-minded corporate culture, enables bottom-up sustainability measures (Kiesnere & Baumgartner, 2019, 2020). However, SMEs' emission reduction debates often overlook cultural factors (Persson et al., 2015). Corporate culture influences members' understanding of climate change and motivation for emission reduction (Kaesehage et al., 2014), propelling organizational CCA forward. Prioritizing adaptability helps organizations thrive in dynamic landscapes, especially regarding climate change (Do et al., 2022). Thus, the authors hypothesize the following:

*H2: AC has a positive impact on AWA*

#### *2.5.3. Awareness of climate change adaptation (AWA) and Climate Change Adaptation (CCA)*

Adger et al. (2005) argue that adaptations occur in the milieu of cultural, demographic, and economic change and transformation in information technology, social conventions, global governance, and capital flows. Climate change awareness influences climate adaptation capacity's nature, quality, and strength (Abbasi & Nawaz, 2020). Climate change awareness determines land fragmentation as an adaptation strategy to climate change (Antwi-Agyei et al., 2021). Therefore, increasing public awareness and understanding of risks among residents in vulnerable communities is crucial to improving CCA policies (Khatibi et al., 2021). Some companies see climate change as a strategic opportunity to grow through mitigation plans by entering the electricity supplier market. Marshall et al. (2013) and Van et al. (2015) examined the impact of small-scale farmers' awareness of climate change and climate risks on their ability to adapt. Hillary (2004) identified internal barriers, such as resources, understanding, and company culture, and external barriers, such as lack of support and guidance, as factors that hinder engagement with environmental issues. Therefore, when employees and managers know how to enhance climate change, it may increase the organization's ability to CCA.

*H3: AWA has a positive impact on CCA*

#### *2.5.4. Awareness of climate change adaptation (AWA) mediates the relationship between Adaptability Culture (AC) and Climate Change Adaptation (CCA)*

It is posited that adaptive organizational cultures can significantly influence CCA by shaping perceptions and behaviors. Culture is a valuable resource, enabling organizations to navigate dynamic environments and sustain operations (Costanza et al., 2016). Moreover, it is pivotal in fostering innovation (Martins & Terblanche, 2003). Diverse cultural values can facilitate or hinder the adoption of climate-resilient livelihood strategies (Nielsen & Reenberg, 2010). Initiating CCA often involves raising AWA (Bowyer et al., 2014); however, successful

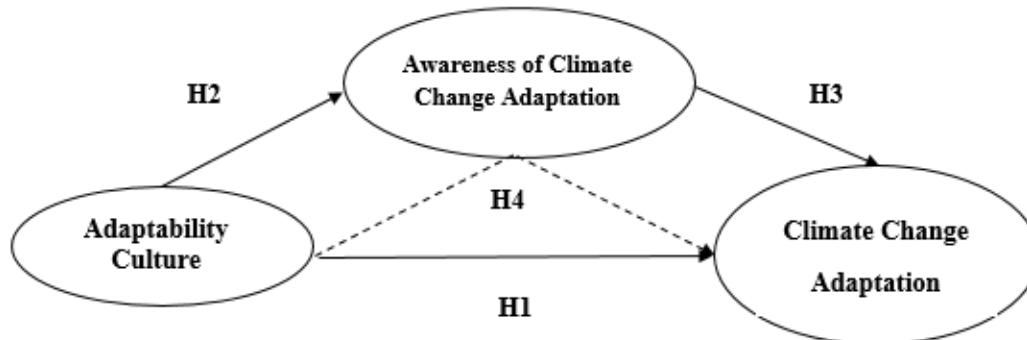
implementation can be challenging due to existing vulnerabilities, cultural norms, and social constraints (Dow et al., 2013). In line with sustainable development literature (Grin et al., 2010), CCA is conceptualized as a process rather than a fixed goal characterized by actions and outcomes (Pelling, 2010). To effectively address climate change, it is imperative to acknowledge the interplay between social, psychological, and cultural factors (Moos, 2002). Transformation, often associated with resilience, can be viewed as both an outcome and a cognitive shift within the adaptation process (Pelling, 2010). Dominant cultural perspectives prioritizing individualism may hinder social solidarity and collective action, which are essential for local adaptive capacity (Smith et al., 2003). The limitations of adaptation are deeply rooted in cultural and social contexts, potentially subjective but susceptible to change (Adger et al., 2009; Pelling, 2010). Organizations with adaptive cultures demonstrate a keen understanding of their environment, including climate change, and proactively address emerging challenges. These organizations can effectively navigate a constantly evolving business landscape by investing in adaptive capacity building and implementing appropriate strategies (Costanza et al., 2016). Cultivating an adaptive culture can enhance employee and managerial awareness of CCA, boosting confidence in related strategies. Thus, the authors posit that the following:

*H4: AWA mediates the relationship between AC and CCA*

The conceptual research framework is shown in Figure 1.

**Figure 1**

*Conceptual Model*



*Note.* Solid lines represent direct effects; Dotted lines represent indirect effects. Author's work

### 3. Methodology

#### 3.1. Procedure and participants

Following Maynard and Parfyonova (2013), data was collected from Vietnamese SMEs managers. As key economic contributors (OECD, 2021), SMEs play a crucial role in climate change adaptation (World Economic Forum [WEF], 2015). This study investigates their proactive responses to climate change, focusing on those operating in major Vietnamese cities, as defined by Decree 80/2021/ND-CP (Vietnam Government, 2022).

A bilingual questionnaire, developed in English and translated into Vietnamese using a double translation method, was administered. After expert review and pilot testing, the final questionnaire was deemed clear and relevant to the Vietnamese business context. In an official survey, the authors reached 548 SME managers through in-person and online invitations via Google Forms from December 15, 2023, to January 20, 2024, targeting training courses and

conferences. Snowball sampling expanded our participant pool (Parker et al., 2019).

### **3.2. Sample**

Chin (2010) suggests that 100 - 200 respondents are adequate for PLS-SEM analysis. Using Hair et al.'s (2021) 10 times rule, the minimum sample size for this study is 20, given its two impact paths. Based on Vietnam's SME Support Law, SMEs were defined as enterprises with no more than 200 employees, total capital under VND 100 billion, and annual revenue below VND 300 billion. A purposive sample of 548 managers yielded 314 valid responses (57.3% response rate). Exclusions were due to company size, capital, or revenue exceeding SME criteria. Invalid surveys were also removed.

### **3.3. Measures**

In this study, all measurements, comprising 17 items across 03 constructs, were drawn from previous relevant research and rated on a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). AC was measured using six items adopted from Wright and Snell (1998), Lau and Ngo (2004), and Bhattacharya et al. (2005). AWA was measured using five items developed by Todaro et al. (2021). CCA was measured using six items carefully designed based on an extensive literature review and suggestions from industrial experts for climate change adaptation (Berkhout, 2012; Odeh et al., 2023; Zilberman et al., 2018).

The sample was statistically selected based on several business characteristics: age, sector, size (number of employees), and revenue. Industry was encoded as follows: retail and trade (0), tourism and service (1), manufacturing and processing (2), and construction (3). Employee size was categorized: Below 10 employees (0), from 10 to 50 employees (1), and from 50 to 200 employees (2). Annual revenue was similarly categorized: Below VND 03 billion (0), from VND 03 - 20 billion (1), from VND 20 - 100 billion (2), and VND 100 - 200 billion (3).

### **3.4. Data analysis**

The authors used PLS-SEM (Hair et al., 2010) to analyze their model due to its suitability for exploring new relationships and assessing out-of-sample predictive ability, especially for models with 60 higher-order variables (Hair et al., 2017). In a two-stage process, PLS-SEM was evaluated using SmartPLS (Hair et al., 2019).

#### **3.4.1. Measurement model**

The measurement model's composite reliability and discriminant validity were assessed using Cronbach's Alpha (Fornell & Larcker, 1981; Hair et al., 2019). All constructs exhibited acceptable internal consistency with values above 0.7 (Hair et al., 2019), except overload confusion, which fell slightly below but remained within the acceptable range (Cui et al., 2023; Hair et al., 2016; Lam, 2012). Hair et al. (2006) suggested that a Cronbach alpha between 0.6 and 0.7 is considered acceptable when supported by other reliability indicators.

Convergent Validity (CV) was assessed using factor loadings, scale Composite Reliability (CR), and Average Variance Extracted (AVE). Items with factor loadings below 0.50 and those not meeting the AVE criteria were eliminated. The scale composite reliability, factor loadings, and AVE satisfied the threshold criteria of 0.7, 0.5, and 0.5, respectively, as Hair et al. (2019) and Sarstedt et al. (2021) suggested. The internal consistency and convergent validity of the model are detailed in Table 2.

Discriminant validity was assessed using the Fornell and Larcker criterion was employed. The square roots of the AVE values exceeded the corresponding correlations, meeting the requirement for discriminant validity.

#### *3.4.2. Structural model*

This study employed Partial Least Squares Structural Equation Modeling (PLS-SEM) to assess multiple relationships. To evaluate model fit, the Standardized Root Mean squared Residual (SRMR) was calculated (Schomburgk & Hoffmann, 2023; Sohaib & Han, 2023). A 5000-bootstrap resampling procedure was used to test hypotheses (Sarstedt et al., 2021).

The  $R^2$  value was examined, indicating the proportion of variance explained by the model. Values between 0.02 and 0.35 suggest moderate effects (Hair et al., 2012), while values above 0.35 indicate strong effects. The  $Q^2$  index, calculated using Blindfolding, was also assessed. A  $Q^2$  value greater than 0 indicates a good fit (Fornell & Cha, 1994).

To assess the relative influence of exogenous latent variables on endogenous latent variables, the  $f^2$  index was calculated (Chin, 1998). This index measures the increase in  $R^2$  of the endogenous latent variable when a connected path is present.

#### *3.5. Common method bias and multicollinearity*

A cross-sectional design was used to mitigate common method bias, and Harman's one-factor test was conducted. The results (42.011% extracted variance) indicated no significant standard method bias (Change et al., 2010; Cooper et al., 2020; Kock, 2015; Podsakoff et al., 2003). Multicollinearity was addressed by checking the VIF values for each item, which were all below 2.0 (Hair et al., 2017; Hair et al., 2019). Therefore, neither standard method bias nor multicollinearity posed significant threats to the validity of the analyses.

### **4. Results**

#### *4.1. Descriptive analysis*

Table 1 presents descriptive statistics and intercorrelations among the constructs. The sample predominantly comprised businesses under 10 years old (74.52%), with an average age of 6.535. Commercial and retail businesses (45.86%) were slightly more prevalent than service and tourism businesses (52.87%). Most companies (76.11%) had fewer than 50 employees, including 6.69% with fewer than 10. Revenue distribution was skewed towards smaller businesses, with 9% earning less than VND 03 billion annually. However, a significant portion (51.91%) generated revenue between VND 03 and 20 billion.

#### *4.2. Measurement model assessment*

As cited in Hair et al. (2017), Jarvis et al. (2003) posit that their measurement model is reflective. This is evidenced by the unidirectional causality from the latent construct to the manifest indicators, which are conceptualized as reflections of the underlying variable. Furthermore, the indicators exhibit thematic consistency, suggesting their shared relevance to the construct of interest.

The Composite Reliability (CR) for all variable groups exceeded 0.7, indicating adequate consistency (Hair et al., 2019). Additionally, each group's Average Variance Extracted (AVE) surpassed 0.5, confirming convergent validity. This suggests that the observed variables within each factor are highly correlated and effectively represent the underlying latent construct (Hair et al., 2019).

Discriminant validity, a fundamental aspect of model validation, ensures the distinctiveness of constructs. Cross-loading coefficients and the Fornell-Larcker criterion (Fornell & Larcker, 1981; Hair et al., 2019) are commonly employed methods. The latter requires the Average Variance Extracted (AVE) square root to exceed the inter-construct correlations.

**Table 1**

*Mean, SD, and Correlation Values among Variables*

	Mean	SD	1	2	3	4	5	6	7
<b>1. Age</b>	6.535	0.53756	1.00						
<b>1. Industry</b>	2.5127	0,58917	0.669**	1.00					
<b>3. Employee</b>	1.6943	0.88293	0.409**	0.597**	1.00				
<b>4. Revenue</b>	1.5892	0.68676	0.727**	0.849**	0.667**	1.00			
<b>5. AC</b>	3.6682	0.64	-0.122*	-0.07	-0.03	-0.140*	1.00		
<b>6. AWA</b>	3.9643	0.79	-0.075127	-0.01	-0.03	-0.05	0.562**	1.00	
<b>7. CCA</b>	3.5642	0.53756	-0.155**	-0.03	-0.03	-0.118*	0.507**	0.458**	1.00

Note. \*\* Correlation is significant at the 0.01 level (2-tailed)

\* Correlation is significant at the 0.05 level (2-tailed). Data analysis result of the research

**Table 2**

*The Measurement Model Assessment Result*

	Cronbach's Alpha	CR	AVE	Fornell-Larcker criterion		
				1	2	3
<b>1. AWA</b>	0.837	0.853	0.605	0.778		
<b>2. CCA</b>	0.903	0.906	0.674	0.471	0.821	
<b>3. AC</b>	0.812	0.822	0.570	0.587	0.511	0.755

Note. Data analysis result of the research

The measurement model's adequacy is confirmed in Table 2. All Cronbach's Alpha and CR values exceed 0.5, indicating convergent validity (Hair et al., 2019). AVE values also surpass 0.5, and the Fornell-Larcker criterion is met (Fornell & Larcker, 1981). These findings support the construct validity of the model.

#### **4.3. Structural model assessment**

The results of the model fit assessment indicated that the criteria for model fit were satisfied. A chi-square value of 600.351 was obtained, which is significant at  $p < 0.05$ . The Standardized Root Mean Square Residual (SRMR) was determined to be 0.076, lower than the recommended threshold of 0.08 (Hair et al., 2017). Consequently, the PLS path model demonstrated predictive relevance regarding the construct under investigation (Hair et al., 2019). The results of structural model testing are presented in Table 3.

Table 3 presents the  $R^2$  and  $Q^2$  results. In the PLS-SEM model, the primary criterion

for assessing the structural model's quality is explanatory power, indicated by  $R^2$ . In this analysis, the  $R^2$  values for CCA and AWA were 0.306 and 0.345, respectively. This means the model accounts for 30.6% of the variance in CCA and 34.5% in AWA. The  $R^2$  value 0.306 suggests the model offers moderate but meaningful predictive power for CCA. The study also determined that the  $f^2$  effect sizes were relatively small for the influence of AWA on CCA ( $f^2 = 0.064 < 0.15$ ) and for AC's effect on CCA ( $f^2 = 0.121 < 0.15$ ). In contrast, the impact of AC on AWA was notably high ( $f^2 = 0.526 > 0.5$ ). Additionally, all  $Q^2$  values were positive, measuring the model's predictive capability for out-of-sample data. Using resampling techniques, the  $Q^2$  values demonstrated that all exogenous variables possess predictive relevance ( $Q^2$  for CCA = 0.249, and AWA = 0.333), suggesting average model predictive ability ( $0.25 \leq Q^2 \leq 0.5$ ).

**Table 3**

*Results of Hypotheses Testing*

Hypothesis	Path	Coeff	STDV	t-value	p-values	R <sup>2</sup>	f <sup>2</sup>	Q <sup>2</sup>	Decision
H1	AC → CCA	0.358	0.056	6.402	0.000	0.306	0.121	0.249	Supported
H2	AC → AWA	0.587	0.049	11.913	0.000	0.345	0.526	0.333	Supported
H3	AWA → CCA	0.261	0.061	4.297	0.000		0.064		Supported
H4	AC → AWA → CCA	0.153	0.035	4.425	0.000				Supported

*Note.* Data analysis result of the research

Hierarchical regression analysis was used to test the proposed hypotheses. Regarding the effect of AC, hypothesis 1 showed a positive and significant coefficient for CCA ( $\beta = 0.358$ ,  $t = 6.402$ ,  $p < 0.001$ ). Similarly, hypothesis 2 predicted a positive association between AC and AWA. The results confirmed this relationship with a significant  $\beta$  coefficient of 0.587 ( $t = 11.913$ ,  $p < 0.001$ ), supporting hypothesis 2. Concerning the effect of AWA, hypothesis 3 examined the impacts of AWA on CCA. The results revealed significant effects of AWA on CCA ( $\beta = 0.261$ ,  $t = 4.297$ ,  $p < 0.001$ ). Consequently, hypothesis 3 was supported. Finally, hypothesis 4 postulated a mediating effect of AWA on the relationship between AC and CCA. A mediation analysis was conducted to test this effect, following the procedure outlined by Preacher et al. (2007), which emphasizes indirect effects. As shown in Table 3, the results revealed a significant indirect effect of AC on CCA through AWA ( $\beta = 0.153$ ,  $t = 4.425$ ,  $p < 0.001$ ), thereby supporting hypothesis 4.

#### **4.4. Discussion**

##### *4.4.1. Theoretical implications*

This study confirms that adaptability culture positively impacts CCA. This result aligns with the proposed conceptual model and the findings of previous studies (Aftab & Veneziani, 2024; Angrist et al., 2024; Sharma et al., 2021; Southwick et al., 2017; Suryaningtyas et al., 2019). These findings indicate that adaptability culture is crucial for businesses, particularly SMEs, in enhancing their CCA capacity. SMEs can create a dynamic, flexible environment by building a culture of adaptation, thereby providing employees and management with clear direction on CCA issues and equipping them with a foundational understanding of adaptation and strategies for responding to climate change risks, including those related to the business. This study demonstrates that awareness of CCA mediates the

relationship between adaptation culture and CCA. This result is consistent with the proposed conceptual model and the conclusions of previous studies (Costanza et al., 2016).

Understanding the origins and consequences of AC is essential for firms seeking to modify their organizational culture and foster corporate strategic innovation effectively (Verdu-Jover et al., 2018). AC empowers individuals to navigate diverse working environments, cultivating their capacity to manage emergencies and crises (McLoughlin & Priyadarshini, 2021). By cultivating AC that prioritizes innovation, organizations can nurture creativity and problem-solving abilities among their employees (Mogaji & Dimingu, 2024). Highly adaptive cultures serve as a mechanism for organizations to cope with change and mitigate external shocks, such as climate change (Costanza et al., 2016). AC is shaped by transformational leaders who reorient existing goals toward greater adaptability. Such leaders cultivate an environment that fosters high-goal achievement, personal growth, and self-actualization, thereby encouraging the adaptive capacity of individual members within the organization (Xenikou & Simosi, 2006).

In this study, the effect of AC on AWA was notably high ( $f^2 = 0.526 > 0.5$ ), and this relationship was confirmed with the highest significant  $\beta$  coefficient ( $\beta = 0.587, t = 11.913, p < 0.001$ ). The belief of employees and managers that CCA awareness is a crucial factor to address in developing climate change response strategies may have led to this finding (Matos et al., 2022; Paschen & Ison, 2014). When businesses create a dynamic working environment and adaptable culture, motivation to expand knowledge, invest time and effort in research activities, and learn about the impacts of climate change on business operations is generated. This leads to developing a strategy to respond to climate change (Matos et al., 2022; Van de Kerkhof & Wiczorek, 2005). Previous research has indicated that increased awareness of CCA, encompassing risks and losses from climate change, can enhance climate change adaptation ability (Marshall et al., 2013; Van et al., 2015). Our results suggest that when a flexible culture enables the generation of innovative, creative CCA strategy ideas, businesses, employees, and managers tend to invest in activities analyzing and evaluating potential CCA risks and business opportunities. Consequently, their understanding and awareness of effective climate change adaptation improves, positively influencing their capacity to devise suitable solutions and strategies to address climate change (Costanza et al., 2016; Nielsen & Reenberg, 2010).

The literature on adaptability and organizational creativity theory related to CCA in SMEs is also extended by this study. In other words, adaptability is seen as a catalyst, a free space where flexibility, creativity, and innovation are enabled for employees and managers, allowing the formation of awareness and understanding of the adaptation and change climate and organizational adaptation. This, in turn, improves the business's adaptive capacity towards climate change issues. The call of recent studies conducted in similar contexts (Fünfgeld et al., 2023; Shilomboleni et al., 2023) is also answered by this study by contributing to the enhanced understanding of climate change for SMEs. Recognizing the importance of climate adaptation is identified as one of two basic strategies to address climate change, which is crucial when making decisions about climate adaptation-related innovation activities (Naeem, 2023).

#### *4.4.2. Managerial implications*

SMEs can benefit from this study by learning how to adapt to climate change effectively. The key lies in focusing on three core areas: cultivating an adaptability culture,

enhancing climate change awareness, and implementing proactive adaptation strategies. This study outlines a structured, four-step approach to help SMEs build an adaptability culture and strengthen their capacity to respond to climate challenges.

The first step is cultivating an adaptability culture. Organizations must prioritize innovation and resource efficiency to foster a culture of adaptability in SMEs (Du Plessis et al., 2015). Effective communication and training programs can enhance employee awareness of climate change and its implications (Berrang-Ford et al., 2011). By promoting positive environmental behaviors and setting clear climate goals, SMEs can strengthen their adaptive capacity and gain a competitive edge (Chang, 2011; Sharma, 2021). Cross-functional learning and simulated disaster scenarios can further develop employees' adaptive capabilities and prepare them for climate-related challenges. Building external relationships can also facilitate knowledge sharing and continuous improvement.

The second step is building climate change awareness through training and development. SMEs should prioritize the development of adaptive competencies in their employees, tailoring training programs to foster initiative, resilience, and experiential learning. This holistic approach aligns with the balanced life perspective Park and Park (2020) advocated. Additionally, SMEs should facilitate translating knowledge about Corporate Social Responsibility (CSR) into actionable work values, especially when formulating business strategies. Given small business managers' diverse responsibilities and limited resources, investing in sustainability and CSR training can enhance their ability to implement these practices effectively and profitably (Halme & Korpela, 2014).

The third step is encouraging risk-taking and continuous learning. The third step highlights the importance of accepting risks, learning from mistakes, and cultivating the ability to adapt as market needs evolve (Denison & Mishra, 1995; Eisenhardt & Martin, 2000). Proactively equipping employees with knowledge about climate change adaptation while encouraging them to seek information independently is crucial. Employees and managers should shape an adaptability culture by continuously upgrading their knowledge and skills, fostering innovation, and generating climate-resilient solutions.

The fourth step is integrating adaptation into business functions. The final stage of climate change adaptation for SMEs involves embedding it across all business functions. This necessitates a culture shift towards flexibility, creativity, and adaptability, supported by updated standards and streamlined processes. By aligning strategic plans with sustainability goals, SMEs can ensure that climate change adaptation is a core component of their operations. A collaborative culture fosters information sharing and joint problem-solving, empowering employees to address climate risks proactively. This proactive approach requires clear goals and contingency planning for various climate scenarios, including reserve strategies, distribution plans, and disaster recovery measures. By preparing for climate-related disruptions, SMEs can minimize operational risks and ensure long-term sustainability.

Additionally, clear policies are crucial in supporting these efforts. Targeted government policies, including financial support, consulting services, and legal guidance, are essential to bolstering the climate resilience of Small and Medium-sized Enterprises (SMEs) in developing economies like Vietnam (Alkahtani et al., 2020). Such policies should incentivize continuous learning and innovation to ensure SMEs' long-term sustainability and adaptability in the face of climate change.

## 5. Conclusion

The rapid acceleration of climate change presents more threats to global development and economic expansion. In such a context, efforts to adapt to the impacts of climate change are urgent. This study contributes to the literature on climate change adaptation by investigating the influence of AC on climate change proactive adaptation of SMEs in Vietnam. The findings emphasize the significance of AC in fostering proactive responses to climate change among SMEs in Vietnam. Indeed, AC is imperative for businesses, especially SMEs, to promote their CCA capacity. This study also highlights that AWA mediates the relationship between AC and CCA. Such implications provide practical insights for SMEs to establish AC to boost proactive climate change adaptation capabilities.

This study possesses some limitations. Using purposive sampling while allowing for in-depth exploration may compromise generalizability. Future research could mitigate this by combining purposive sampling with random selection to capture broader perspectives. Moreover, the study's focus on Vietnam limits its applicability to other contexts. Future investigations should consider diverse samples and explore human resources, technology, and finance factors.

Additionally, research models could be enhanced by incorporating motivating factors and addressing potential objective barriers to adjustment. Furthermore, the study's exclusive focus on managerial perspectives overlooks other key stakeholders, such as customers. Future research should consider these alternative viewpoints to gain a more comprehensive understanding of CCA. Additionally, the study does not account for potential heterogeneous impacts across different groups. Future investigations could address this by incorporating additional survey questions and exploring the influence of factors like firm size, industry, firm type, geographic region, and managerial characteristics. Finally, the study's focus on SMEs could include other business types, such as startups, to gain a broader understanding of crisis adaptation strategies.

## SCIENTIFIC CONTRIBUTION

The manuscript clearly identifies a research gap; the manuscript provides new datasets or empirical evidence; the manuscript opens new directions for further research.

## AUTHOR CONTRIBUTIONS

CRedit: [**Pham Thi Chau Quyen**]: Methodology, Writing - Original Draft, Writing - Review & Editing, Software, Investigation, Supervision, Funding Acquisition; [**Truong Thanh Trung**]: Conceptualization, Writing - Original Draft, Writing - Review & Editing, Formal Analysis, Validation; [**Tran Thi Phuong Thuy**]: Conceptualization, Writing - Review & Editing, Supervision.

## ACKNOWLEDGMENTS

This article is a product of the Science and Technology Project at Foreign Trade University, with project code NTCS2022.22.

## FUNDING

This research was funded by Foreign Trade University under Grant No.NTCS2022-22.

## NO CONFLICT OF INTEREST STATEMENT

All authors declare that they have no conflict of interest.

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