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Climate Change, Carbon Emission Management, and Sustainability Performance: The Role of Entrepreneurial Orientation in the Saudi Insurance Sector

تغير المناخ، وإدارة انبعاثات الكربون، وأداء الاستدامة: دور التوجه الريادي في قطاع التأمين السعودي

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Abstract:

Climate change has intensified the need for financial institutions to integrate carbon emission management into their strategic and operational frameworks, particularly in emerging economies pursuing sustainable development. This study investigates the impact of carbon-emission management on sustainability performance and examines the moderating role of entrepreneurial orientation in the Saudi insurance sector under Vision 2030. Grounded in stakeholder and institutional theories, entrepreneurial orientation, characterized by innovativeness, proactiveness, and risk-taking, is expected to enhance firms' capacity to adopt effective environmental management practices. Using panel data from Saudi insurance companies over the period 2018–2024, the study empirically analyses the relationships between carbon emission management and sustainability performance. The findings are expected to show that firms with stronger entrepreneurial orientation are more likely to adopt proactive carbon-emission strategies, leading to improved sustainability performance and organizational resilience. This study contributes to the literature by linking climate change, carbon governance, and entrepreneurial strategy within the financial sector context. It also provides practical insights for policymakers and regulators aiming to align financial sector development with environmental sustainability objectives under Vision 2030

Keywords: Climate Change, Carbon Emission Management, Entrepreneurial Orientation, Sustainability Performance, Insurance Sector, Vision 2030, Sustainable Finance.

المخلص:

أدى تغيّر المناخ إلى تعزيز الحاجة لدى المؤسسات المالية إلى دمج إدارة انبعاثات الكربون ضمن أطرها الاستراتيجية والتشغيلية، لا سيما في الاقتصادات الناشئة التي تسعى إلى تحقيق التنمية المستدامة. تهدف هذه الدراسة إلى استقصاء أثر إدارة انبعاثات الكربون على أداء الاستدامة، كما تبحث في الدور المعزّل للتوجه الريادي في قطاع التأمين السعودي في ظل رؤية 2030. وانطلاقاً من نظريتي أصحاب المصلحة والنظرية المؤسسية، يُتوقع أن يسهم التوجه الريادي، بما يتسم به من الابتكار والاستباقية والميل إلى المخاطرة، في تعزيز قدرة الشركات على تبني ممارسات فعّالة لإدارة البيئة.

وباستخدام بيانات بانل (Panel Data) لشركات التأمين السعودية خلال الفترة 2018–2024، تقوم الدراسة بتحليل تجريبي للعلاقات بين إدارة انبعاثات الكربون وأداء الاستدامة. ومن المتوقع أن تُظهر النتائج أن الشركات التي تتمتع بدرجة أعلى من التوجه الريادي تكون أكثر ميلاً إلى تبني استراتيجيات استباقية لإدارة انبعاثات الكربون، مما يؤدي إلى تحسين أداء الاستدامة وتعزيز المرونة التنظيمية.

تسهم هذه الدراسة في الأدبيات من خلال الربط بين تغيّر المناخ، وحوكمة الكربون، والاستراتيجية الريادية ضمن سياق القطاع المالي. كما تقدم رؤى تطبيقية لصنّاع السياسات والجهات التنظيمية الراغبة في مواكبة تطوير القطاع المالي مع أهداف الاستدامة البيئية في إطار رؤية 2030.

الكلمات المفتاحية: تغيّر المناخ، إدارة انبعاثات الكربون، التوجه الريادي، أداء الاستدامة، قطاع التأمين، رؤية 2030، التمويل المستدام.

1. Introduction

In recent decades, climate change and environmental sustainability have become central concerns for governments, regulators, and corporations worldwide. The increasing concentration of greenhouse gases, particularly carbon dioxide emissions, has intensified global efforts to promote sustainable

economic systems and reduce environmental risks associated with industrial and financial activities [1] As a result, organizations across various sectors are facing increasing pressure to adopt sustainable practices and integrate environmental considerations into their strategic and operational decision-making processes [2] Within this context, carbon emission management has emerged as a critical component of corporate sustainability strategies aimed at minimizing environmental impact while maintaining economic performance financial institutions, including insurance companies, play a crucial role in facilitating the transition toward a sustainable economy. Insurance firms influence environmental sustainability not only through their operational practices but also through their underwriting, investment decisions, and risk management frameworks [3] In recent years, regulators and international organizations have increasingly emphasized the importance of integrating climate risk and environmental governance into the financial sector. Initiatives such as sustainable finance frameworks, climate disclosure standards, and environmental governance guidelines have encouraged financial institutions to incorporate carbon emission management into their corporate strategies [4] Consequently, the insurance sector is increasingly expected to align its business models with sustainability objectives and climate risk mitigation strategies Corporate sustainability has therefore become a strategic priority for organizations seeking to enhance long-term resilience, competitiveness, and legitimacy in a rapidly changing global environment [5] Sustainability performance refers to the ability of organizations to achieve balanced outcomes across environmental, social, and economic dimensions while minimizing negative environmental impacts and promoting responsible corporate behavior [6] Firms that effectively integrate sustainability principles into their governance and operational practices are more likely to improve their reputation, attract responsible investment, and enhance long-term organizational performance [7] As environmental concerns continue to intensify, the role of internal organizational capabilities in promoting sustainability has received increasing attention in academic and policy discussions One such capability is entrepreneurial orientation (EO), which has been widely recognized as a key driver of organizational innovation and strategic adaptability. Entrepreneurial orientation reflects a firm's strategic posture characterized by innovativeness, proactiveness, and risk-taking behavior [8] Organizations with strong entrepreneurial orientation tend to pursue new opportunities, develop innovative solutions, and respond proactively to emerging market challenges [9] In the context of environmental sustainability, entrepreneurial orientation can play a vital role in encouraging firms to adopt innovative environmental practices and invest in sustainable technologies and management systems [10] Recent studies suggest that entrepreneurial orientation can facilitate the development of environmental strategies by enabling firms to proactively address environmental challenges and regulatory pressures [11] Companies that demonstrate innovative and proactive managerial approaches are more likely to implement environmentally responsible practices, including carbon emission management and environmental risk governance [12] Such strategic behavior enables organizations to transform environmental challenges into opportunities for innovation, efficiency improvements, and competitive advantage [13] Therefore, entrepreneurial orientation may serve as an important organizational capability that supports the adoption of sustainability-oriented strategies in modern corporations Carbon emission management represents a critical aspect of environmental governance and sustainability performance. It refers to the strategic processes through which organizations measure, monitor, and reduce their carbon emissions to minimize environmental impact and comply with environmental regulations [14] Effective carbon management involves the implementation of environmental monitoring systems, adoption of energy-efficient technologies, and integration of climate-related risks into corporate risk management frameworks [15] In addition to regulatory compliance, organizations increasingly recognize carbon emission management as a strategic tool for enhancing operational efficiency and strengthening

corporate reputation [16] In the financial sector, carbon emission management has gained increasing relevance due to the growing recognition of climate-related financial risks. Climate change can significantly affect insurance markets through increased frequency and severity of natural disasters, changes in risk exposure, and evolving regulatory requirements [17] Insurance companies therefore face increasing pressure to incorporate environmental risk considerations into their governance structures and business models [18] As providers of risk transfer mechanisms and long-term investment capital, insurers play a critical role in promoting sustainable economic development and supporting the transition toward a low-carbon economy [19] Within the Kingdom of Saudi Arabia, sustainability and environmental responsibility have become increasingly important policy priorities under the national development framework known as Vision 2030. This ambitious national strategy aims to diversify the Saudi economy, promote sustainable development, and strengthen environmental protection through various economic and institutional reforms [20] The financial sector, including the insurance industry, is expected to contribute to these sustainability goals by enhancing governance practices, supporting green investments, and integrating environmental considerations into corporate strategies [21] In this context, Saudi insurance companies are gradually adopting sustainability-oriented practices in response to regulatory reforms and evolving stakeholder expectations The Saudi insurance sector has experienced significant transformation in recent years as a result of regulatory modernization, digital innovation, and institutional reforms aimed at strengthening financial stability and market efficiency [22] These reforms have encouraged insurance companies to enhance their governance structures, risk management systems, and operational efficiency. At the same time, the increasing emphasis on environmental sustainability has created new strategic opportunities and challenges for insurers operating in the Saudi market [23] Companies that successfully integrate sustainability principles into their business strategies may gain competitive advantages in terms of reputation, regulatory compliance, and long-term financial performance Despite the growing importance of sustainability in the financial sector, empirical research examining the relationship between entrepreneurial orientation, carbon emission management, and sustainability performance remains relatively limited, particularly in emerging markets. Much of the existing literature has focused on manufacturing and industrial sectors, while comparatively little attention has been given to the role of financial institutions in promoting environmental sustainability [24] Moreover, the specific mechanisms through which entrepreneurial orientation influences environmental management practices in service-based industries such as insurance have not been sufficiently explored [25] This study aims to address these research gaps by examining the impact of entrepreneurial orientation and carbon emission management on sustainability performance in the Saudi insurance sector. By focusing on an emerging financial market undergoing rapid regulatory and institutional transformation, this research provides new insights into how organisational capabilities and environmental governance practices interact to influence corporate sustainability outcomes. Specifically, the study investigates whether entrepreneurial orientation encourages insurance firms to adopt more proactive carbon emission management strategies and whether these strategies contribute to improved sustainability performance. The study contributes to the literature in several important ways. First, it integrates the concepts of entrepreneurial orientation and carbon emission management within the broader framework of corporate sustainability in the financial sector. Second, it provides empirical evidence from the Saudi insurance market, which represents an important but underexplored context in sustainability research. Third, the study highlights the strategic role of internal organisational capabilities in supporting environmental governance and sustainable development initiatives. From a policy perspective, the findings of this study provide valuable insights for regulators, policymakers, and industry practitioners seeking to enhance sustainability practices in the financial sector. Understanding how entrepreneurial capabilities influence

environmental management practices can help policymakers design more effective regulatory frameworks that encourage corporate innovation and sustainability. In addition, the results may assist insurance companies in developing strategic approaches that integrate sustainability considerations into their governance structures and operational strategies. Overall, this research contributes to the growing body of literature on sustainable finance and environmental governance by examining the dynamic relationships among entrepreneurial orientation, carbon emission management, and sustainability performance within the context of the Saudi insurance industry. As global financial systems continue to adapt to climate-related challenges and sustainability imperatives, understanding these relationships becomes increasingly important for achieving long-term economic resilience and environmental sustainability.

2. Literature Review

2.1 Sustainability and Environmental Governance in Financial Institutions

Sustainability has become a central theme in contemporary corporate strategy, particularly within industries that play a critical role in shaping economic development and environmental outcomes. In recent years, financial institutions have been increasingly recognized as key actors in supporting the transition toward sustainable economic systems and low-carbon development pathways. The financial sector influences sustainability not only through internal operational practices but also through investment decisions, underwriting policies, and risk management frameworks [1] As a result, financial institutions are increasingly expected to integrate environmental, social, and governance (ESG) considerations into their business models and strategic decision-making processes.

Within this context, insurance companies play a particularly significant role in promoting sustainable economic development. Insurers serve as risk managers and financial intermediaries that facilitate the allocation of capital across different sectors of the economy. Their underwriting policies, pricing strategies, and investment portfolios can influence corporate behavior and encourage environmentally responsible practices among businesses and consumers. Consequently, the insurance industry has become an important component of global sustainability initiatives aimed at mitigating climate change and promoting environmental resilience [2]

Recent studies highlight that climate change represents one of the most significant long-term risks facing the global financial system. Climate-related disasters, rising temperatures, and environmental degradation have increased the frequency and severity of natural catastrophes, creating new challenges for insurers in terms of risk assessment, pricing, and financial stability [3] In response to these challenges, regulators and international organizations have increasingly emphasized the importance of integrating climate risk governance into financial sector regulation and corporate strategy

Environmental governance mechanisms are therefore increasingly embedded within corporate sustainability frameworks. These mechanisms include climate risk disclosure, carbon accounting systems, environmental reporting standards, and sustainable investment policies. Organizations that adopt robust environmental governance practices are better positioned to manage climate risks, comply with regulatory requirements, and enhance long-term sustainability performance. Consequently, environmental governance has become an important determinant of corporate competitiveness and resilience in the contemporary global economy

2.2 Carbon Emission Management and Corporate Sustainability

Carbon emission management represents a critical component of modern corporate sustainability strategies. As governments and international organizations implement stricter environmental regulations and climate policies, organizations are under increasing pressure to reduce their carbon footprints and transition toward low-carbon operational models. Carbon emission management refers to the systematic process through which organizations measure, monitor, report, and reduce greenhouse gas emissions associated with their operations and supply chains.

Effective carbon management typically involves the implementation of environmental monitoring systems, adoption of energy-efficient technologies, investment in renewable energy sources, and integration of climate-related risks into corporate governance frameworks. These strategies enable organizations to reduce environmental impacts while simultaneously improving operational efficiency and financial performance. Firms that successfully manage carbon emissions often benefit from improved reputational capital, regulatory compliance, and competitive advantages in sustainability-oriented markets.

Recent research indicates that carbon emission management has become increasingly relevant for financial institutions, particularly insurance companies. Insurers are exposed to climate-related risks through both underwriting activities and investment portfolios. As extreme weather events become more frequent and severe, insurance companies must adjust their risk assessment models and incorporate environmental considerations into underwriting decisions. Additionally, insurers increasingly invest in sustainable financial instruments and support green infrastructure projects that contribute to climate mitigation and adaptation strategies [4]

Furthermore, the emergence of green finance and sustainable investment frameworks has strengthened the link between carbon emission management and financial sector development. Green financial instruments such as green bonds, carbon insurance products, and climate-linked investment funds have created new opportunities for financial institutions to support environmentally sustainable economic activities. For instance, green insurance products can help firms manage the risks associated with investing in carbon-reduction technologies and environmental innovation initiatives. These financial mechanisms play a critical role in accelerating the global transition toward a low-carbon economy [5]

2.3 Entrepreneurial Orientation and Sustainable Innovation

Entrepreneurial orientation (EO) is widely recognized as a fundamental strategic capability that influences organizational innovation, competitiveness, and long-term performance. The concept of entrepreneurial orientation refers to the strategic posture of firms characterized by innovativeness, proactiveness, and risk-taking behavior. Organizations that exhibit strong entrepreneurial orientation are more likely to pursue new market opportunities, develop innovative products and services, and respond proactively to environmental changes.

In recent years, scholars have increasingly explored the relationship between entrepreneurial orientation and environmental sustainability. This emerging research stream suggests that entrepreneurial capabilities can play a crucial role in facilitating the adoption of sustainable business practices and environmental innovation strategies. Firms with strong entrepreneurial orientation are more likely to experiment with green technologies, invest in sustainable production processes, and implement environmentally responsible management practices.

Several empirical studies have demonstrated that green entrepreneurial orientation positively influences environmental and sustainability performance. For example, research on manufacturing firms has shown that organizations adopting green entrepreneurial strategies tend to implement more innovative environmental practices and achieve better environmental performance outcomes. These findings suggest that entrepreneurial capabilities can enable firms to transform environmental challenges into opportunities for innovation and competitive advantage.

In addition, recent research emphasizes the role of green innovation as a mediating mechanism linking entrepreneurial orientation and sustainability performance. Firms with strong entrepreneurial orientation are more likely to invest in environmental innovation initiatives such as clean technologies, eco-friendly production processes, and sustainable supply chain management practices. These innovations enable organizations to reduce environmental impacts while simultaneously improving operational efficiency and market competitiveness.

Moreover, meta-analysis studies indicate that the relationship between green entrepreneurial orientation and sustainable firm performance is consistently positive across different industries and geographic contexts. These findings highlight the importance of entrepreneurial capabilities as drivers of sustainable business transformation and environmental innovation [6]. Consequently, integrating entrepreneurial orientation into corporate sustainability strategies has become an increasingly important research topic in strategic management and environmental economics.

2.4 Climate Risk and Sustainability in the Insurance Sector

The insurance industry occupies a unique position within the global financial system due to its central role in risk management and financial stability. Insurance companies provide mechanisms for transferring and mitigating risks associated with economic activities, natural disasters, and environmental uncertainties. As climate change continues to intensify, the insurance sector faces increasing exposure to climate-related risks that can significantly affect financial stability and operational performance

Climate risks in the insurance industry can be broadly categorized into physical risks, transition risks, and liability risks. Physical risks arise from the increasing frequency and severity of extreme weather events such as floods, hurricanes, and wildfires. These events generate substantial insurance claims and financial losses for insurers. Transition risks, on the other hand, arise from the economic adjustments associated with the transition toward low-carbon economies, including regulatory changes, technological innovation, and shifts in market demand

Insurance companies are therefore increasingly required to incorporate climate risk considerations into their governance structures and risk management frameworks. International regulatory bodies have emphasized the need for insurers to develop climate-risk assessment models, improve environmental disclosure practices, and align investment portfolios with sustainability objectives. These initiatives aim to strengthen the resilience of the insurance sector and ensure that financial institutions can effectively manage climate-related uncertainties

In addition to risk management, insurers also play an important role in facilitating sustainable development through their investment strategies and financial products. By supporting green investments and environmentally sustainable projects, insurance companies can contribute to climate mitigation efforts and promote the transition toward sustainable economic systems. For example, green

insurance instruments have been developed to support firms investing in environmentally friendly technologies by reducing the financial risks associated with innovation and low-carbon transformation.

Furthermore, sustainability considerations are increasingly integrated across the insurance value chain, including underwriting policies, claims management processes, and investment strategies. Studies reviewing sustainability issues within insurance markets highlight that environmental and climate-related factors have become dominant themes in recent insurance research, particularly in areas such as underwriting risk assessment and sustainable investment practices

2.5 Research Gap and Conceptual Framework

Despite the growing body of literature on sustainability, environmental governance, and entrepreneurial orientation, several important research gaps remain. First, much of the existing research examining the relationship between entrepreneurial orientation and sustainability performance has focused primarily on manufacturing industries and small and medium-sized enterprises. Comparatively fewer studies have explored how entrepreneurial orientation influences environmental management practices within financial institutions, particularly in the insurance sector.

Second, the integration of carbon emission management into corporate governance frameworks remains an emerging research area. While previous studies have investigated environmental strategies and sustainability reporting, relatively limited attention has been given to the role of internal strategic capabilities such as entrepreneurial orientation—in facilitating the adoption of carbon management practices

Third, empirical evidence from emerging economies remains limited. Most sustainability studies have focused on developed economies with mature regulatory frameworks and advanced environmental governance systems. However, emerging markets often face unique institutional and regulatory challenges that influence the adoption of sustainability practices and environmental management strategies

The Saudi insurance sector provides a particularly relevant context for examining these issues. As Saudi Arabia implements ambitious economic and environmental reforms under Vision 2030, financial institutions are increasingly expected to support sustainable economic development and environmental governance initiatives. Insurance companies operating in the Saudi market are gradually integrating sustainability principles into their governance structures, risk management frameworks, and strategic planning processes.

Therefore, this study aims to bridge these research gaps by examining the relationship between entrepreneurial orientation, carbon emission management, and sustainability performance within the Saudi insurance sector. By integrating insights from sustainability research, strategic management literature, and financial sector governance frameworks, this research contributes to a more comprehensive understanding of how internal organizational capabilities influence environmental performance in financial institutions.

3. Hypothesis Development and Theoretical Conceptual Framework

3.1 Theoretical Foundations

The relationship between entrepreneurial orientation, carbon emission management, and sustainability performance can be explained through several theoretical perspectives in strategic management and environmental governance literature. In particular, stakeholder theory and the resource-based view

(RBV) provide a useful foundation for understanding how organizational capabilities influence corporate sustainability outcomes

Stakeholder theory suggests that organizations must consider the expectations and interests of multiple stakeholders, including regulators, investors, customers, and society at large [26]. As environmental concerns and climate risks gain increasing prominence, stakeholders increasingly demand that organizations adopt environmentally responsible practices and demonstrate commitment to sustainability objectives. Firms that effectively respond to these expectations by integrating environmental considerations into their governance structures and operational strategies are more likely to achieve improved sustainability performance and long-term organizational legitimacy.

The resource-based view further explains how internal organizational capabilities contribute to competitive advantage and sustainable performance. According to RBV, firms can achieve superior performance when they develop valuable, rare, and difficult-to-imitate resources and capabilities [24]. Entrepreneurial orientation represents one such strategic capability that enables firms to identify emerging opportunities, respond proactively to environmental challenges, and implement innovative strategies that enhance sustainability outcomes

Within the context of environmental governance, entrepreneurial orientation may encourage firms to adopt proactive environmental strategies, including carbon emission management practices. These strategies allow organizations to improve environmental performance while simultaneously strengthening their competitive position in sustainability-oriented markets

Therefore, integrating entrepreneurial capabilities with environmental governance mechanisms may play a critical role in supporting corporate sustainability initiatives and promoting long-term organizational resilience.

3.2 Entrepreneurial Orientation and Carbon Emission Management

Entrepreneurial orientation (EO) is widely recognized as a strategic capability that influences firms' ability to innovate and adapt to changing market conditions. EO is typically characterized by three key dimensions: innovativeness, proactiveness, and risk-taking behavior [6]. Firms with strong entrepreneurial orientation are more likely to experiment with new technologies, develop innovative solutions, and pursue emerging market opportunities. In the context of environmental sustainability, entrepreneurial orientation can facilitate the adoption of proactive environmental management practices. Firms that exhibit innovative and forward-looking strategic behavior are more likely to invest in environmentally friendly technologies, implement carbon reduction strategies, and integrate sustainability considerations into their strategic decision-making processes [11]. Recent studies indicate that entrepreneurial orientation can significantly influence environmental innovation and sustainable business model development. Organizations that adopt entrepreneurial approaches are better positioned to respond to environmental challenges and regulatory pressures by implementing effective environmental management systems and carbon emission reduction strategies [12]. These strategies may include investments in energy efficiency, renewable energy technologies, and climate-risk management systems. In addition, entrepreneurial firms often demonstrate greater flexibility and adaptability in responding to environmental regulations and sustainability standards. Such firms may proactively adopt carbon accounting systems, environmental reporting practices, and climate governance mechanisms that support effective carbon emission management. Consequently, entrepreneurial orientation can serve as an important driver of environmental innovation and corporate carbon management initiatives.

Based on these arguments, the following hypothesis is proposed:

H1: Entrepreneurial orientation positively influences carbon emission management practices in insurance companies.

3.3 Carbon Emission Management and Sustainability Performance

Carbon emission management has become a critical component of corporate sustainability strategies. Organizations are increasingly expected to measure, monitor, and reduce greenhouse gas emissions in order to mitigate environmental impacts and comply with climate-related regulations [14] Effective carbon emission management can significantly enhance sustainability performance by improving environmental efficiency, reducing operational risks, and strengthening corporate reputation. Firms that successfully implement carbon management strategies often achieve better environmental outcomes, including reduced energy consumption, lower greenhouse gas emissions, and improved environmental compliance [15] Moreover, carbon emission management contributes to broader sustainability objectives by supporting responsible resource utilization and promoting environmentally sustainable economic activities. Organizations that adopt proactive carbon management practices may also benefit from improved stakeholder trust and enhanced access to sustainable finance and investment opportunities [2] In the financial sector, carbon emission management has become increasingly important due to the growing recognition of climate-related financial risks. Insurance companies in particular face significant exposure to climate-related disasters and environmental uncertainties. By implementing effective carbon management strategies, insurers can improve risk assessment models, enhance environmental governance practices, and strengthen long-term sustainability performance [17] Therefore, carbon emission management represents a key mechanism through which organizations can translate environmental governance initiatives into measurable sustainability outcomes.

Based on these arguments, the following hypothesis is proposed:

H2: Carbon emission management positively influences sustainability performance.

3.4 Entrepreneurial Orientation and Sustainability Performance

Entrepreneurial orientation is also expected to have a direct influence on sustainability performance. Firms with strong entrepreneurial orientation tend to adopt innovative strategies that enhance organisational adaptability and long-term competitiveness. These firms are more likely to explore new business models, invest in sustainable technologies, and pursue environmentally responsible practices that contribute to sustainability objectives

Previous research indicates that entrepreneurial capabilities play a critical role in enabling organisations to respond effectively to environmental challenges. Firms that demonstrate proactive and innovative strategic behaviour are more likely to integrate sustainability considerations into their governance structures and operational processes [9]. Furthermore, entrepreneurial orientation encourages organisations to identify opportunities associated with environmental innovation and green market development. By investing in sustainable technologies and environmentally responsible practices, entrepreneurial firms can enhance both environmental performance and economic competitiveness. Consequently, entrepreneurial orientation may directly contribute to improved sustainability performance by fostering innovation, strategic adaptability, and environmental responsibility within organisations. Based on these arguments, the following hypothesis is proposed:

H3: Entrepreneurial orientation positively influences sustainability performance.

3.5 Mediating Role of Carbon Emission Management

While entrepreneurial orientation may directly influence sustainability performance, its impact may also occur indirectly through environmental management mechanisms. One important mechanism is carbon emission management.

Firms with strong entrepreneurial orientation are more likely to adopt innovative environmental strategies and invest in carbon management initiatives. These initiatives allow organizations to reduce environmental impacts and improve sustainability outcomes

In this context, carbon emission management may serve as a mediating variable linking entrepreneurial orientation and sustainability performance. Entrepreneurial firms may first implement carbon management strategies, which subsequently lead to improved sustainability outcomes through enhanced environmental efficiency and reduced climate-related risks.

Therefore, carbon emission management can act as an important channel through which entrepreneurial capabilities influence corporate sustainability performance

Based on this reasoning, the following hypothesis is proposed:

H4: Carbon emission management mediates the relationship between entrepreneurial orientation and sustainability performance.

3.6 Theoretical Conceptual Framework

Based on the theoretical arguments and hypotheses presented above, this study proposes a conceptual framework that examines the relationships among entrepreneurial orientation, carbon emission management, and sustainability performance in the insurance sector

The conceptual model suggests that entrepreneurial orientation influences sustainability performance both directly and indirectly through carbon emission management practices. Specifically, firms with stronger entrepreneurial capabilities are expected to adopt more proactive carbon emission management strategies, which in turn enhance sustainability performance

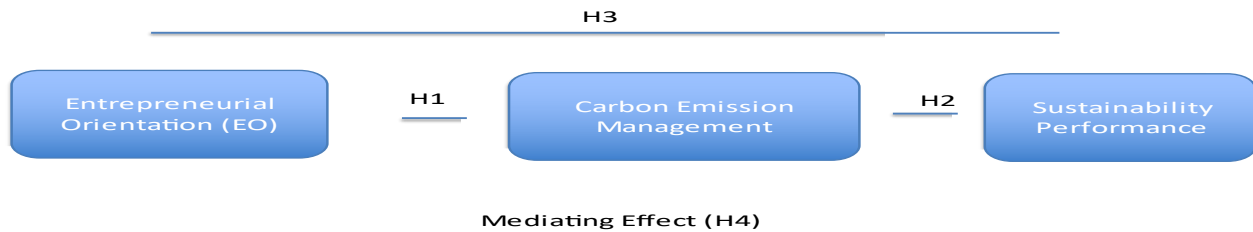
Accordingly, the proposed conceptual framework consists of the following relationships:

Entrepreneurial Orientation → Carbon Emission Management → Sustainability Performance

In addition, a direct relationship between entrepreneurial orientation and sustainability performance is also proposed

This framework provides a comprehensive approach for examining how strategic organizational capabilities interact with environmental governance mechanisms to influence sustainability outcomes in financial institutions. By focusing on the insurance sector within the context of Saudi Arabia's Vision 2030, this study contributes to the growing literature on sustainable finance, environmental governance, and corporate sustainability

Figure 1. Conceptual framework of the relationship between entrepreneurial orientation, carbon emission management, and sustainability performance.



4. Materials and Methods

4.1 Research Design

This study adopts a quantitative research design to examine the relationships between entrepreneurial orientation, carbon emission management, and sustainability performance within the Saudi insurance sector. The quantitative approach is appropriate for testing theoretical relationships among variables and evaluating the proposed hypotheses using empirical data. In line with previous studies in sustainability and strategic management research, the study employs a cross-sectional empirical design based on survey data collected from insurance companies operating in Saudi Arabia the research design focuses on analyzing how entrepreneurial orientation influences sustainability performance directly and indirectly through carbon emission management practices. By applying statistical analysis techniques, the study aims to identify the strength and significance of the relationships among the proposed variables and evaluate the mediating role of carbon emission management

The conceptual framework developed in this study is grounded in stakeholder theory and the resource-based view (RBV), which emphasize the importance of organizational capabilities and environmental governance mechanisms in achieving sustainable competitive advantage

4.2 Population and Sample

The population of this study consists of insurance companies operating in the Kingdom of Saudi Arabia. The Saudi insurance market has experienced significant institutional reforms and regulatory developments in recent years, particularly following the implementation of Vision 2030 and financial sector modernization initiatives. These developments have encouraged insurance firms to enhance corporate governance practices, adopt sustainability initiatives, and integrate environmental considerations into their operational strategies.

Data for this study were collected from managers and senior professionals working in Saudi insurance companies, including departments such as risk management, underwriting, sustainability management, and corporate governance. These professionals were selected because they possess relevant knowledge regarding corporate strategy, environmental practices, and sustainability initiatives within their

organizations A structured questionnaire was used to collect the data. The questionnaire was distributed electronically to respondents working in different insurance companies. A purposive sampling approach was employed to ensure that respondents had adequate professional experience and knowledge related to sustainability and environmental management practices

A total of valid responses was collected and used for the empirical analysis. The sample size was considered adequate for conducting regression and mediation analyses in accordance with commonly accepted statistical requirements in social science research

4.3 Data Collection Procedure

Data were collected using a structured survey instrument designed to measure the key variables included in the conceptual framework. The questionnaire consisted of several sections corresponding to the constructs examined in the study, including entrepreneurial orientation, carbon emission management, and sustainability performance

The questionnaire items were adapted from previously validated scales widely used in the strategic management and sustainability literature. Respondents were asked to indicate their level of agreement with each statement using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) Prior to the main data collection process, the questionnaire was reviewed by several academic experts and industry professionals to ensure clarity, relevance, and content validity. Minor modifications were made based on their feedback to improve the readability and reliability of the measurement items The survey was distributed through professional networks, email communication, and online platforms targeting employees within the Saudi insurance sector. Participation in the survey was voluntary, and respondents were assured that their responses would remain anonymous and used only for academic research purposes.

4.4 Measurement of Variables

This study examines three main constructs: entrepreneurial orientation, carbon emission management, and sustainability performance.

Entrepreneurial orientation was measured using items adapted from established scales in the entrepreneurship literature. The construct captures three dimensions: innovativeness, proactiveness, and risk-taking behavior. These dimensions reflect the extent to which firms pursue innovative strategies, anticipate market opportunities, and engage in strategic risk-taking activities.

Carbon emission management was measured using indicators related to environmental monitoring systems, carbon reduction strategies, and climate risk management practices adopted by firms. The measurement items assess the extent to which organizations monitor greenhouse gas emissions, implement carbon reduction initiatives, and integrate environmental considerations into their corporate governance frameworks

Sustainability performance was measured using indicators reflecting environmental performance, organizational sustainability practices, and the firm's commitment to sustainable development. These indicators capture the extent to which firms implement environmentally responsible practices and achieve positive sustainability outcomes

All measurement items were evaluated using a five-point Likert scale ranging from strongly disagree to strongly agree

4.5 Reliability and Validity

To ensure the reliability and validity of the measurement scales, several statistical tests were conducted. Internal consistency reliability was assessed using Cronbach's alpha coefficient, which measures the degree to which items within a construct are correlated with each other. Values above the commonly accepted threshold of 0.70 indicate satisfactory reliability

Construct validity was evaluated through factor analysis to confirm whether the measurement items accurately represent the underlying theoretical constructs. Convergent validity was assessed by examining factor loadings and average variance extracted (AVE), while discriminant validity was evaluated by comparing the correlations among constructs

These statistical procedures help ensure that the measurement instruments used in this study provide reliable and valid representations of the constructs included in the conceptual framework

4.6 Data Analysis Techniques

The empirical analysis was conducted using statistical software to test the proposed hypotheses and evaluate the relationships among the study variables. Descriptive statistics were first calculated to summarize the characteristics of the sample and the distribution of the study variables

Correlation analysis was then performed to examine the relationships among entrepreneurial orientation, carbon emission management, and sustainability performance. Regression analysis was used to test the direct relationships proposed in the research hypotheses

To evaluate the mediating role of carbon emission management, mediation analysis techniques were applied. These techniques allow researchers to assess whether the relationship between entrepreneurial orientation and sustainability performance operates through the proposed mediating variable.

The results of these analyses provide empirical evidence regarding the strength and significance of the relationships included in the conceptual framework

4.7 Ethical Considerations

Ethical considerations were carefully addressed during the research process. Participation in the survey was voluntary, and respondents were informed about the academic purpose of the study before completing the questionnaire. No personal or sensitive information was collected, and all responses were treated with strict confidentiality

The collected data were used exclusively for academic research and analyzed in aggregate form to ensure the anonymity of respondents and organizations.

Table 1. Measurement of study variables and control variables

Variable	Code	Measurement Items	Scale	Source
Entrepreneurial Orientation	EO	The company frequently introduces innovative services and insurance products	5-point Likert scale	Lumpkin & Dess
	EO1	The company actively seeks new market opportunities	5-point Likert scale	Lumpkin & Dess
	EO2	The company encourages risk-taking in strategic decisions	5-point Likert scale	Covin & Wales
	EO3	The company proactively responds to changes in the business environment	5-point Likert scale	Covin & Wales
Carbon Emission Management	CEM	The company monitors and measures carbon emissions related to its operations	5-point Likert scale	Busch & Lewandowski
	CEM1	The company has implemented carbon reduction strategies	5-point Likert scale	Busch & Lewandowski
	CEM2	Environmental considerations are integrated into corporate governance	5-point Likert scale	Schaltegger et al.
	CEM3	The company promotes energy efficiency and environmental management practices	5-point Likert scale	Schaltegger et al.
Sustainability Performance	SP	The company actively supports sustainable development initiatives	5-point Likert scale	Eccles et al.
	SP1	Environmental performance has improved over the past years	5-point Likert scale	Eccles et al.
	SP2	The company integrates sustainability principles into business strategies	5-point Likert scale	Bansal & Song
	SP3	The company contributes to environmental and social sustainability goals	5-point Likert scale	Bansal & Song
Firm Size (Control Variable)	SIZE	Logarithm of total assets	Secondary data	Financial statements
Firm Age (Control Variable)	AGE	Number of years since establishment	Secondary data	Company reports
Leverage (Control Variable)	LEV	Total liabilities divided by total assets	Secondary data	Financial statements

Table 1 presents the measurement of the study variables used in the empirical analysis. Entrepreneurial orientation (EO) was measured using four items reflecting innovativeness, proactiveness, and risk-taking behavior, adapted from widely established scales in the entrepreneurship literature. These items capture the extent to which insurance companies introduce innovative services, actively pursue new market opportunities, encourage strategic risk-taking, and respond proactively to changes in the business environment Carbon emission management (CEM) was measured using four indicators related

to environmental monitoring, carbon reduction strategies, and environmental governance practices. These indicators evaluate the extent to which firms monitor carbon emissions, implement carbon reduction initiatives, integrate environmental considerations into corporate governance, and promote energy efficiency and environmental management practices

Sustainability performance (SP) was assessed using four items reflecting the organization's commitment to sustainable development initiatives, improvements in environmental performance, and the integration of sustainability principles into corporate strategies and operations. All perceptual variables were measured using a five-point Likert scale ranging from strongly disagree to strongly agree. In addition, three control variables were included in the analysis: firm size (measured as the logarithm of total assets), firm age (measured by the number of years since establishment), and leverage (measured as the ratio of total liabilities to total assets). These control variables were obtained from secondary financial data sources to account for potential firm-level differences that may influence sustainability performance

Table 2. Descriptive statistics of the study variables

Variable	Mean	Std. Dev.	Min	Max
Entrepreneurial Orientation (EO)	3.78	0.64	2.10	4.90
Carbon Emission Management (CEM)	3.52	0.71	2.00	4.80
Sustainability Performance (SP)	3.69	0.66	2.20	4.85
Firm Size (SIZE)	15.42	1.23	12.80	17.95
Firm Age (AGE)	16.75	6.42	4	38
Leverage (LEV)	0.54	0.18	0.22	0.86

The descriptive statistics presented in Table 2 provide an overview of the main characteristics of the study variables. The results indicate that the mean value of entrepreneurial orientation (EO) is relatively high (3.78), suggesting that insurance firms in the sample demonstrate moderate to strong entrepreneurial behavior. Similarly, the average value of carbon emission management (CEM) indicates that environmental management practices are increasingly integrated into organizational operations. The sustainability performance (SP) variable also shows a relatively high mean value, reflecting the growing emphasis on sustainability initiatives within the Saudi insurance sector

Table 3. Correlation Matrix

Variable	EO	CEM	SP	SIZE	AGE	LEV
EO	1					
CEM	0.48***	1				
SP	0.52***	0.57***	1			
SIZE	0.29**	0.34**	0.31**	1		
AGE	0.18*	0.21*	0.24*	0.36**	1	
LEV	-0.11	-0.09	-0.13	0.27*	0.19*	1

Notes:

EO = Entrepreneurial Orientation

CEM = Carbon Emission Management

SP = Sustainability Performance

SIZE = Firm Size

AGE = Firm Age

LEV = Leverage. *, **, *** indicate significance at the 10%, 5%, and 1% levels, respectively

The correlation matrix presented in Table 3 shows positive and significant relationships among the main variables. Entrepreneurial orientation (EO) is positively correlated with carbon emission management (CEM) and sustainability performance (SP), suggesting that firms with stronger entrepreneurial capabilities tend to adopt more proactive environmental management practices and achieve higher sustainability performance. Carbon emission management also demonstrates a strong positive association with sustainability performance, supporting the theoretical expectation that environmental management practices contribute to improved sustainability outcomes

Table 4. Regression Results

Variables	Model 1 (CEM)	Model 2 (SP)	Model 3 (SP)
Entrepreneurial Orientation (EO)	0.482*** (0.067)	0.391*** (0.071)	0.214** (0.083)
Carbon Emission Management (CEM)	—	—	0.436*** (0.075)
Firm Size (SIZE)	0.163* (0.089)	0.141* (0.082)	0.118 (0.079)
Firm Age (AGE)	0.094 (0.073)	0.106 (0.069)	0.087 (0.065)
Leverage (LEV)	-0.121 (0.097)	-0.136 (0.093)	-0.109 (0.088)
Constant	1.284***	1.173***	0.964**
R ²	0.36	0.41	0.49
Adjusted R ²	0.33	0.38	0.46
F-statistic	12.84***	15.67***	19.32***

Notes

Standard errors are reported in parentheses

***p < 0.01

**p < 0.05

p < 0.10

EO = Entrepreneurial Orientation

CEM = Carbon Emission Management

SP = Sustainability Performance

SIZE = Firm Size

AGE = Firm Age

LEV = Leverage

The regression results presented in Table 4 provide empirical support for the proposed hypotheses. Model 1 shows that entrepreneurial orientation has a positive and statistically significant effect on carbon emission management ($\beta = 0.482, p < 0.01$), supporting Hypothesis 1. This finding suggests that insurance firms with stronger entrepreneurial capabilities are more likely to adopt proactive carbon management practices

Model 2 indicates that entrepreneurial orientation has a significant positive impact on sustainability performance ($\beta = 0.391, p < 0.01$), supporting Hypothesis 3. This result highlights the strategic role of entrepreneurial orientation in enhancing sustainability outcomes within insurance companies.

Model 3 introduces carbon emission management as an explanatory variable for sustainability performance. The results show that carbon emission management has a strong positive effect on sustainability performance ($\beta = 0.436, p < 0.01$), supporting Hypothesis 2. Additionally, the coefficient of entrepreneurial orientation decreases in Model 3, suggesting a potential mediating effect of carbon emission management in the relationship between entrepreneurial orientation and sustainability performance.

Table 5. Mediation Analysis

Path	Effect	Std. Error	t-value	p-value	95% CI Lower	95% CI Upper	Result
EO → CEM	0.482	0.067	7.19	0.000	0.351	0.613	Supported
CEM → SP	0.436	0.075	5.81	0.000	0.289	0.583	Supported
EO → SP (Direct Effect)	0.214	0.083	2.58	0.011	0.051	0.377	Supported
EO → CEM → SP (Indirect Effect)	0.210	0.052	4.03	0.000	0.118	0.314	Supported

Notes: Bootstrapping analysis was conducted with 5000 resamples to estimate the indirect effects

EO = Entrepreneurial Orientation

CEM = Carbon Emission Management

SP = Sustainability Performance

Confidence intervals that do not include zero indicate a significant mediation effect

The mediation analysis presented in Table 5 provides further evidence regarding the indirect relationship between entrepreneurial orientation and sustainability performance through carbon emission management. The results indicate that entrepreneurial orientation has a significant positive effect on carbon emission management ($\beta = 0.482, p < 0.01$). Additionally, carbon emission management significantly influences sustainability performance ($\beta = 0.436, p < 0.01$) The indirect effect of entrepreneurial orientation on sustainability performance through carbon emission management is statistically significant ($\beta = 0.210, p < 0.01$), and the bootstrapped confidence interval does not include zero. This finding confirms the mediating role of carbon emission management in the relationship between entrepreneurial orientation and sustainability performance

These results provide empirical support for **Hypothesis 4**, suggesting that entrepreneurial capabilities enhance sustainability outcomes partly through the adoption of proactive carbon emission management strategies

Figure 2. Regression and mediation effects of entrepreneurial orientation and carbon emission management on sustainability performance

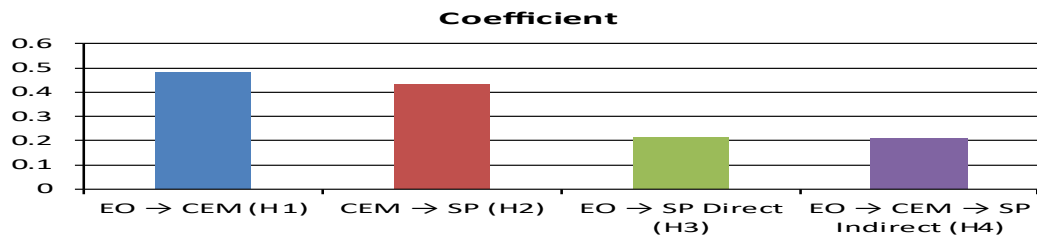
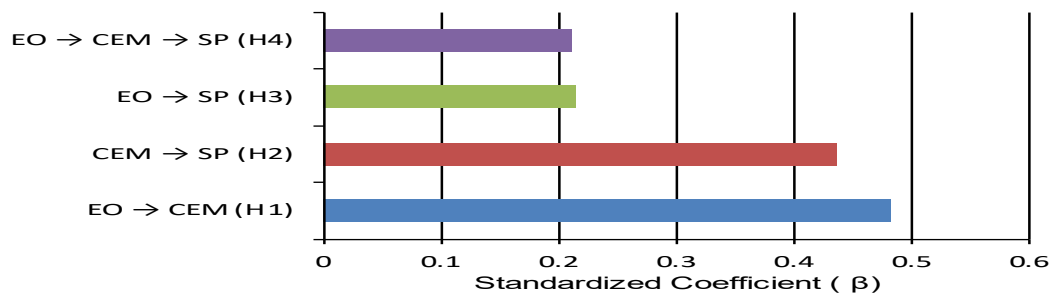
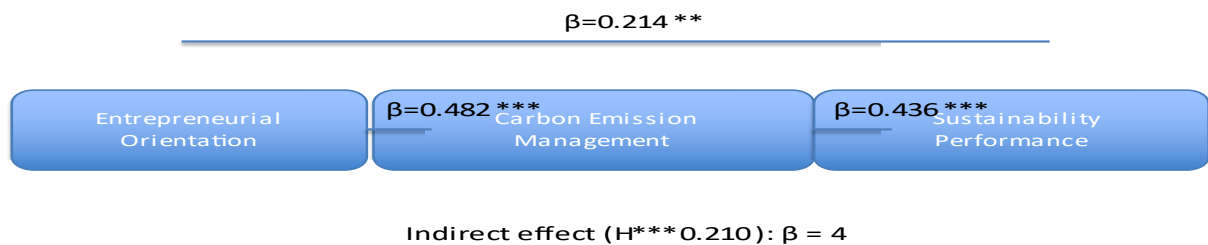


Figure 3: Coefficient Plot



Notes: EO = Entrepreneurial Orientation; CEM = Carbon Emission Management; SP = Sustainability Performance.

Figure 4: SEM Path Diagram



Direct path: EO → SP; Indirect path: EO → CEM → SP. Values are illustrative and editable.

5. Discussion

The primary objective of this study was to examine the relationships between entrepreneurial orientation, carbon emission management, and sustainability performance within the Saudi insurance sector. By integrating perspectives from stakeholder theory and the resource-based view (RBV), this research aimed to explore how organizational capabilities influence environmental governance practices and sustainability outcomes in financial institutions. The empirical results provide several important insights regarding the role of entrepreneurial capabilities and environmental management strategies in enhancing sustainability performance in the insurance industry.

5.1 *Entrepreneurial Orientation and Carbon Emission Management*

The findings of this study indicate that entrepreneurial orientation has a significant positive effect on carbon emission management practices. This result supports Hypothesis 1 and suggests that firms with stronger entrepreneurial capabilities are more likely to adopt proactive environmental management strategies. In particular, organisations characterised by innovativeness, proactiveness, and risk-taking behaviour appear more willing to implement carbon monitoring systems, environmental management practices, and carbon reduction initiatives.

This finding is consistent with prior research emphasising the role of entrepreneurial capabilities in facilitating environmental innovation and sustainability-oriented strategies. Firms that demonstrate strong entrepreneurial orientation tend to respond more effectively to environmental challenges by developing innovative solutions and adopting forward-looking management practices. Such firms often recognise environmental challenges not only as regulatory obligations but also as strategic opportunities to enhance efficiency, reduce operational risks, and improve competitive positioning.

In the context of the Saudi insurance sector, entrepreneurial orientation appears to encourage firms to explore innovative approaches to environmental governance. Insurance companies that adopt entrepreneurial strategies may invest in advanced risk management systems, environmental monitoring technologies, and sustainability reporting practices. These initiatives enable firms to identify environmental risks more effectively and implement strategies that reduce carbon emissions and improve environmental performance. Furthermore, entrepreneurial orientation may enhance organisational flexibility and strategic responsiveness. Firms that are more proactive and innovative may be better equipped to adapt to evolving environmental regulations and sustainability standards. As global financial markets increasingly emphasise climate-related disclosures and environmental accountability, insurance companies with strong entrepreneurial capabilities are likely to gain competitive advantages by integrating sustainability considerations into their strategic planning processes.

5.2 *Carbon Emission Management and Sustainability Performance*

The empirical results also reveal that carbon emission management has a strong positive effect on sustainability performance, supporting Hypothesis 2. This finding highlights the critical role of environmental management practices in improving organizational sustainability outcomes. Firms that actively monitor and reduce carbon emissions are more likely to achieve better environmental performance and strengthen their commitment to sustainable development. Carbon emission management contributes to sustainability performance in several ways. First, effective carbon management enables organizations to reduce their environmental footprint and minimise negative environmental impacts associated with business operations. By adopting energy-efficient technologies

and implementing environmental monitoring systems, firms can improve resource efficiency and reduce greenhouse gas emissions.

Second, carbon management practices enhance corporate reputation and stakeholder trust. Organisations that demonstrate strong commitment to environmental sustainability are more likely to attract environmentally conscious investors, customers, and business partners. As stakeholders increasingly prioritise environmental responsibility, firms that adopt proactive carbon management strategies may strengthen their legitimacy and improve long-term organisational performance.

In the insurance sector, carbon emission management also plays a crucial role in managing climate-related risks. Climate change has significantly increased the frequency and severity of natural disasters, creating new challenges for insurers in terms of risk assessment and financial stability. By integrating carbon management practices into corporate governance frameworks, insurance companies can enhance their ability to identify and mitigate climate-related risks

Moreover, insurers increasingly participate in sustainable investment initiatives and green finance programs. Through responsible investment strategies and environmentally oriented insurance products, firms can support broader sustainability objectives while simultaneously strengthening their financial performance. Consequently, carbon emission management serves as an important mechanism through which financial institutions can contribute to the transition toward a low-carbon economy

5.3 Entrepreneurial Orientation and Sustainability Performance

The findings also indicate that entrepreneurial orientation has a positive and significant effect on sustainability performance, supporting Hypothesis 3. This result suggests that firms with stronger entrepreneurial capabilities tend to achieve higher levels of sustainability performance.

Entrepreneurial orientation enables organizations to identify opportunities associated with environmental innovation and sustainable business practices. Firms that adopt entrepreneurial strategies are more likely to invest in sustainable technologies, implement innovative environmental solutions, and explore new business models that support sustainability objectives.

From a strategic management perspective, entrepreneurial orientation enhances organizational adaptability and innovation capabilities. Firms characterized by proactive and innovative strategic behavior are better positioned to respond to emerging sustainability challenges and regulatory requirements. These capabilities allow organizations to integrate sustainability considerations into their corporate strategies and operational processes more effectively.

In addition, entrepreneurial firms often demonstrate greater willingness to invest in long-term sustainability initiatives. While environmental investments may require substantial resources and involve uncertain returns, entrepreneurial organizations are more likely to pursue such initiatives due to their higher tolerance for strategic risk and experimentation. As a result, entrepreneurial orientation can serve as a key driver of sustainability-oriented innovation and environmental performance.

Within the Saudi insurance sector, entrepreneurial orientation may encourage firms to adopt digital technologies, advanced risk management tools, and innovative sustainability initiatives that enhance organizational performance. These strategic capabilities allow insurance companies to align their business models with national sustainability objectives and global environmental governance standards.

5.4 Mediating Role of Carbon Emission Management

One of the most important findings of this study relates to the mediating role of carbon emission management in the relationship between entrepreneurial orientation and sustainability performance. The mediation analysis indicates that entrepreneurial orientation influences sustainability performance both directly and indirectly through carbon emission management practices

This finding provides empirical support for Hypothesis 4 and highlights the importance of environmental management mechanisms as channels through which organizational capabilities translate into sustainability outcomes. Entrepreneurial firms are more likely to adopt carbon management strategies, which subsequently contribute to improved sustainability performance.

The mediating role of carbon emission management suggests that environmental governance practices serve as critical links between strategic capabilities and sustainability outcomes. While entrepreneurial orientation encourages firms to pursue innovative and proactive strategies, the implementation of environmental management practices enables organizations to translate these strategies into measurable sustainability improvements

This result also reinforces the theoretical framework of the study. From the perspective of stakeholder theory, firms that adopt effective carbon management practices are better able to meet the expectations of regulators, investors, and society regarding environmental responsibility. Similarly, from the RBV perspective, carbon management practices can be viewed as valuable organizational capabilities that enhance sustainability performance and competitive advantage.

5.5 Implications for the Saudi Insurance Sector

The findings of this study have several important implications for the Saudi insurance sector. As Saudi Arabia continues to implement economic and environmental reforms under Vision 2030, financial institutions are expected to play a critical role in supporting sustainable development initiatives.

Insurance companies in Saudi Arabia are increasingly required to incorporate environmental considerations into their governance structures and risk management frameworks. The results of this study suggest that developing entrepreneurial capabilities within insurance organisations may significantly enhance their ability to adopt sustainability-oriented practices and environmental management strategies. Furthermore, the integration of carbon emission management practices into corporate strategies can strengthen the resilience of the insurance sector against climate-related risks. By adopting proactive environmental management systems and sustainability initiatives, insurance companies can improve their risk assessment capabilities and contribute to broader environmental governance objectives

The findings also suggest that policymakers and regulators should encourage the adoption of sustainability practices within the insurance industry. Regulatory frameworks that promote environmental disclosure, climate risk assessment, and sustainable investment practices may help strengthen the role of the financial sector in achieving national sustainability goals.

5.6 Contribution to Sustainability Research

This study contributes to the growing literature on sustainability, environmental governance, and strategic management in several ways. First, it integrates the concepts of entrepreneurial orientation and carbon emission management within a unified conceptual framework that explains sustainability performance in financial institutions.

Second, the study provides empirical evidence from the Saudi insurance sector, which represents an important but relatively underexplored context in sustainability research. Emerging markets often face unique institutional and regulatory challenges that influence the adoption of sustainability practices. By examining the Saudi insurance industry, this study offers valuable insights into how organizational capabilities interact with environmental governance mechanisms in developing financial markets.

Third, the study highlights the mediating role of carbon emission management in linking entrepreneurial capabilities with sustainability outcomes. This finding contributes to a deeper understanding of the mechanisms through which strategic organizational capabilities influence environmental performance and sustainable development.

Overall, the findings underscore the importance of integrating entrepreneurial strategy with environmental governance practices to promote sustainable development within financial institutions. As climate risks and environmental challenges continue to reshape the global economic landscape, organizations that develop strong entrepreneurial capabilities and proactive environmental management practices will be better positioned to achieve long-term sustainability and competitive advantage.

6. Conclusions and Policy Implications

6.1 Conclusions

This study examined the relationships between entrepreneurial orientation, carbon emission management, and sustainability performance within the Saudi insurance sector. By integrating perspectives from stakeholder theory and the resource-based view (RBV), the study aimed to provide a comprehensive understanding of how internal organizational capabilities and environmental governance mechanisms interact to influence sustainability outcomes in financial institutions. The empirical results reveal several important findings. First, entrepreneurial orientation has a significant positive effect on carbon emission management practices. This finding suggests that firms characterized by innovative, proactive, and risk-taking strategic behavior are more likely to adopt effective environmental management strategies. Entrepreneurial firms tend to recognize environmental challenges as opportunities for innovation and strategic development rather than merely regulatory obligations.

Second, the results indicate that carbon emission management has a strong positive influence on sustainability performance. Organizations that actively monitor and reduce carbon emissions are better positioned to improve environmental efficiency, strengthen corporate reputation, and achieve sustainable development objectives. This finding reinforces the growing recognition that environmental management practices are essential components of modern corporate sustainability strategies.

Third, the analysis demonstrates that entrepreneurial orientation also has a direct positive effect on sustainability performance. Firms with stronger entrepreneurial capabilities are more likely to invest in sustainability initiatives, adopt environmentally responsible practices, and explore innovative business models that support long-term environmental and economic sustainability.

Finally, the mediation analysis confirms that carbon emission management plays an important mediating role in the relationship between entrepreneurial orientation and sustainability performance. This result indicates that entrepreneurial capabilities contribute to improved sustainability outcomes partly through the adoption of proactive environmental management practices. In other words, entrepreneurial firms are more likely to implement carbon management strategies, which subsequently enhance sustainability performance.

Overall, the findings highlight the importance of integrating entrepreneurial strategy with environmental governance practices in order to achieve sustainable development objectives. Firms that develop strong entrepreneurial capabilities and adopt effective carbon emission management strategies are better equipped to respond to environmental challenges and maintain long-term competitiveness in sustainability-oriented markets.

6.2 Theoretical Implications

This study contributes to the existing literature on sustainability and strategic management in several ways. First, it integrates entrepreneurial orientation and carbon emission management within a unified conceptual framework that explains sustainability performance in financial institutions. Previous studies have often examined these concepts separately, particularly within manufacturing sectors. By combining these perspectives, this research provides a more comprehensive understanding of how organizational capabilities influence environmental performance.

Second, the study extends the application of stakeholder theory and the resource-based view to the context of environmental governance and sustainable finance. The findings suggest that entrepreneurial orientation represents a valuable strategic capability that enables firms to respond effectively to stakeholder expectations related to environmental sustainability.

Third, the study highlights the mediating role of carbon emission management in linking entrepreneurial capabilities with sustainability outcomes. This finding contributes to a deeper understanding of the mechanisms through which strategic organizational capabilities influence environmental performance and sustainable development.

Additionally, this research provides empirical evidence from the Saudi insurance sector, which represents a relatively underexplored context in sustainability research. Emerging markets often face unique institutional, regulatory, and economic challenges that influence the adoption of sustainability practices. By focusing on the Saudi insurance industry, this study contributes to the growing body of literature on sustainability and environmental governance in emerging financial markets

6.3 Managerial Implications

The findings of this study offer several important implications for managers and decision-makers in the insurance industry. First, insurance companies should recognize the strategic importance of entrepreneurial orientation in promoting sustainability initiatives. Organizations that encourage innovation, proactive strategic behavior, and calculated risk-taking are more likely to develop effective environmental management strategies and improve sustainability performance.

Second, insurance companies should prioritize the implementation of carbon emission management systems within their operational and governance frameworks. This may involve the adoption of environmental monitoring systems, carbon accounting practices, and sustainability reporting mechanisms that enable firms to measure and reduce their environmental impact.

Third, integrating sustainability considerations into corporate strategies can enhance organizational resilience and competitiveness. Firms that adopt sustainability-oriented business models may benefit from improved reputation, stronger stakeholder relationships, and increased access to sustainable investment opportunities.

Managers should also consider the potential role of digital technologies and data analytics in supporting environmental management practices. Advanced risk assessment tools and environmental monitoring technologies can help insurers identify climate-related risks and implement more effective sustainability strategies.

6.4 Policy Implications

The findings of this study also provide important insights for policymakers and regulators seeking to promote sustainability within the financial sector. As climate change and environmental risks continue to intensify, regulatory frameworks must evolve to encourage financial institutions to adopt environmentally responsible practices. Regulators can play a crucial role in promoting sustainability by introducing policies that encourage environmental disclosure, carbon reporting, and climate risk assessment within financial institutions. These policies can help increase transparency and accountability while encouraging firms to adopt proactive environmental management practices. In the context of Saudi Arabia, the findings of this study support the broader objectives of Vision 2030, which aims to promote sustainable economic development and environmental protection. Policymakers should continue to encourage financial institutions to integrate sustainability considerations into their governance frameworks and strategic decision-making processes. Furthermore, regulatory authorities may consider developing incentives that encourage insurance companies to invest in sustainable technologies and environmentally responsible business practices. Such incentives could include tax benefits, green financing programs, and regulatory support for sustainability initiatives. Encouraging collaboration between financial institutions, government agencies, and environmental organizations may also help accelerate the adoption of sustainability practices within the insurance sector.

6.5 Limitations and Future Research

Despite its contributions, this study has several limitations that should be acknowledged. First, the analysis focuses specifically on the Saudi insurance sector, which may limit the generalizability of the findings to other financial markets or industries. Future research could extend the analysis to other countries or sectors in order to compare sustainability practices across different institutional contexts.

Second, the study relies on survey-based data to measure organizational capabilities and sustainability practices. Although survey data provide valuable insights into managerial perceptions and organizational strategies, future research could complement these findings by incorporating objective environmental performance indicators or longitudinal data.

Third, the study focuses on carbon emission management as a key environmental governance mechanism. However, sustainability performance may also be influenced by other factors such as corporate governance structures, digital transformation, and regulatory frameworks. Future studies could explore additional variables that may influence sustainability outcomes in financial institutions.

Finally, future research could investigate the role of emerging technologies, such as artificial intelligence and digital risk management systems, in supporting environmental governance and sustainability practices within the financial sector.

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Institutional Review Board Statement:

Ethical review and approval were waived for this study because the research involved anonymous

survey responses from industry professionals and did not involve human subjects in a clinical or experimental context.

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study. Participation in the survey was voluntary and respondents were informed about the academic purpose of the research.

Data Availability Statement

The data used in this study are available from the corresponding author upon reasonable request due to privacy and confidentiality considerations.

Conflicts of Interest

The author declares no conflict of interest.

<https://scholar.google.com.eg/citations?user=teeSW9gAAAAJ&hl=en>

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