Determinants of Green Innovations in North Macedonian SMEs: A Stakeholders' Perspective

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Abstract: Green innovation has emerged as a strategic mechanism through which firms strengthen their environmental performance and long-term competitiveness. In the context of North Macedonian SMEs, stakeholders play a decisive role in shaping the extent, direction and success of green innovation practices. This study focuses exclusively on examining how key stakeholder groups such as customers, suppliers, competitors, employees, technology providers and government institutions influence the adoption, development and implementation of green innovations. Findings from the empirical analysis demonstrate that stakeholder pressures, expectations and collaborations act as critical drivers for stimulating eco-innovative activities within SMEs. Customers increasingly demand environmentally friendly products, suppliers facilitate access to greener materials and technologies, while employees contribute through environmentally responsible behavior and internal capabilities. Competitors accelerate innovation by creating competitive pressures, and government institutions further reinforce green transformation through regulations, incentives and policy frameworks.

Keywords: Green innovation, Stakeholder influence, SMEs, Environmental performance, Sustainable practices, North Macedonia, Eco-innovation drivers, Stakeholder engagement

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Introduction

The growing global emphasis on environmental sustainability has placed significant pressure on firms to adopt greener practices and develop environmentally responsible innovations. In this context, green innovation has emerged as a key strategic tool through which companies can reduce their ecological footprint, enhance competitiveness, and comply with rising environmental expectations. However, green innovation does not occur in isolation. Research consistently demonstrates that stakeholders, customers, suppliers, employees, competitors, technology providers, and government institutions, play a decisive role in shaping the adoption and implementation of eco-innovative practices within firms.

In emerging economies such as North Macedonia, SMEs face challenges related to limited resources, technological constraints, and regulatory pressures, making stakeholder-driven innovation even more critical. Stakeholders influence green innovation through their expectations, collaboration, information sharing, market pressures, and regulatory frameworks. Customers increasingly demand eco-friendly products; suppliers facilitate access to sustainable materials; employees contribute through internal capabilities and pro-environmental behavior; competitors create market pressure to innovate; technology providers enable the adoption of advanced green solutions; while government institutions shape the regulatory and financial environment for eco-innovation.

A central question guiding this study is: *How do different stakeholder groups influence the emergence and development of green innovation in Macedonian SMEs?* Although the literature emphasizes the relevance of stakeholder engagement in promoting sustainable practices, there is still limited empirical evidence in the context of developing economies, particularly in the Western Balkans. Macedonian SMEs operate in an environment shaped by economic constraints, evolving regulations, and growing environmental awareness, making it important to understand which stakeholders exert the strongest influence and through what mechanisms. Addressing this question helps clarify whether green innovation arises primarily from market demand, internal organizational capabilities, supply-chain dynamics, competitive pressures, or government-driven initiatives.

The main objective of this research is to examine and explain the role of stakeholders in shaping green innovation within SMEs in North Macedonia. Specifically, the study aims to identify which stakeholder groups have the most significant impact, how their expectations and interactions stimulate eco-innovative practices, and how this engagement ultimately contributes to improved environmental performance. By doing so, the research provides not only theoretical contributions to stakeholder theory and green innovation literature but also practical insights for managers and policymakers seeking to support sustainable transitions. Understanding these dynamics is essential for creating targeted strategies that strengthen stakeholder collaboration, accelerate green innovation adoption, and build more resilient and environmentally responsible business models.

Literature Review

Green Innovation, a term defined as the process of developing and implementing new ideas, strategies and technologies, all with a focus on environmental sustainability. Mansoor, Jahan and Riaz (2021) define green innovation management as the strategic process of using innovative methods to achieve environmental sustainability goals. It plays a critical role in connecting environmental management and performance, resulting in sustainable competitive advantage. Green innovation actively responds to both regulatory requirements and trends towards sustainability; It makes it easier to translate environmentally friendly concepts into concrete practices while increasing competitiveness. The term includes macro-level strategies as well as micro-level organizational learning activities; In this framework, organizational learning acts as an intermediate factor that influences how green innovations affect competitive advantage.

By implementing successful green innovations, companies can achieve greater efficiency and strengthen their core competencies. In addition, the implementation of green innovation strategies paves the way for companies to secure sustainable competitive advantages; This makes it a crucial process for organizations seeking sustainable development. Despite its importance, managing green innovations poses significant challenges, such as: B. investing in

environmentally friendly designs that optimize solar, wind or geothermal technologies: these are all crucial elements of effective eco-innovation. Magistretti et al. (2021) claim that proactive environmental management represents an integral aspect of managing green innovation: a concept closely linked to environmentally conscious practices, producing bundles of resources and capabilities that are firmly embedded in the procedures and ultimately lead to sustainable competitive advantages.

Lee and Min (2015) emphasize that green product innovation, a process of creating environmentally friendly products with lower environmental impact, requires a new perspective on the product life cycle. The aim of this innovative approach is not only to change or improve energy efficiency, but also to redesign the design to use non-toxic compounds or biodegradable materials during production, thus minimizing the impact of disposal. Research shows that compared to its counterpart, green process innovation, green product innovation has a more profound impact on important constructs such as competitive advantage in green products and the successful introduction of new green raw materials.

The data also clearly suggests that it pays to prioritize this type of development when resources are scarce; This suggests that this should be the main focus for companies operating under restrictions. Scholars have examined the influence of green product innovations on company performance (Thomas, Scandurra and Carfora, 2022) and consider them to be a predictor of this. Companies often consider green product innovations, which are type-specific within green technology innovations, as an effective strategy; Through its application, they strengthen their sustainable competitive advantages while achieving environmental goals in a financially prudent manner (Mubarak et al., 2021).

Companies are actively engaging in green process innovation, a proactive approach that focuses on developing and implementing environmentally friendly operations within their company. This strategy focuses on reducing environmental risks, emissions and other harmful impacts. It is particularly attractive for companies that are new to environmentally friendly processes. Palcic and Prester (2020) have identified different forms of this innovation: clean

production; Environmental Protection; Prevention eco-efficiency, all underpinned by circularity as an overarching principle. Green process innovation includes three key components: energy conservation, pollution reduction – particularly through prevention and not just control – and waste management/recycling strategies. Additionally, it includes methods and procedures to minimize environmental impact, a crucial aspect of sustainable business practices. Implement process changes that are not only beneficial to the industry but also environmentally conscious.

The focus of the transformation towards sustainable business models is on green innovations. This section examines the different categories of these innovative practices and highlights their importance in the context of SMEs from North Macedonia. Rennings (2000) identifies a number of developments that comprise green innovations: these range from product-level advancements such as eco-design and the use of environmentally friendly materials; Process innovations that include cleaner production techniques and sustainable supply chain management. In this context, research from 2017 emphasizes the equal importance of organizational improvements, such as implementing environmentally friendly marketing strategies or sustainability reporting.

Green innovation goes beyond individual companies. Boons and Lüdeke-Freund (2013) point out that societies could be on the threshold of a systemic change towards more sustainable approaches if a large number of companies in many industries develop green innovations. Improving environmental performance is based on the central role played by green innovations. They give companies the opportunity to reduce their ecological footprint; lower resource consumption, a central aspect of sustainability, and meet the demands of environmentally conscious consumers (Lüdeke-Freund & Zvezdov, 2019). This importance is reinforced within SMEs and offers not only competitive advantages, but also opportunities for market differentiation in our increasingly sustainability-oriented modernity.

Customers

In recent years, customer behavior has emerged as a key factor for green innovations in companies' sustainability strategies (Burki 2018). Today's consumers are increasingly aware of the environmental impact of their purchasing decisions and are willing to pay higher prices for eco-friendly products. This perception of "good consumption" has led to growing environmental awareness among customers, putting pressure on companies to integrate green process innovations into their sustainability strategies. In addition, companies are forced to take environmental protection measures to counteract the influence of customer behavior and the regulatory pressure of international society (Clarkson et al., 2008). However, there is still a lack of empirical research on what benefits green technology brings to consumers.

Existing research on green innovation predominantly focuses on product-based production and reducing pollutants in the process of product innovation, with little effort being made to comprehensively examine both the company and the consumer in terms of green innovation. To have a green core competency, it is important that companies build a green image so that consumers can demonstrate more environmentally friendly behavior. In order to study the company's actual performance through green innovation, it is necessary to analyze not only the product manufacturing process, but also the post-consumption process of the product. Open innovation with other firms is expected to have a positive relationship with green consumer innovation, which is a promising area for future research.

In this context, the influence of customer behavior is examined as an important factor to be considered when developing effective green innovation strategies in corporate sustainability (Chang, Iakovou and Shi, 2020). Many studies show that consumers have a very large influence on green innovations. Consumer awareness has made them more discerning when purchasing their products. Today, when choosing certain products, consumers also analyze their impact on the external environment. They ignore products that harm the environment (Weng, Chen, and Chen, 2015). The great influence of consumers on the activities of companies has led to companies increasingly offering green innovations

(Du L, 2018). Some research shows that consumers do not have much influence on the growth of green innovations as they focus more on purchasing quality products at reasonable prices while avoiding eco-products as they have higher prices (X. Huang et al., 2016). In addition to the increase in green innovation, customer pressure has also led to increased investments in research and development and the increase in the company's collaboration with a new partner (X. Huang et al., 2016).

The increasing consumer demand for a particular product has led companies to be more creative and increase the number of eco-innovations through growth strategies (Liao and Tsai, 2018). Many consumers prefer to purchase more environmentally friendly products given the positive changes these products have on the outdoor environment and, for this reason, are the greatest supporters of companies that offer green innovations despite the higher price of these products (Labuschagne, 2013). Companies equipped with appropriate information systems have received feedback from consumers that have influenced the growth of their range of environmentally friendly products and processes (Siagian, Tarigan and Basana, 2022).

H1: Customers have a significantly positive influence on green innovations.

Competitors

Competition has a significant impact on green innovation, both in terms of driving investment and creating value creation challenges. Political competition can stimulate investment in green technology innovations as governments prioritize green innovations to gain an advantage in political competition. However, competition between political parties can also lead to policies that support green innovation. However, competitive intensity may make it more difficult to derive benefits from green innovations, as the potential competitiveness arising from green innovations is more likely to be imitated and surpassed as the market grows

The article examines the direct and indirect influence of political competition on companies' innovation strategies in the field of green technologies, using Stackelberg game theory to construct modes for decentralized decision-making

with and without cost and revenue sharing. The differentiation strategy can negatively moderate the relationship between green process innovation and firm performance and lead to resource tensions that undermine firm performance, especially when there is a mismatch between green process innovation and the differentiation strategy. In highly competitive contexts, the differentiation strategy is more effective in capturing the value of green product innovations, while competition hinders the benefits of green process innovations (Iwata and Okada, 2011).

Competitive intensity strengthens the negative modulation effect of differentiation strategy on the relationship between green process innovation and firm performance and at the same time strengthens the positive modulation effect of differentiation strategy on the relationship between green product innovation and firm performance. Therefore, effective management of green innovation in a competitive environment is crucial for managers to optimize their companies' green technology innovation strategies, especially when it comes to harnessing the value of green innovations in an intense competition.

Green innovation is a crucial aspect of modern businesses, and companies are investing in improving their manufacturing and production processes by adopting environmentally friendly technologies and improving their green capabilities. As competition intensity increases, differentiation strategy becomes more and more necessary for companies to stand out from their competitors in the market (R. Dubey, 2015). The relationship between green innovation and firm performance is significantly influenced by competitive intensity. By using a differentiation strategy, companies can benefit from environmentally friendly product innovations by standing out from their competitors and strengthening customer loyalty (Muhammed et al., 2015). Although the differentiation strategy focuses allocation on bringing distinctive products to market, it fails to achieve the low-cost potential of environmentally friendly process innovations.

Political competition is a type of competition that impacts green innovation. Fiscal decentralization and political competition can influence the six modes of optimal green technology innovation strategies for enterprises. Competitive intensity strengthens the positive moderating effect of differentiation strategy on

green product innovation, but the text does not provide information about other types of competition that influence green innovation.

H2: Competitors have a significantly positive influence on green innovations.

Suppliers

When analyzing the relationship of these two factors to each other, we can see many studies in which some of the authors have analyzed the impact of green innovations on suppliers, while others have analyzed the impact of suppliers on the growth of green innovations (Thomas, Scandurra and Carfora, 2022; Yang & Jiang, 2022; Zhang & Lei, 2019). In the past, suppliers have focused more on the price of raw materials, finding long-term partners and equipping them with sophisticated technology that speeds up the process of raw material production. However, to all these goals there is now added the green perspective, which advises suppliers to find green-oriented partners, develop green processes in the work process and offer green products that are less harmful to the environment (Burki, 2018).

To promote green innovation, companies must create a connection between the right consumer and the right supplier (Melander, 2018). Supplier participation has a positive impact on green innovation, including the growth of green products and processes (Du, Zhang, and Feng, 2018). Consumer demands as a single indicator cannot positively influence the growth of green innovations if companies do not work with the right suppliers (Li et al., 2022). Consumers' desire for green products and suppliers' aim to satisfy consumers' desires have created a connecting path that has led to the growth of green innovations in the market, which have higher prices compared to other products (Labuschagne, 2013). Choosing to cooperate with suppliers that offer environmentally friendly raw material products increases the company's chances of staying ahead of current market trends and reduces the behavior of harmful products towards the external environment (Chiou et al., 2011).

The indirect effect between green innovation and supplier greening leads to better competitive advantage, which in turn improves companies' performance. The study is based on a questionnaire survey conducted in Taiwan that

examines the impact of supplier greening and green innovation on firm performance (Du, Zhang, and Feng, 2018). The study measures company performance using competitive advantages and environmental performance as indicators. The results of the study show that implementing greener supplier and green innovation practices can significantly contribute to company performance while improving their environmental and competitive performance (Mansoor, Jahan and Riaz, 2021). The results of the study can help develop better strategies for companies that want to improve their performance in the long term.

H3: Suppliers have a significantly positive influence on green innovations.

Employees

The role of employees in driving green innovation is an important aspect of companies' sustainability efforts. Research suggests that employee behavior has a significant and positive impact on green innovation practices, regardless of organizational culture or strategy settings around innovation (De Blas, 2020). However, the level of innovation orientation may moderate this relationship as it influences employees' behavior toward environmentally friendly product innovation practices (Khan, P. Johl, & Akhtar, 2021). It is worth noting that companies that pay more attention to innovation could help their employees develop new ideas and improve engagement in developing new environmentally friendly products (Li et al., 2022). Furthermore, the influence of employee behavior on green process innovation is insignificant, suggesting that a highly motivated innovative environment may not contribute to the establishment of green processes (Du, Zhang, and Feng, 2018).

It is important to consider that business strategy and organizational culture attitudes correlate with innovation orientation, which in turn is related to the company's employees (Li et al., 2022). Therefore, companies need to pay attention to their innovation orientation and develop strategies to promote a culture of sustainable innovation that encourages and rewards employee participation in green innovation practices. Furthermore, it is critical for companies to understand that innovation orientation influences the relationship between employee behavior and green innovation practices, highlighting the need for a holistic

approach to sustainability efforts that takes into account both employee behavior and organizational culture. Green innovation has recently become a current problem for all companies as it is the result of pressure from many external and internal factors.

When employees have the opportunity to make decisions within the company, they are more creative and more likely to invest their knowledge in green innovations; Therefore, companies should create a more open and flexible organizational culture so that employees feel comfortable expressing ideas related to green innovations (Chu, Wang, and Lai, 2019). Employees are more likely to support green innovations if the company rewards their participation in environmentally friendly developments. In those companies where the workspace is more harmonious, warm and sociable, employees have shown a positive influence on the development of environmentally friendly products and processes (Zailani et al., 2017). The workforce, motivated in all the company's management activities and focused on the development of a new green era, has increased the company's green innovations and competitiveness in the market in which it operates (Muisyo et al., 2021).

Employees' green behavior has had a positive impact on the company's environmentally sustainable performance. To achieve these results, the greatest work lies with company leaders who must introduce green policies into the company and all employees must be encouraged to implement new decisions (Mansoor, Jahan and Riaz, 2021). The main goal of a successful leader is to achieve organizational goals through self-confidence, increasing the desire to succeed and increasing creativity in the area of green innovation. If leaders do their jobs well, we will see a positive influence on employees in creating a green business model (Memon et al., 2022).

H4: Employees have a significant positive influence on green innovations.

Technology

Green innovation is a crucial aspect of sustainable business performance and its constructs, and innovative technologies and greener strategies are critical to achieving sustainable performance (Clarkson et al., 2008). Knowledge

management processes and their constructs lead to green innovations, while organizational agility has a positive impact on green innovations and sustainable corporate performance (Clarkson et al., 2008). However, the success of green innovations is not guaranteed for all organizations, as necessary and sufficient conditions are required in every dimension to enable and facilitate such innovations. In addition, the development of green technologies involves a long-term exploration process that cannot guarantee quick success.

Therefore, it is essential for companies to recognize the right value and positioning of green innovations, as investments in green product and process innovations can be helpful for companies. The Technology-Organization-Environment Framework provides a useful self-assessment tool for organizations to strategically plan the preparation and implementation of green innovations for optimal sustainability outcomes. Furthermore, green innovation can lead to competitive advantage by mediating environmental and corporate performance, with the performance of green product and process innovations being positively correlated with the firm's competitive advantage. The absorptive capacity of companies, which continuously helps them to absorb, transform and use external knowledge and is crucial for achieving sustainable competitive advantages, affects the adoption process and costs of green innovations. Therefore, companies should strive to build and restructure a variety of knowledge sources to achieve green innovation and adapt to the ever-evolving digital economy (Burki, 2018). Companies must constantly search for new knowledge and technologies that lead the company to environmentally friendly production (Melander, 2018).

Technological changes have influenced the growth of green innovations. The development of the Internet network is an important driver that has influenced the invention of green innovations (Jiang & Zheng, 2021). Digital technological transformations have shown positive impacts on business performance by increasing green innovation and creating long-term sustainability in the performance of the external business environment (Yadav, Kumar and Luthra, 2020). Given that companies operate in highly competitive markets, the sophisticated technologies that have led companies to eco-products have enabled them to gain competitive advantages in the market (Magistretti, Pham, and Dell, 2021).

Advanced technologies in the manufacturing industry have been shown to have a positive impact on green innovation and business performance (Palcic & Prester, 2020).

One type of technology that has influenced the behavior of green innovation is Industry 4.0 technology, which has expanded the company's mission with its intelligent and unique component systems. By using Industry 4.0 technology, companies not only want efficient and effective products, but now also environmentally friendly products that have less impact on the environment (Mubarak et al., 2021). In addition, blockchain technology has shown a great contribution to green innovation with a transparent manner of use by third parties who want to collaborate with the company or receive important information from the company. The information once placed in blockchain technology cannot be changed by the company in the future, so it represents the flow of company activities in different time periods in a real and transparent manner (Chang, Iakovou and Shi, 2020).

Companies that have refused to make changes in the application of new technologies have shown negative results in developing green innovations. Green innovations are more complicated and different from other mainstream innovations; For this reason, technological support is essential for their implementation (Guo et al., 2021).

H5: Technology has a significantly positive influence on green innovations.

Government

The government has introduced several measures to promote green innovation, including environmental regulations, taxes, subsidies and credit tariffs. These measures were primarily aimed at enabling investments in the transition to a low-carbon economy and financing early-stage green innovations (Muisyo et al., 2021). Green Investment Bank was founded to provide financing for clean energy projects. In addition, the government uses the feed-in tariff to incentivize renewable energy production by paying for excess electricity that is fed back into the grid. The energy company obligation also obliges energy companies to finance energy efficiency measures. Additionally, the Renewable Heat Incentive

provides financial incentives for installing renewable heating systems. In China, the government offers tax incentives and subsidies to companies that engage in green innovation, while in the United Kingdom, the Climate Change Act of 2008 sets legally binding emissions reduction targets (De Blas, 2020).

However, the effectiveness of these measures in promoting green innovation is still debated. Studies have shown that market-based regulation (MER) has a negative impact on green innovation; informal regulation (IER) has a significant positive effect on green innovation; Domestic Direct Investment (IFDI) plays a positive role in the development of green innovations and confirms the "Pollution Halo Hypothesis"; while command and control regulation (CER) has a significant positive effect on green innovation. Therefore, it is crucial for policymakers to understand the different impacts of different government policies on green innovation in order to formulate targeted policies for different locations. The impact of policies on green innovation varies by sector. However, it is recommended that the government provide more support to private companies to invest in environmentally friendly projects. Private companies that are severely affected by financing restrictions have a relatively high ability to innovate.

Green finance policies can generally be effective in alleviating financing constraints for green innovations, but private companies are less likely to receive green loans. In addition, private companies face greater financing constraints for green innovations compared to state-owned companies. Policies can distort green incentives and make companies unwilling to undertake high-quality innovation activities, but they also have the potential to direct companies towards high-quality green innovations. The impact of green credit policies on green innovation may be influenced differently by factors of government behavior. For example, the promotion pressure of local government officials and fiscal decentralization have a moderate influence on the impact of green credit policies on the quality of green innovation in firms. In addition, there is heterogeneity in the innovation effect of the type of patent between the green invention of the innovation effect and the green utility model, suggesting that different types of patents may be differently affected by policies promoting green innovation (Burki, 2018).

Finally, renewable energy policy fails to promote green innovation in the least innovative countries in five different renewable energy sectors and exerts the least influence on geothermal green innovation compared to other renewable energy sources. Promoting green innovation through government policies is not without challenges and limitations. Environmental regulations can increase the cost of controlling pollution, resulting in a reduction in industrial output, inhibition of business innovation, and reduced R&D investment in green technology (Muhammed et al., 2015). The lack of standardized research methods and differences in sample selection and measurement techniques further complicate drawing definitive conclusions about the impact of environmental regulations on green innovation.

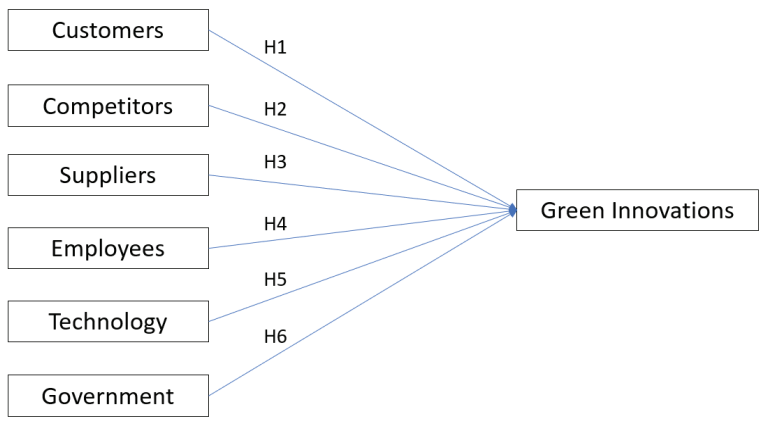
Although some companies comply with environmental regulations, they mainly purchase new pollution control equipment to achieve clean production standards rather than increasing the intensity of their research, development and innovation (Muhammed et al., 2015). The effectiveness of government policies to promote green innovation may depend on the adequacy of environmental regulation. However, environmental regulations can have a positive impact on green technological innovation by promoting the "innovation compensation effect," which stimulates corporate innovation in green technologies.

Limited empirical research has been conducted on the effectiveness of green industrial policies at the firm level in developing countries, and further research is needed to guide the implementation of green industrial policies in these countries. Green industrial policy can promote green innovation among enterprises through the mediating role of government subsidies and bank loans, but is more effective for state-owned enterprises in eastern China. Financing constraints pose a challenge in promoting green technology innovation, and low-carbon city pilots can mitigate these constraints through tax incentives and government subsidies. Regional heterogeneity and the carbon intensity of industry may impact the implementation and targeting of pilot measures for low-carbon cities. Benchmark regression analysis can be used to analyze the impact of these measures on companies' environmentally friendly technological innovations. However, some scholars argue that government subsidies can crowd

out business investment in research and development and trigger rent-seeking activities, thereby reducing the incentive effect of subsidies. In addition, due to the relative situation, companies face significant limitations in accumulating research and development funds.

H6: The government has a significant positive influence on green innovation.

Figure 1. Conceptual framework



Source: Author's own elaboration.

The conceptual framework of this study is grounded in stakeholder theory and is designed to capture the direct influence of key stakeholder groups on green innovation within SMEs. Given the exploratory nature of this research and the limited empirical evidence available in the context of North Macedonian SMEs, the model deliberately emphasizes direct relationships between stakeholders and green innovation outcomes.

While more complex models incorporating mediating or moderating relationships could offer additional insights, the present framework provides a parsimonious and theoretically coherent structure that allows for clear interpretation of stakeholder effects. This approach ensures analytical clarity and methodological robustness, while laying the groundwork for future studies to extend the model by incorporating endogenous relationships among stakeholders.

Interrelationships among stakeholders and green innovation

Although prior research has predominantly examined the individual effects of stakeholders on green innovation, recent studies increasingly emphasize the importance of interdependencies among stakeholder groups. Stakeholders rarely operate in isolation; rather, their influence on green innovation often emerges through mutual reinforcement and interaction. For example, customer demand for environmentally friendly products frequently translates into green innovation only when firms possess sufficient technological capabilities or collaborate closely with environmentally oriented suppliers. Similarly, government regulations and incentives may indirectly stimulate green innovation by encouraging firms to adopt advanced green technologies or restructure their supply chains.

From a stakeholder theory perspective, these interrelationships suggest the presence of endogenous effects, where the influence of one stakeholder group may amplify or mediate the impact of another. In the context of SMEs, particularly in transition economies such as North Macedonia, such interactions may be even more pronounced due to resource constraints and institutional pressures. While the current study focuses on the direct effects of key stakeholder groups on green innovation, acknowledging these interdependencies provides a richer theoretical foundation and opens avenues for future research to explore more complex causal mechanisms.

Methodology

Research Design

A quantitative research approach was used in this study. This approach enabled the collection and analysis of numerical data essential for understanding the impact of green business models on the environmental performance of small businesses in North Macedonia. This led us to choose a quantitative research framework for the study in order to present precise numerical relationships between variables such as green business models and the environmental performance of small businesses in North Macedonia. It is best suited for quantitative

research that attempts to calculate the degree of co-occurrence and can be analyzed using statistical measures to examine patterns or trends. In this research, a quantitative method enabled the targeted assessment of important factors that influence environmental quality.

The purpose of using a quantitative method was to obtain some objective measurements that could be analyzed with statistics. This methodological framework allows researchers to find out how much and in what way the green business model influences environmental performance indicators. It is a way to obtain empirical evidence that goes beyond qualitative reports. The focus is on whether green activities actually have a concrete impact and how they are related to environmental outcomes for specific SME industries. This emphasis on numbers fits with the study's goal of examining quantitative aspects of implementing green business practices. The study attempted to find some objective measures with which statistical tests could be carried out - reliable factors that answer the question of what relationships exist between these variables. Therefore, this quantitative approach is a practical tool to gain insight into the complex relationship between green business strategy and environmental performance in SMEs in North Macedonia.

Surveys were used as a practical means to collect information from a large sample of small businesses in the North Macedonian territory. The choice of a quantitative approach through surveys was motivated by the need to systematically collect empirical data on the impact of green business models on environmental performance. The surveys provided a practical method to explore SME stakeholders' perceptions and practices on green business models. The use of a Likert scale (from 1 to 5) facilitated structured data collection and analysis. To ensure a representative data set, a sample size of 220 SMEs was selected, while a data collection period of three months was chosen to capture possible seasonal variations and obtain a comprehensive overview of operations and practices.

Data Collection

The data for this research was primarily collected through structured questionnaires. The questionnaire method is an established approach to data collection

in economic and social research (Sekaran, 2006). In this case, the questionnaire consisted of items measuring various constructs related to the impact of green business models on environmental performance, with responses on a Likert scale.

A systematic random sampling technique was used to select the sample of SMEs in North Macedonia. A sample size of 220 SMEs was chosen, which was considered appropriate for this study and provided a balance between feasibility and statistical power (Hair et al., 2014). This sample size allowed the results to be generalized to the SME population in North Macedonia. The data was collected over a period of three months from SMEs operating in North Macedonia. The research team distributed the questionnaires through both online and offline channels. Offline sales involved direct contact with SME representatives, while online sales were facilitated through email and online survey platforms. The three-month data collection period ensured a comprehensive data set that captured potential seasonal variations.

The reliability and validity of the questionnaire was checked using established measures. Reliability was assessed using Cronbach's alpha and composite reliability (Chin, 1998). The use of Cronbach's alpha ensured the internal consistency of the questionnaire, while composite reliability measured the reliability of the latent constructs (Hair et al., 2011). Validity was confirmed through an extensive literature review to ensure that the questionnaire items adequately represented the constructs of interest.

Data Analysis

The data collected from questionnaires were subjected to rigorous statistical analysis to test the research hypotheses. The research used structural equation modeling (SEM) to analyze the relationships between the selected stakeholders, green innovations and their impact on environmental and corporate performance. SEM is a powerful analytical technique that allows the exploration of complex relationships in a structural model (Hair et al., 2014). The use of SEM enabled the examination of both direct and mediating effects and provided a comprehensive understanding of the research constructs. According to Hair et

al. (2019), structural equation modeling (SEM) is a well-established statistical technique that is widely used to evaluate complex relationships between latent variables. In the context of green business models, SEM provides a complete architecture for measuring not only the interaction between different stakeholders, but also between them and green innovations and how such combinations affect both environmental performance and corporate profitability. In this way, the indirect impacts of stakeholders on green innovations are captured.

Kline (2015) notes that the strength of SEM lies in its ability to synthesize measurement and structural models, providing an overall view of the factors that influence green innovations and their outcomes. SEM can use latent constructs with multiple indicators, increasing the precision and reliability of measurements. In addition, the method enables the effects of mediation and moderation to be examined. In this way, one can develop a more comprehensive picture of the complex two-way dialogue between stakeholders, green innovation and company performance.

In addition to its analytical function, SEM also opens the door to examining latent interactions (Byrne, 2016), helping researchers find hidden patterns and dependencies in their raw data. But by using SEM to examine how stakeholders influence green innovation and then observing its impact on environmental performance and firm-level profits, scientists can draw conclusions that go beyond mere correlational analyses. The technique used in this study deepens our understanding of the complex interactions that underlie sustainability in business models.

SmartPLS, a widely accepted structural equation modeling software, was used for data analysis. SmartPLS is particularly suitable for complete models and is strongly recommended for partial least squares (PLS) analysis (Hair et al., 2014). The software enabled estimation of path coefficients, assessment of model fit, and assessment of mediation effects. In the field of quantitative research, SmartPLS (Partial Least Squares) is one of these powerful weapons. As Ringle et al. (2015), SmartPLS provides researchers and practitioners with a user-friendly interface for conducting sophisticated statistical analyses, which is particularly

useful because they can use it themselves. The graphical user interface allows scientists to easily build complex relationships between latent data constructs.

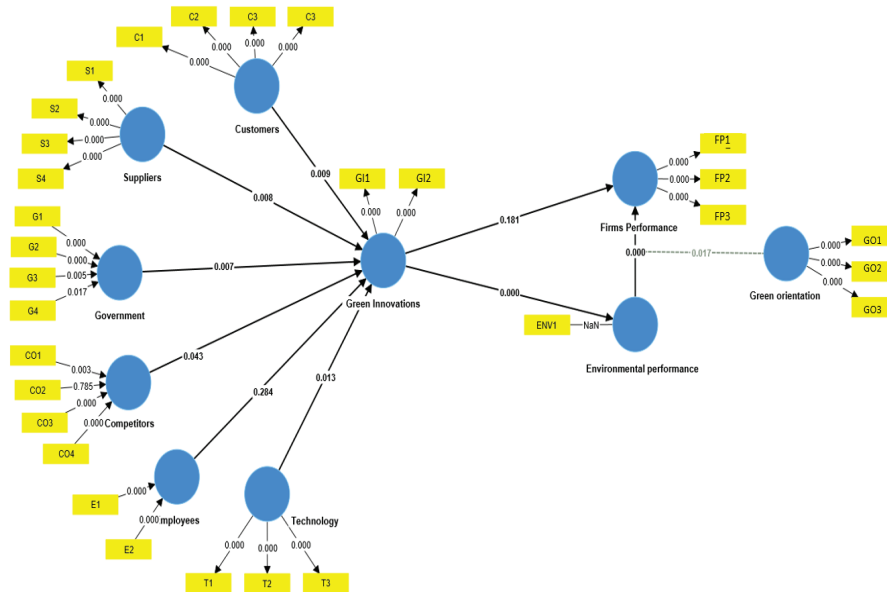
A feature of SmartPLS is its ability to enable predictive modeling in environments where theory development and testing overlap. Haar et al. (2017) note that SmartPLS is particularly well suited for predictive analysis and is an ideal choice for researchers interested in the predictive capabilities of their models. This tool allows the researcher to simultaneously estimate both the measurement and structural models. The overall relationships between latent constructs are illuminated. This versatility makes SmartPLS an easy-to-use but powerful package for researchers seeking a flexible approach to SEM.

Stakeholders (Independent Variables): The stakeholders in your model represent various entities or groups that have a vested interest in a company's activities and performance. This may include customers, suppliers, government agencies, competitors and other parties who may be affected or affected by the Company's actions. As independent variables, examine how the presence and influence of these stakeholders impact the company's sustainability practices.

Green Innovations (dependent variable): As a result, green innovation emerges as the dependent variable that reflects how effectively the firm reacts to stakeholder influence and integrates environmental considerations into its strategic decisions.

Although structural equation modeling allows for the examination of mediating and moderating effects, this study focuses on estimating the direct effects of stakeholders on green innovation. This decision was guided by the primary objective of identifying the most influential stakeholder groups within SMEs and by the need to maintain model parsimony. Given the sample size and the exploratory nature of the research, testing highly complex endogenous structures could reduce estimation stability and interpretability. Consequently, the adopted SEM-PLS approach provides a reliable foundation for identifying key drivers of green innovation, while future research may build upon these findings by testing more intricate stakeholder interrelationships.

Figure 2. Conceptual framework of the SEM model



Empirical Results

Table 1. R-square

	R-square	R-square adjusted
Green Innovations	0,598	0,591

These R-squared values indicate how well your model accounts for the observed variance in each of the dependent variables. The R-squared value for green innovation is 59.8% and the adjusted R-squared is 59.1%. The model predicts almost 59.8% of the variation in green innovations. This implies that independent variables provide a strong explanatory framework for understanding the development of green innovations in the environment.

Table 2. Construct reliability and validity

	Cronbach's alpha	Composite reliability	Composite reliability	Average variance extracted (AVE)
Customers	0,779	0,804	0,858	0,603
Green Innovations	0,769	0,774	0,866	0,684
Suppliers	0,767	0,773	0,852	0,590
Technology	0,831	0,838	0,898	0,747

Reliability and validity are critical to ensuring your measurement tools are robust and accurately represent the designs you measure. These results suggest that the customer construct has good internal consistency as indicated by Cronbach's alpha. The composite reliability values (rho_a and rho_c) also show that the measure is reliable. Furthermore, the AVE, which represents the proportion of variance captured by the construct relative to its measurement error, is moderately high, indicating good convergent validity.

Green innovations construct has good internal consistency as indicated by Cronbach's alpha. Composite reliability scores are also strong, suggesting reliability. The AVE is reasonably high, suggesting good convergent validity. The supplier construct has good reliability, as evidenced by Cronbach's alpha and composite reliability values. However, the AVE is comparatively lower. The technology construct exhibits exceptional reliability, with high values for Cronbach's alpha and composite reliability. The AVE is significant, indicating good convergent validity. The model shows that most of the constructs have good reliability and convergent validity.

Table 3. Discriminant Validity

	Saturated model	Estimated model
SRMR	0,063	0,080
d_ULS	1,874	2,951
d_G	2,657	2,699
Chi-square	3205,461	3241,975
NFI	0,604	0,600

Model fit statistics are critical for evaluating how well your structural equation model fits the data. Here is an interpretation of the fit summary provided, comparing the saturated model to the estimated model. The SRMR is a measure of the discrepancy between the model-implied correlations and the sample correlations. The NFI measures the relative fit of the model compared to the null model. A higher NFI indicates better adaptation. The NFI of the estimated model (0.600) is close to that of the saturated model (0.604), indicating that the estimated model provides adequate fit.

Table 4. Path coefficient

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Competitors -> Green Innovations	0,117	0,125	0,058	2,020	0,043
Customers -> Green Innovations	0,197	0,192	0,075	2,611	0,009
Employees -> Green Innovations	0,060	0,063	0,056	1,071	0,284
Government -> Green Innovations	0,178	0,191	0,066	2,709	0,007
Suppliers -> Green Innovations	0,196	0,189	0,073	2,674	0,008
Technology -> Green Innovations	0,152	0,147	0,061	2,491	0,013

Competitors and Green Innovations: The path coefficient is 0.117, indicating a positive relationship between competitors and green innovations. This relationship is statistically significant with a p-value of 0.043. In other words, as competition participation increases, green innovations tend to increase.

Customers and Green Innovations: The path coefficient is 0.197, suggesting a positive and significant relationship between customers and green innovations (p = 0.009). More customer involvement is associated with higher levels of green innovation.

Employees and Green Innovations: The path coefficient is 0.060, but it is not statistically significant (p = 0.284). Employee involvement does not appear to have a significant direct impact on green innovations in this context.

Government and Green Innovations: The path coefficient is 0.178, indicating a positive relationship between government participation and green innovations (p = 0.007). When the government plays a role, it seems to stimulate green innovations.

Suppliers and Green Innovations: The path coefficient is 0.196, indicating a positive relationship between suppliers and green innovations (p = 0.008). Supplier participation is associated with higher levels of green innovations.

Technology and Green Innovations: The path coefficient is 0.152, indicating a positive relationship between technology and green innovations (p = 0.013). The use of technology is associated with increased green innovations.

This suggests that the effect of green orientation on firm performance is moderated by environmental performance, and the interaction reduces firm performance. These results provide valuable information on the relationships between various factors in the implementation of green innovations and their impact on the environmental and firm performance of small and medium enterprises in North Macedonia. It is essential to consider the practical implications of these findings and how they can inform strategies for companies and policymakers.

Hypothesis Testing

This hypothesis proposes that stakeholders in the business model, including customers, suppliers, competitors, employees, technology, and government, have a significant impact on green innovations. The results generally support this hypothesis, as evidenced by the significant positive path coefficients between these stakeholders and green innovations.

H1: Customers have a significantly positive influence on green innovations.

This hypothesis suggests that customers positively influence the development of green innovations. The results support this hypothesis, indicating a significant positive path coefficient between customers and green innovations.

The finding is consistent with theory, as customers increasingly demand sustainable products and services, prompting companies to innovate in environmentally friendly ways to meet these demands.

Companies should prioritize understanding customer preferences for sustainability and develop green products, services, and processes accordingly. Engaging with customers through surveys, feedback mechanisms, and transparent communication can help identify opportunities for green innovation.

H2: Suppliers have a significantly positive influence on green innovations.

This hypothesis suggests that suppliers positively influence the development of green innovations. The results support this hypothesis, showing a significant positive path coefficient between suppliers and green innovations.

The result is consistent with theory, as suppliers play a critical role in the supply chain and can drive sustainability improvements through eco-friendly sourcing, production methods, and collaborative innovation efforts.

Companies should collaborate closely with suppliers to promote sustainability throughout the supply chain. Encouraging suppliers to adopt green practices, providing incentives for eco-friendly sourcing, and fostering innovation partnerships can enhance green innovation efforts.

H3: Competitors have a significantly positive influence on green innovations.

This hypothesis suggests that competitors positively influence the development of green innovations. The results support this hypothesis, indicating a significant positive path coefficient between competitors and green innovations.

The finding is consistent with theory, as competitive pressure can drive companies to adopt sustainable practices and differentiate themselves through green innovation to gain a competitive advantage.

Companies should monitor competitors' sustainability initiatives and strive to innovate in environmentally friendly ways to maintain competitiveness. Collaboration with industry peers through initiatives such as industry alliances or sustainability networks can also foster collective green innovation efforts.

H4: Employees have a significant positive influence on green innovations.

This hypothesis suggests that employees positively influence the development of green innovations. However, the results do not support this hypothesis, as the path coefficient between employees and green innovations is not statistically significant.

While employees are often considered key drivers of innovation, the lack of a significant relationship in this study may suggest that other factors or stakeholders play a more dominant role in driving green innovations.

Companies should explore strategies to enhance employee engagement and involvement in sustainability initiatives. Providing training, fostering a culture of innovation and sustainability, and incentivizing green ideas from employees can help harness their potential to drive green innovation.

H5: Technology has a significantly positive influence on green innovations.

This hypothesis suggests that technology positively influences the development of green innovations. The results support this hypothesis, showing a significant positive path coefficient between technology and green innovations.

The finding aligns with theoretical expectations, as technological advancements can enable the development of sustainable solutions, improve resource efficiency, and facilitate eco-friendly processes and products.

Companies should invest in innovative technologies such as renewable energy systems, smart manufacturing processes, and green supply chain management tools to drive green innovation. Embracing digitalization and adopting emerging technologies can unlock new opportunities for sustainability-driven innovation.

H6: The government has a significant positive influence on green innovations.

This hypothesis suggests that government policies and regulations positively influence the development of green innovations. The results support this hypothesis, indicating a significant positive path coefficient between government and green innovations.

Government intervention through policies, incentives, and regulations can create a conducive environment for green innovation by providing support, setting standards, and promoting sustainability initiatives.

Companies should actively engage with policymakers, participate in public-private partnerships, and advocate for supportive regulatory frameworks to accelerate green innovation. Leveraging government incentives and grants for sustainable projects can also facilitate green innovation efforts.

Discussion

This study provides empirical evidence on the role of stakeholders in driving green innovation within SMEs in North Macedonia. The findings highlight that green innovation is predominantly shaped by external pressures and institutional factors, rather than internal organizational dynamics alone.

Differential effects of stakeholders

The results reveal that customers and government institutions exert the strongest influence on green innovation. This finding reflects the growing environmental awareness among consumers and the increasing role of regulatory frameworks in shaping firm behavior. In a transition economy such as North Macedonia, SMEs are particularly sensitive to market demand and regulatory compliance, which explains the dominant role of these stakeholders. Similar findings have been reported in prior studies conducted in developing and emerging economies, where external pressures often act as primary catalysts for sustainability-oriented innovation.

The limited role of employees in green innovation

Contrary to theoretical expectations, employee influence on green innovation was not statistically significant. This result may be attributed to the structural characteristics of SMEs, where decision-making is often centralized and employees have limited autonomy in strategic innovation processes. Additionally, the lack of formalized sustainability training and incentive systems may constrain employees' ability to contribute effectively to green innovation. This finding does not diminish the importance of employees but suggests that their potential remains underutilized in many SMEs.

Comparison with prior research

Compared to studies conducted in more developed economies, where internal capabilities and employee engagement play a stronger role, the findings of this study underscore the contextual nature of green innovation drivers. In transition economies, external stakeholders such as customers, suppliers, and government institutions appear to play a more decisive role, highlighting the importance of institutional and market-based pressures in shaping sustainability strategies.

Conclusion

This study examined the influence of key stakeholder groups on the development of green innovations within SMEs in North Macedonia. The empirical results clearly demonstrate that most stakeholders—customers, suppliers, competitors, technology providers, and government institutions—play a significant and positive role in driving eco-innovative practices. Among these, customers and government agencies emerged as particularly influential, highlighting how market expectations and regulatory environments jointly shape firms' sustainability trajectories. These findings reinforce the notion that green innovation in SMEs is not only a strategic managerial choice but also a response to external pressures and collaborative opportunities.

The results confirm that SMEs that actively engage with their supply chains, leverage technological advancements, and monitor competitive dynamics are

more likely to adopt environmentally friendly processes and products. Although the influence of employees was not statistically significant, this does not undermine their importance. Instead, it suggests that SMEs may require stronger internal structures, training systems, and motivational frameworks to fully harness employee potential for green innovation.

Overall, the study contributes valuable insights into how stakeholder-driven dynamics support the transition toward sustainable business practices. Strengthening cooperation with stakeholders, investing in green technologies, and fostering supportive governmental measures can significantly accelerate eco-innovation across the SME sector. These findings offer both theoretical contributions to stakeholder and innovation literature and practical implications for managers and policymakers aiming to enhance sustainability and environmental performance in emerging economies.

While this study provides valuable insights into the direct effects of stakeholders on green innovation, future research could extend the analysis by incorporating mediating and moderating mechanisms. For instance, technological capability or supplier collaboration may mediate the relationship between government policy and green innovation, while firm size or industry type could moderate stakeholder influence. Longitudinal studies could further explore how stakeholder pressures evolve over time and how SMEs adapt their innovation strategies accordingly. Such extensions would contribute to a deeper understanding of the dynamic and interconnected nature of stakeholder-driven green innovation.

Contribution Rates and Conflicts of Interest

Ethical Statement	İt is declared that scientific and ethical principles have been followed while carrying out and writing this study and that all the sources used have been properly cited
Author Contributions	
Data Collection	SM (60%), BB (40%)
Data Analysis	SM (60%), BB (40%)
Research Design	SM (60%), BB (40%)
Writing the Article	SM (40%), BB (60%)
Article Submission and Revision	SM (30%), BB (70%)
Complaints	journalbem@gmail.com
Conflicts of Interest	The author(s) has no conflict of interest to declare.
Grant Support	The author(s) acknowledge that they received no external funding in support of this research
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REFERENCES

Aboelmaged, M., & Hashem, G. (2019). Absorptive capacity and green innovation adoption in SMEs: The mediating effects of sustainable organisational capabilities. *Journal of Cleaner Production, 220*, 853–863. https://doi.org/10.1016/j.jclepro.2019.02.150.

Boons, F., & Lüdeke-Freund, F. (2013). Business models for sustainable innovation: State-of-the-art and steps towards a research agenda. *Journal of Cleaner Production, 45*, 9–19. https://doi.org/10.1016/j.jclepro.2012.07.007

Bowen, F. E., Cousins, P. D., Lamming, R. C., & Faruk, A. C. (2001). The role of supply management capabilities in green supply. *Production and Operations Management, 10*(2), 174–189. https://doi.org/10.1111/j.1937-5956.2001.tb00077.x

Burki, U. (2018). Green innovation management and sustainable competitive advantage. *Management Decision, 56*(6), 1235–1254. https://doi.org/10.1108/MD-03-2017-0295

Camison, C., Boronat-Navarro, M., & Forés, B. (2014). The interplay between firms' internal and external capabilities in green innovation. *Journal of Business Research, 67*(9), 2092–2100. https://doi.org/10.1016/j.jbusres.2013.02.016

Chang, C. H., & Chen, Y. S. (2012). The determinants of green intellectual capital. *Management Decision, 50*(1), 74–94. https://doi.org/10.1108/00251741211194925

Chang, Y., Iakovou, E., & Shi, W. (2020). Blockchain in global supply chains and green innovation. *Transportation Research Part E: Logistics and Transportation Review, 131*, 1–18. https://doi.org/10.1016/j.tre.2019.09.020

Chen, Y. S., Lai, S. B., & Wen, C. T. (2006). The influence of green innovation performance on corporate advantage. *Journal of Business Ethics, 67*(4), 331–339. https://doi.org/10.1007/s10551-006-9025-5

Chen, Y. S., & Chang, C. H. (2013). The determinants of green product development performance. *Journal of Business Ethics, 116*(1), 107–119. https://doi.org/10.1007/s10551-012-1455-9

Chiou, T. Y., Chan, H. K., Lettice, F., & Chung, S. H. (2011). The influence of greening the suppliers and green innovation on environmental performance. *Transportation Research Part E, 47*(6), 822–836. https://doi.org/10.1016/j.tre.2011.05.002

Chu, Z., Wang, L., & Lai, F. (2019). Customer pressure and green innovations. *Journal of Cleaner Production, 222*, 412–425. https://doi.org/10.1016/j.jclepro.2019.03.012

Clarkson, P. M., Li, Y., Richardson, G. D., & Vasvari, F. P. (2008). Revisiting the relation between environmental performance and environmental disclosure. *Accounting, Organizations and Society, 33*(4–5), 303–327. https://doi.org/10.1016/j.aos.2007.05.003

De Blas, I. (2020). Environmental regulation and green innovation. *Ecological Economics, 169*, 106516. https://doi.org/10.1016/j.ecolecon.2019.106516

Du, L., Zhang, Z., & Feng, T. (2018). Linking green customer and supplier integration with green innovation performance. *Journal of Cleaner Production, 190*, 229–239. https://doi.org/10.1016/j.jclepro.2018.04.136

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2014). *A primer on partial least squares structural equation modeling (PLS-SEM).* Sage Publications.

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European Business Review, 31*(1), 2–24. https://doi.org/10.1108/EBR-11-2018-0203.

Iwata, H., & Okada, K. (2011). How does environmental performance affect firm value? *Ecological Economics, 70*(9), 1691–1700. https://doi.org/10.1016/j.ecolecon.2011.04.005

Jiang, W., & Zheng, H. (2021). Digital transformation and green innovation. *Technological Forecasting and Social Change, 166*, 120660. https://doi.org/10.1016/j.techfore.2021.120660.

Khan, P. A., Johl, S. K., & Akhtar, S. (2021). Firm sustainability and employee green behavior. *Business Strategy and the Environment, 30*(3), 1469–1482. https://doi.org/10.1002/bse.2705

Lee, K. H., & Min, B. (2015). Green R&D for eco-innovation. *Journal of Business Ethics, 129*(1), 203–215. https://doi.org/10.1007/s10551-014-2143-9

Li, D., Cao, C., Zhang, L., Chen, X., Ren, S., & Zhao, Y. (2017). Effects of environmental regulation on green innovation. *Journal of Cleaner Production, 153*, 471–482. https://doi.org/10.1016/j.jclepro.2016.10.129

Lüdeke-Freund, F., & Zvezdov, D. (2019). Green innovation and sustainable business models. *Organization & Environment, 32*(4), 1–24. https://doi.org/10.1177/1086026619857333

Magistretti, S., Pham, M. T., & Dell'Era, C. (2021). Exploring the link between innovation and sustainability. *Journal of Product Innovation Management, 38*(3), 1–22. https://doi.org/10.1111/jpim.12560

Mansoor, A., Jahan, N., & Riaz, H. (2021). Green innovation management and firm performance. *Journal of Cleaner Production, 305*, 127097. https://doi.org/10.1016/j.jclepro.2021.127097

Mubarak, M. F., Tiwari, S., & Petraite, M. (2021). Industry 4.0 technologies and green innovation. *Technological Forecasting and Social Change, 173*, 121090. https://doi.org/10.1016/j.techfore.2021.121090

Palcic, I., & Prester, J. (2020). Impact of advanced manufacturing technologies on green innovation. *Journal of Cleaner Production, 257*, 120577. https://doi.org/10.1016/j.jclepro.2020.120577

Rennings, K. (2000). Redefining innovation—Eco-innovation research and the contribution from ecological economics. *Ecological Economics, 32*(2), 319–332. https://doi.org/10.1016/S0921-8009(99)00112-3

Ringle, C. M., Wende, S., & Becker, J. M. (2015). *SmartPLS 3.* SmartPLS GmbH.

Utterback, J. M., & Abernathy, W. J. (1975). A dynamic model of process and product innovation. *Omega, 3*(6), 639–656. https://doi.org/10.1016/0305-0483(75)90068-7

Appendices

Table 1A: Questionnaire design

Variables	Item Content	Source
	C1. Our customers require our company to improve our environmental performance	El-Kassar and Singh, 2019 Lin et al.,2013
Customers (C)	C2. You collaborate with your customers to develop eco-innovations. C3. Customer requests have motivated your company to include ecological products. C4. Your customers have a clear interest in increasing the number of ecological products.	
	S1. Our supply chains and business partners require our company to improve our environmental performance	Schiederig et al., 2012 Qi et al., 2018

Suppliers (S)	S2. You collaborate with suppliers to develop eco-innovations. S3. Your suppliers offer raw materials or other components to realise eco-innovations. S4. Suppliers have a clear interest in increasing the supply of raw materials and ecological components for environmental protection.	
Employees (E)	E1. Your staff is happy to provide ecological products and services. E2. Your staff uses team-work to protect the environment with ecological products. E3. Your staff receive complete support for environmental protection with ecological products. E4. Your staff understands how green operations fit into daily work. E5. Your staff is free to make decisions about environmental issues and ecological products.	Bowen et al., 2001 Dubey et al.,2015 Srinivasan and Kurey, 2014

Technology (T)	T1. My company adopts green technology. T2. It is difficult to obtain the latest green manufacturing technologies due to rapid technological changes. T3. It is difficult to implement green production technologies because of the high degree of technological compatibility.	Camison et al., 2014 Sui et al., 2015
Competitors (CO)	CO1. Our company enters new markets faster than competitors CO2. Introducing new products/services faster than competitors CO3. The success rate of new products/services is higher compared to the competition. CO4. Market share was exceeded compared to competitors.	Aboelmaged & Hashem,2019 Zacharia et al., 2011

Regulatory (REG)	RG1.The government requires our company to improve our environmental performance. RG2. Your company develops eco-innovations to comply with regulations, laws, or restrictions that are epected to be imposed in the future. RG3. Your company develops eco-innovations to comply with current regulations, laws, or regulations. RD4. Your company develops eco-innovations using government grants, subsidies, or other financial incentives for environmental protection. RD5. Your company does not use government grants, subsidies, or other financial incentives for the development of ecoinnovations for environmental protection.	Schiederig et al., 2012 Chang and Chen, 2012 Chen and Chang, 2013;

Green Product Innovation (GPR)	GRP1. My company uses materials that produce the least pollution. GRP2. My company uses materials that consume less energy and resources. GRP3. My company uses materials that to design an environmentally friendly product. GRP4. My company uses materials that are easy to recycle, reuse, and decompose.	Chen et al., 2006 Utterback & Abernathy, 1975
Green Process Innovation (GPC)	GPC1. The manufacturing processes of my company effectively reduce hazardous substances or waste. GPC2. The manufacturing processes of my company effectively reduce the consumption of coal, oil, electricity, or water. GPC3. The manufacturing processes of my company effectively reduces use of raw materials	Chen et al., 2006 Utterback &Abernathy, 1975