Research Journal for Societal Issues
Vol 6 No 3 (2024): 87-105

Leveraging Green Innovation to Foster Sustainable Development through Green Dynamic Capabilities

Naheed Shaban*[1], Talat Afza[2], Sadaf Ehsan[3], Rizwan Qaiser Danish[4]

[1*] PhD Scholar, Lahore Business School, University of Lahore, Lahore, Punjab, Pakistan.

[2]Professor, Lahore Business School, University of Lahore, Lahore, Punjab, Pakistan.

[3]Assistant Professor, Department of Management Sciences, COMSATS University, Lahore, Punjab, Pakistan.

[4]Associate Professor, Institute of Business Administration, University of the Punjab, Lahore, Punjab, Pakistan.

Corresponding author: naheedshaban@vu.edu.pk

Keywords: *Green Dynamic Capability, Green Innovation, Sustainable Development and Environmental Regulations*

DOI No: https://doi.org/10.56976/rjsi.v6i3.264

Green dynamic capabilities are crucial for sustainable development and have gained substantial scholarly as well as practitioners' attention. Given the escalating concerns about climate change, resource depletion, and environmental stress, companies must address ecological issues and promote green innovation. The literature emphasizes the role of environmental management practices, institutional pressures, and government regulations in driving green innovation. Despite this, there exists a significant knowledge gap regarding the impact of GDCs on sustainable development through green innovation, especially with environmental regulations as a moderating factor in manufacturing firms. Effective use of GDCs can alleviate challenges faced by sustainability, such as pollution and resource depletion. This study aims to investigate the impact of GDCs on Sustainable Development via green innovation, moderated by environmental regulations, offering new insights into the interplay between Green Dynamic Powers Sustainable development and green innovation within manufacturing firms in Pakistan. Primary data through survey design was gathered from manufacturing firms publicly traded on Pakistan's stock exchange. After testing for assumptions, a covariance-based structural equation modeling approach was used where measurement model and structural model were developed. The data validates the underlying factor structure, their loadings and then tests the proposed hypotheses for direct relation, mediation and moderation. The results indicate that green innovation mediates the impact of GDCs on sustainable development, with environmental regulations moderating the relationship between GDCs and green innovation. The findings present important implications for both theory and practice.

1. Introduction

Dynamic capabilities have acquired considerable attention from scholars and businesses worldwide, particularly in the perspective of sustainable development (Yu et al., 2022). The literature on Dynamic Capabilities and Sustainability is predominantly focused on "eco-innovation," which addresses ecological issues through innovation. Green dynamic capability encompasses strategical decision making from an environmental standpoint, with the goal of advancing green products and processes. This capability cultivates sustainability awareness, enabling businesses to improve their resources to create environment friendly products (Yu et al., 2022). Research indicates that green dynamic capabilities have significant impact on various aspects of the firm like profitability (Ali et al., 2021), assets' growth (Peng, 2020), brand image (Huang et al., 2016a), and repute (Li et al., 2017). As a result, GDC is considered as a crucial element for enhancing company's worth for stakeholders, customers (Huang et al. 2016a), recruits (Latif et al. 2020), and partner organizations etc. (Kobarg et al.2.18).

In today's world, it's essential for firms to tackle ecological issues and find ways to save the environment (Musaad et al., 2020). Organizations must focus on environmental management practices, make environmentally conscious decisions, and drive green innovation (Appolloni et al., 2022). The growing concerns about rapid climate changes, environmental problems, resource depletion, and ecological stress have led to increased academic interest in green innovation over the current decade (Kawai et al., 2018). Companies face significant challenges in pursuing green innovation, largely due to insufficient green dynamic capabilities and the impacts of climate change. Therefore, it is essential to conduct thorough research to understand how green dynamic capabilities can impact sustainable development through green innovation, particularly with environmental regulations serving as a moderating factor in manufacturing firms. Addressing this knowledge gap is crucial, as existing environmental literature often overlooks these key issues, especially in developing countries.

Companies maintain their superior performance due to dynamic capabilities, as it re-configures the competencies in a dynamic environment (Amaranti et al., 2019). Green dynamic capability is a base for the green practices because getting green is urgent requirement for sustainable development of the environment and society. Expertise, assets and technologies used by an organization to cope with the various demands of the stakeholders are considered as the GDCs (Albort-Morant et al., 2018).

GDC has emerged as a powerful tool to combat the severe impacts of challenges related to sustainability, including environmental pollution, climate change, and worldwide depletion of natural resources (Latif et al., 2020). Effective and appropriate application of green dynamic capabilities can significantly alleviate these sustainability issues (Lin et al., 2019). Factors such as environmental policies, institutional pressure, competition, government regulations and market dynamics are known to influence the adoption of GINN (Zhang et al., 2020). However, the previous research remains uncertain about the role of GINN as a mediator between GDCs and SUSD, particularly regarding how environmental regulation moderates this relationship.

To enhance green innovation, it is necessary for companies to cultivate green dynamic capabilities. Environmental regulations are serving as a catalyst for promoting green innovation. As part of environmental strategies, these regulations address the environmental objectives of product development in the early stages of the production process to minimize negative impacts on the environment (Mulaessa & Lin, 2021).

The primary emphasis of environmental regulations is on penalties (López-Gamero et al., 2010). For instance, if a company fails to comply with the specific rules and regulations for production or processes, the relevant authorities may impose penalties and require adherence to environmental regulations to safeguard the environment for others, according to (Graafland & Smid, 2017) . Organizations that abide by environmental regulations are effectively implementing proactive environmental strategies that improve environmental protection and enhance their reputation in the market (Horbach, 2008) .

Consequently, these innovative green solutions are recommended for manufacturing firms, and we believe that the promotion of green innovation will be facilitated as a result.

Existing research has looked at the positive relationship between GDCs and GI variables that enable GI from various perspectives (Arshad et al., 2023). However, they have overlooked this relationship through environmental regulations. Given the identified gaps in the literature, the following questions are the main focus of this research.

1. What role does dynamic green capability play to achieve sustainable development for a manufacturing firm?

2. How can green innovation contribute to the integration of sustainable development and green dynamic capabilities?

3. What is the role of green innovation in linking green dynamic capabilities with sustainable development?

4. Do environmental regulations enhance the link between green dynamic capabilities and green innovation?

5. Do environmental regulations reinforce the relationship between GDC, GINN and long-term sustainability of the manufacturing firms in Pakistan?

A theoretical model is being created to analyze GDC influence on GI practices in the organization in an encompassing model. Specifically, this research expands the previous research work around targeted variables such as GDC, GI and SD in different ways. Firstly, it is not very clear how GDC act in driving a firm toward SUSD through Green Innovation, as it has received no attention previously. Besides, the critical role of GI as mediator for SUSD in the context of manufacturing firms is not examined in prior literature in Pakistan. Secondly, the Environmental regulations have been introduced as a moderating construct in the interaction between GDCs and GI, which is going to provide us with innovative insight. Lastly, we will collect data from Pakistan’s manufacturing industry listed on all stock exchanges to see how well this study approach worked in an underdeveloped country.

2. Literature Review and Hypothesis Development

2.1 Green Dynamic Capabilities (GDCs)

Resources and capabilities are often confused as interchangeable terms, but they have distinct meanings. A resource is an organization's strength or weakness, and a firm's competency is its ability to use its resources efficiently. In other words, capabilities allow a firm to leverage its strengths and minimize the impact of its weaknesses. According to (Foss, 1997) , resources can be defined as any factor that can be a strength or weakness for the firm, while (Wernerfelt, 1984) defined capabilities as a firm's capacity to effectively allocate and utilize its resources.

The capacity of a company to attain sustainability via green innovation and development in a business environment that is changing quickly is referred to as "green dynamic capability." This skill may be further broken down into three discrete sub-domains: sensing, seizing, and transforming. A company's capacity to sense the market allows it to identify possibilities that are still available, which helps decide the organization's future course. A company with sizing competence can seize important possibilities and use them as a competitive advantage. But, a corporation must keep adapting to changes in the industry if it is to preserve a competitive edge over the long run (Zhang et al., 2020).

An enterprise’s dynamic capabilities lead to Innovation. Enterprises constantly keep in touch with their stakeholders for the development of new processes and products rather than depending upon the internal sources of the organization (Qiu et al., 2020). It is a unique characteristic of a company that is difficult to replicate. Companies maintain their superior performance due to dynamic capabilities, as they re-configure the internal and external competencies in a constantly changing environment (Amaranti et al., 2019). GDCs are the base

for green practices because getting green is an urgent requirement for the sustainable development of the environment and society.

Green dynamic capability is a pro-environmental behavior, it is a combination of competencies to utilize existing resources for the development of new skills in a dynamic market (Yousaf, 2021). Resource integration capability (process of effectively identifying, acquiring, and allocating external resources), resources reconfiguration capability and environmental insight capability (Insight, creativity and thoughts on the environment) are the subcategories of green dynamic capability for environmental protection (Bernadeta et al., 2021).

2.2 Green innovation (GINN)

Green innovation refers to innovative practices that have fewer harmful effects on the environment, whether intentional or unintentional. This type of innovation has become essential for firms to remain competitive and sustain their operations. By enabling companies to shift towards sustainable production and manufacturing activities, green innovation plays a critical role in reducing environmental damage. In essence, green innovation involves the creation and adoption of eco-friendly products and processes that enhance environmental quality (Ahmad et al., 2022).

Customers are more satisfied with products that meet their needs and are not harmful for the environment. This makes GINN a win-win solution for firms, stakeholders and the environment. Over the last three decades, there has been a growing emphasis on green innovation as a means to enhance business performance, boost market share, and meet customer satisfaction (Nassani et al., 2022).

2.3 Environmental Regulations (Command and Control Legislation) ER(CCL)

Environmental regulations attempt to protect the environment and public health from the pollution produced as a result of industrial development. It is an important component of social regulation. Environmental regulation weakens competitiveness and increases enterprise cost, which negatively influences economic development. Environmental regulations indirectly influence the intelligent upgrading of manufacturing firms through green innovations (Song & Yu, 2018). Firms follow green innovation strategy and tries to follow the government's environmental regulations (Song & Yu, 2018).

Environmental regulation belongs to the environmental strategies that look after the environmental objectives of the product development at the initial stage of the production process to reduce its harmful impact on the environment (Mulaessa & Lin, 2021). The focus of environmental regulations is the penalties (López-Gamero et al., 2010). If a firm does not follow the certain rules and regulations used for production or processes, to keep the environment safe for others, the appropriate authorities will penalize them and require them to abide by certain environmental standards (Graafland & Smid, 2017). Firm that follow environmental regulations are following proactive environmental strategies that help them to augment environmental protection ad boosts their goodwill in the market (Horbach, 2008). As a result, they are strictly supervising the proactive environmental measures (Chen et al., 2016).

As a result, firms are encouraged to cultivate suitable environmental strategies that help them to reduce the cost of the firm in environmental safety (Aragon-Correa, et al., 2004). It covers both proactive and reactive environmental strategies; firms who faithfully follow environmental regulations in their processes may get grants and rewards from the government for protecting the environment and removing hazardous effects from the environment (Mulaessa & Lin, 2021).

2.4 Sustainable Development (SUSD)

The term "sustainable development" refers to the pursuit of enhancing and preserving a balanced and healthy economic, ecological, and social system to foster human growth (Goni et al., 2021). Sustainability can be described as the effective and fair distribution of resources,

both within the current generation and across generations, while conducting socioeconomic activities within the boundaries of a finite ecosystem (Diesendorf, 2000). Sustainable development has emerged as a widely used term in development discussions, representing a concept of development that can be sustained indefinitely or for a specific duration of time (Mensah, 2019). Sustainable development is a strategic approach to development that utilizes resources in a manner that ensures their continued existence and availability for the benefit of present and future generations (Gray, 2010). The objective of sustainable development is to attain a harmony in combination of economic growth, social progress, and equilibrium in environment (Esteves et al., 2021). According to The Sustainable Development is to meet the needs of the present but it should not be at the cost of the needs of the future generations. SUSD goal is to achieve an equilibrium between environmental preservation, growth of the economy and well-being of the society (Brundtland, 1985).

2.5 Research Gap

The relationship between green innovation and several antecedents has been confirmed by earlier research. For instance, the study has determined a number of elements that are essential to attaining green innovation. Green practices, social networks, green information sharing, green innovation, financing restrictions, green credit standards, green dynamic capacity, green intellectual capital, stakeholder pressure, green transformational leadership, and green finance are some of these elements. These factors have been discussed in several published research papers discussed in introduction section. To achieve GI, it is necessary to carefully examine the roles of these factors. Among these factors, green dynamic capabilities are considered the most critical in achieving green innovation.

To achieve sustainability in the long run, various strategies have been examined. Green dynamic capability is deemed significant in facilitating green innovation that leads to sustainable development. An analysis of literature on GDC and GINN shows that firms possessing GDCs are more inclined to adopt new sustainable and innovative solutions for their customers, leading to an increase in green innovation (Yousaf, 2021). Furthermore, GDCs enable organizations to transform their current practices and explore new pro-environmental solutions to problems in novel ways. Consequently, companies must adapt and enhance their capabilities to align with the demands of the business environment. Hence, GDCs are viewed as a necessary requirement for green innovation (Ahmad et al., 2022).

As a result, green DCs are promoted as a predictor of green innovation. Furthermore, companies must possess the essential resources and capabilities for acquiring knowledge, integrating it effectively, and re-configuring existing processes. Therefore, it is suggested that having green dynamic capabilities leads to green innovation, implying that firms require the appropriate competencies, skills, and resources for learning, combining, and restructuring to attain green innovation (Abrudan et al., 2022).

The dynamic capability theory explains how green resources and capabilities impact the firms' performance and help in reducing uncertainties related to the environmental. It highlights the importance of the contingency context, where competitive advantage of the firm and ecological sustainability are closely linked to its green dynamic prospective. Recognizing the importance of green environment for firms, green innovation is considered as a milestone to achieve the goal of sustainable development. This study's framework on GDCs and GINN is theoretically grounded in dynamic capability theory, which posits that an organization's competitive advantage and long-term success stem from its fundamental resources and capabilities.

Previous research on the link between GDCs and GINN highlights the significant role of environmental regulation in achieving SUSD. Therefore, environmental regulation has been introduced as a moderator in the process of GINN. Previous research has indicated that environmental regulations function as an external means of intervening in pollution control through two key mechanisms. The first mechanism involves raising the costs of pollution,

which creates pressure on businesses to alter their approach and adopt eco-friendly production processes (Ouyang et al., 2020). The second mechanism involves a system of incentives and disincentives, where businesses are either rewarded for implementing environmentally friendly practices or punished for failing to comply with regulations (Luo et al., 2021) . This mechanism involves the government providing subsidies to compensate for the lack of funds caused by a business's green innovation activities or imposing fines for failing to meet pollution emission standards. These two approaches can encourage the development of green technology innovation and improve its overall performance (Yang et al., 2022).

Similarly, our conceptual framework also based on Stakeholder theory, it helps us understand why businesses engage in environmental actions, behaviors, and strategies (Freeman, 2010). It suggests that in the context of GINN, ER(CCL) are often influenced by the top management who are responsible for making decisions for carbon free environment. The theory also assumes that stakeholders influence firms' behaviors in response to external pressures (Isaksson et al., 2015), which in turn encourages companies to take environment friendly practices. Stakeholder theory says, an organization's survival depends on its capacity to meet the key requirements of the stakeholders. Thus, priorities of the companies should align with the needs of the stakeholders. Stakeholders play important roles in guiding companies toward greener management and innovation.

The association between GDCs and GINN with the moderating of ER(CCL) in attaining sustainable development is not covered in the literature as of now. As a result, this field of study is quite interesting, especially in light of Pakistani manufacturing enterprises. Green innovation is greatly aided by environmental regulation as businesses with strong ER(CCL) systems foster its growth. Furthermore, this study extends the existing literature by investigating GI as mediators ER(CCL) as moderator. In short, this study provides a comprehensive contribution to understanding GDCs, GINN and SUSD in the context of Pakistan. The findings can benefit researchers, policymakers, and practitioners who seek to gain a deeper understanding of these concepts.

2.6 Relationship Between the Variables

2.7 Green Dynamic Capability and Green Innovation

Businesses with green dynamic capabilities tend to adopt new, sustainable and innovative solutions for their customers, leading to an increase in green innovation. GDCs drive GINN by improving technologies in recycling of waste, energy-saving, green designing of the products and preventing pollution. By efficiently using energy and fuel, businesses can adopt GINN through their GDCs (Yousaf, 2021). Organizations have dynamic capabilities that consist of "sensing,""seizing," and "transforming" to create and put into action a business strategy (Teece, 2017). These capabilities are unique to each organization and are based on their management practices, routines, and culture, making it challenging for competitors to copy (Teece, 2014**).** It is believed that organizations with the ability to comprehend information have quicker reactions to competitors' moves, a better understanding of customer requirements, and are able to innovate and create more environmentally friendly products.

As green innovation often faces high levels of uncertainty, the possession of green dynamic capabilities positively impacts the success of creating eco-friendly products, fulfilling the needs of stakeholders who prioritize the environment (Singh et al., 2021). Hence, it is suggested that green dynamic capabilities play a crucial role in predicting green innovation. In addition, companies must possess the necessary resources and capabilities for learning, integration, and reconfiguration. In essence a company's green dynamic capabilities promotes green innovation (Abrudan et al., 2022).

Firms with strong green dynamic capabilities show a propensity towards embracing new and sustainable solutions for their customers, leading to a rise in green innovation. The presence of green dynamic capabilities has a significant positive impact on green innovation (Ma et al., 2022) **.** Once a company possesses green dynamic capabilities, it seeks to gain a competitive

edge by dominating the market through environmentally-friendly innovation (Nassani et al., 2022).Therefore, it is recommended that having green dynamic capabilities generates green innovation. It means firms need to possess the necessary competencies and skills along with resources for learning, combining, and restructuring in order to achieve green innovation (Abrudan et al., 2022) .

H1: Green dynamic capabilities positively influence green innovation

2.8 Green Dynamic Capability and Sustainable Development

Green dynamic capacity is a guiding idea for reaching sustainable development that addresses stakeholder issues about sustainability. Organizations may show green dynamic potential by including an ecologically sensitive approach into strategic decision-making, therefore producing environmentally friendly goods and procedures (Cheng, 2020). The strategic decision making with respect of green dynamic capabilities plays a pivotal role in guiding businesses towards the adoption of environmentally responsible practices and the development of greener products and services (Yousaf, 2021). Suppliers' environmental practices are influenced by consumers' decisions regarding the environment, primarily due to the existence of green dynamic capability. Embracing green dynamic capacity is crucial for achieving environmental sustainability and successfully integrating green innovation into value-added processes (Qiu et al., 2020) .

Green dynamic capability empowers us to prevent environmental deterioration and explore innovative approaches to develop greener products and processes. By harnessing this capability, we can proactively avoid environmental harm and uncover novel solutions for sustainable and eco-friendly practices (Dangelico et al., 2017). To achieve environmental innovation, it involves the identification and application of technical knowledge, as well as the promotion and utilization of technologies, resources, and productivity functions. The construction of a shared goal, policy integration, and technological information exchange are all included in green dynamic capabilities, on the other hand. This paradigm facilitates decision-making that takes stakeholders' varied requirements and interests into account while also having a good environmental effect (Zahid et al., 2022). As a result, the capacity to generate green dynamically enhances awareness of sustainability, leading to a growth in green resources for both products and processes within businesses (Zahid et al., 2022)

H2: Green dynamic capability exerts a positive influence on sustainable development.

2.9 Green Innovation and Sustainable Development

Environmental innovation encompasses various practices such as minimizing energy consumption and emissions of pollutants, implementing waste recycling measures, optimizing resource utilization, and designing products with environmentally responsible attributes (Arshad et al., 2023). Environmental innovation has the potential to bring about a favorable influence on the environment, whether by reducing harm or boosting beneficial outcomes. Additionally, it holds the capacity to generate economic value alongside its environmental benefits (Pulido-Velazquez et al., 2018). The investigation of current knowledge and the development of strong theoretical frameworks have received the majority of attention in research on green innovation. These models seek to clarify the complex connection between attaining financial success and green innovation (Phrampus & Hornbach, 2012). Waste management, green adaptation, and green innovation are all positively correlated with the concept of sustainable development (Arshad et al., 2023). Therefore, we posit the following:

H3: Green innovation has a positive impact on sustainable development.

2.10 Mediating Role of Green Innovation between Green Dynamic Capabilities and Sustainable Development.

Based on earlier studies the implementation of green practices by an organization has an impact on its environmental performance. However, to assess the direct influence of GDCs on SUSD, a mediating variable is necessary. Businesses are incentivized to follow green

innovation strategy due to the financial impact of environmental restrictions. This secondary effect is commonly referred to as a "mediated effect." Thus, GINN acts as an intermediary between ER(CCL) and firm's environmental performance (Arshad et al., 2023).

Building upon this foundation, we put forth the hypothesis that green innovation serves as a crucial intermediary between GDCs and long-term sustainability. Furthermore, the mediation model proposed by one of the researchers indicates that green suppliers enhance competitive advantage and ecological performance by contributing to green innovation (Chiou et al., 2011)

Resource utilization efficiency, enhancing energy and reducing the impact on the environment are key indicators of ecological performance. These actions have a number of advantages, including lower manufacturing costs, more output, enhanced brand recognition, and the recruitment of environmentally conscientious customers (Arshad et al., 2023).

In many instances, the most effective approach to enhance environmental efficiency is through the implementation of environmental management practices. Embracing crucial strategies like green innovation and environmental planning can not only improve the environmental value of an organization but also enhance the overall business plan. Furthermore, via increasing productivity, encouraging teamwork, raising organizational competitiveness, and cutting expenses, green innovation is essential in greatly improving the environmental performance of industrial companies (Rao & Holt, 2005).

Businesses may improve their green image by fortifying their environmental adaption mechanism and performance. As a consequence, they may enter new markets and gain a competitive advantage. Innovation in green products and processes lowers expenses and waste dramatically, saving money, time, and resources. This mitigates some of the adverse effects of sustainability on the environment (Nazarenko et al., 2022). Our hypothesis is that the sustainable development of organizations will be moderated by the competence of green dynamics, particularly with respect to green innovation. Given this, we suggest using the below actions or techniques:

H4: Sustainable development and green dynamic capacities are mediated by green innovation

2.11 Environmental Regulations' Moderating Influence on Green Innovation and Dynamic Capabilities

By developing less harmful processes and products, organizations with green dynamic capabilities (GDCs) may achieve better environmental performance. Environmentally-focused GDCs have been identified as a critical component of green innovation, based on previous studies. These skills support businesses in locating and acquiring data, forecasting consumer demand for environmentally friendly goods, tracking advancements in green technology, and monitoring changes in regulations pertaining to the adoption of environmentally friendly developments (Ahmad et al., 2022). Green innovation may improve a company's sustainability and social responsibility while reducing its adverse effects on the environment. Furthermore, by implementing green innovation, environmental rules may indirectly support competitiveness and sustainable development. This makes it possible for companies to get premium green patents, which spurs expansion and increases financial gains. An organization's influence on society and the environment increases as its performance rises (Xu, 2023).

According to earlier research, environmental regulations serve as the main motivator for businesses to pursue green innovation. Enforcing environmental regulations is seen as an external intervention strategy that controls pollution using two different methods. The first technique entails increasing the cost of pollution, which encourages businesses to change their methods of production and implement greener tactics. The second method relies on a system of rewards and penalties, wherein the government penalizes individuals who do not satisfy pollution emission requirements or provides subsidies to offset any financial hurdles related to

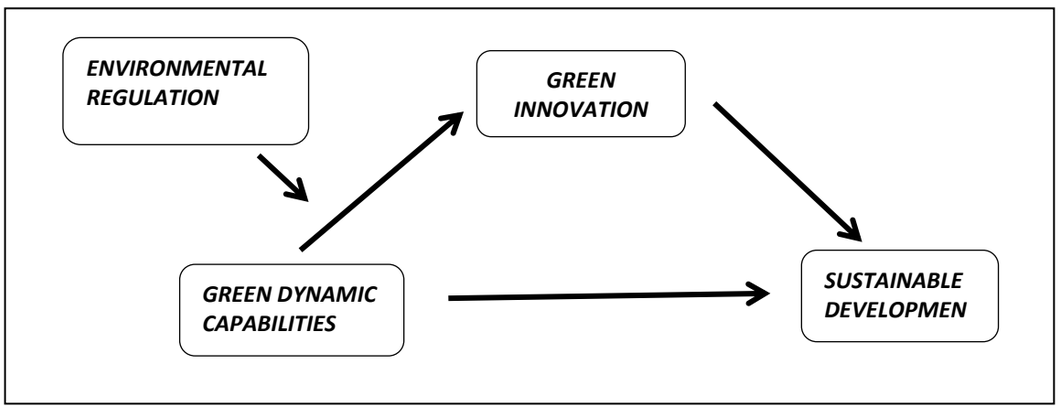
green innovation efforts. These two strategies successfully improve green technology innovation performance (Yang et al., 2022).

The promotion of green innovation is a key benefit of environmental regulation, and the specific type of regulation employed can have varying effects on this innovation. Market-based environmental regulation is particularly effective in promoting green innovation among firms. Meanwhile, research has also shown that government environmental regulations have been successful in driving green innovation (Dong et al., 2022).

Green Innovation would be used more efficiently for sustainable development if intense environmental regulation are implemented (Boubakri et al., 2013). Prior Research confirmed that Enterprises become strategically conservative to invest in low-risk green projects if there are more stringent environmental regulations (Chiu & Lee, 2020).

H5: More intense environmental rules have a more favorable impact on green innovation via green dynamic capabilities.

Figure No 1: Conceptual Model



3- Research Methodology

The nature of this study has been cross sectional explanatory study, expediting the dynamics of mediating and moderating type of inter-relationships among the study variables across trade corporations in Pakistan. Because this research is descriptive in nature, the main data were gathered via a survey, therefore structured questionnaires were administrated. Population of the study was selected based on their managerial position and existing job experience. This study adopted the convenience sampling as the targeted organizations were geographically dispersed and were beyond 200 in count. More than 400 questionnaires were distributed out of which 244 usable responses were received which yielded a response rate of 61%. To test the model, survey design was used. We used the website of PSX to get the list of the companies available on the Pakistan stock exchange and choose explicitly those companies that may contribute to pollute the environment.

3.1 Measures

For this study, we chose measurement tools from previous research. Using a Likert scale that went from 1 (strongly disagree) to 5 (strongly agree), participants answered to every question. We adopted (GDC) consists of Environmental sensing capability (ESC) from (Stanovcic et al., 2015), Resource seizing capability (RSC)from (Wong, 2013) and Resource Reconfiguring Capability (RRC) from (Hung et al., 2010). Green Innovation is adopted from (Song & Yu, 2018). SUSD is adopted from (Wing & Jin, 2015). Environmental Regulation (Command-and-control legislation) is adopted from drawn from Dean and Brown (1995), King (2000) and Porter (1991).

4. Results

To perform the empirical calculations this study used SPSS v. 27. Data was normally distributed as the skewness and kurtosis values were within the allowed range of ± 1, with

skewness of ERCCL within ±2 (Hair et al., 2019; George & Mallery, 2021). Multicollinearity was also ruled out as all the VIF values for predictors in the model were < 3 (Hair et al., 2019), VIF values (< 3.3) also indicate that data has been free from common method bias (Kock, 2015).

Table No 1: Demographics

Characteristic	Frequency	Percentage
Sector		
Cement	9	3.7%
Chemical – Fertilizers	31	12.7%
Engineering – Automobiles	42	17.2%
Food and Personal Care	10	4.1%
Oil and Gas	12	4.9%
Paper – Glass – Ceramics	9	3.7%
Pharmaceuticals	6	2.5%
Power – Electronics	13	5.3%
Sugar and Allied Industry	11	4.5%
Textiles	101	41.4%

N = 244

After examining the demographics, this study used descriptive analysis to assess the mean (M) and standard deviation (SD) of the responses in order to determine the central tendency and variability. It also examined the correlations between the study variables in order to determine the nature and strength of the interrelationships; Table 2 provides more information on this.

Table No 2: Descriptive and Correlational Analysis

Variable	M	SD	GDC	GINN	ERCCL	SUSD	Tolerance	VIF
GDC	3.44	0.83	1				0.723	1.384
GINN	3.65	1.00	.429**	1			0.587	1.703
SUSD	3.75	0.83	.275**	.411**	1		0.567	1.765
ER(CCL)	3.25	1.15	.496**	.593**	.365**	1	0.804	1.243

N = 244, ** = p < .01

4.1 Assessment of Measurement Model

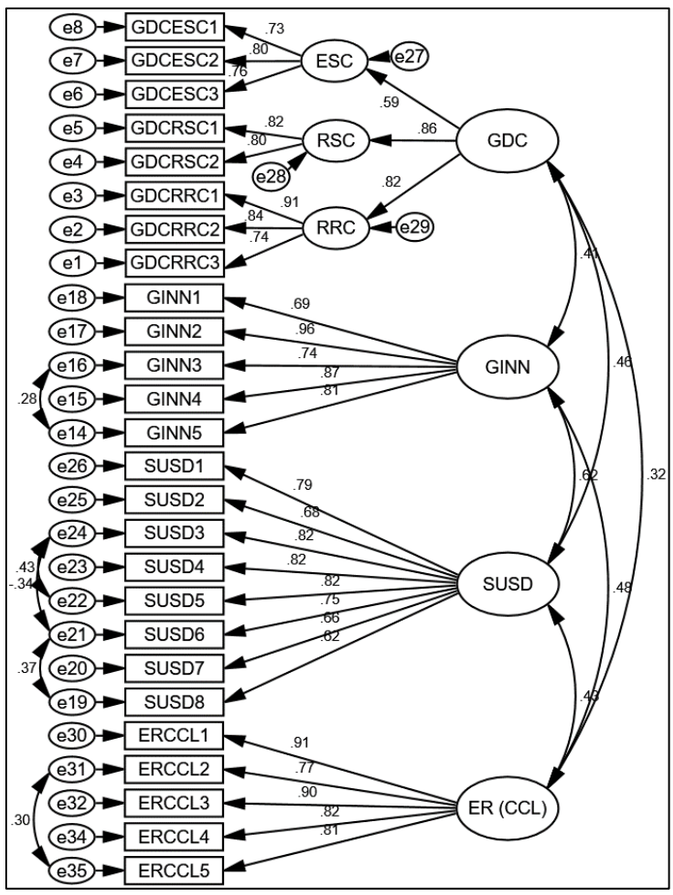
The measurement model's validity and reliability were assessed in this research using AMOS v. 24. To examine the dimensionality and harmony of the GDC, ERCCL, GINN, and SUSD components of the research, a four-factor confirmatory factor analysis (CFA) was performed (Hair et al., 2019). Error terms were covariated with modification index values > 4 (Hair et al., 2019; Byrne, 2016) to get the greatest fit between data and model (see Figure 2). Asterisk indicates that the acceptable criterion is shown by this four-factor model (X2(578) / df (285) = 2.026 (< 3*), IFI =.934 (>.90*), TLI =.924 (>.90*), CFI =.933 (>.90*), RMSEA =.065 (<.08*)). As a result, this model showed a very excellent fit.

As a strong indicator of the model's fitness, this study also validated the measurement model's validity and reliability using factor loadings that were > 0.5 (Figure 2), > 0.7 for Cronbach alpha (CA), > 0.7 for composite reliability (CR), > 0.5 for convergent validity/average variance extracted (AVE), and < 0.85 for discriminant validity/HTMT ratios (Hair et al., 2019). These findings reinforced the suitability of the measurement model and allowed the study to move forward with hypothesis testing (see Table 3).

Table No 3: Reliability and Validity Analysis

Scale	CA	CR	AVE	HTMT			
				GINN	SUSD	GDC	ERCCL
GINN	0.913	0.911	0.673	-			
SUSD	0.908	0.910	0.560	0.651	-		
GDC	0.849	0.806	0.586	0.491	0.570	-	
ER(CCL)	0.926	0.924	0.708	0.496	0.450	0.352	-

Figure No 2: Measurement Model Diagram



4.2 Assessment of Structural Model

Using 2000 samples of bias corrected bootstrapping with 95 confidence intervals as lower bound (LB) and upper bound (UB), this study conducted the structural equation modeling (Figure 3) following the successful evaluation of the validity and reliability of the measurement model see Table 4 for further details.

Confirming the evidence for H1, results indicated that GDC had a favorable and substantial influence on GINN (B =.307, p =.001). Confirming that H2 was supported, results revealed that GDC had a favorable and substantial effect on SUSD (B =.296, p =.001. Analysis revealed that GINN had a favorable and substantial impact on SUSD (B =.466, p =.001), hence H3 was also supported. Results showed that via GINN (B =.252, p =.001), GDC had a favorable and substantial effect on SUSD. GINN mediation resulted thus, thereby supporting H4 as well. Analysis revealed that the interaction between GDC and ER(CCL) had a positive and significant impact on GINN (B =.156, p =.009), so indicating that moderation of ER(CCL) was occurred in a positive manner and so H5 received an obvious support.

Table No 4: Standardized Results of Hypotheses Testing

Path	Estimate	Lower	Upper	P	Status
GDC → GINN	0.307	0.175	0.432	.001	H1: Supported
GDC → SUSD	0.296	0.185	0.401	.001	H2: Supported
GINN →SUSD	0.466	0.356	0.564	.001	H3: Supported
GDC → GINN → SUSD	0.252	0.171	0.342	.001	H4: Supported
GDC x ER(CCL)→ GINN	0.156	0.027	0.291	.009	H5: Supported

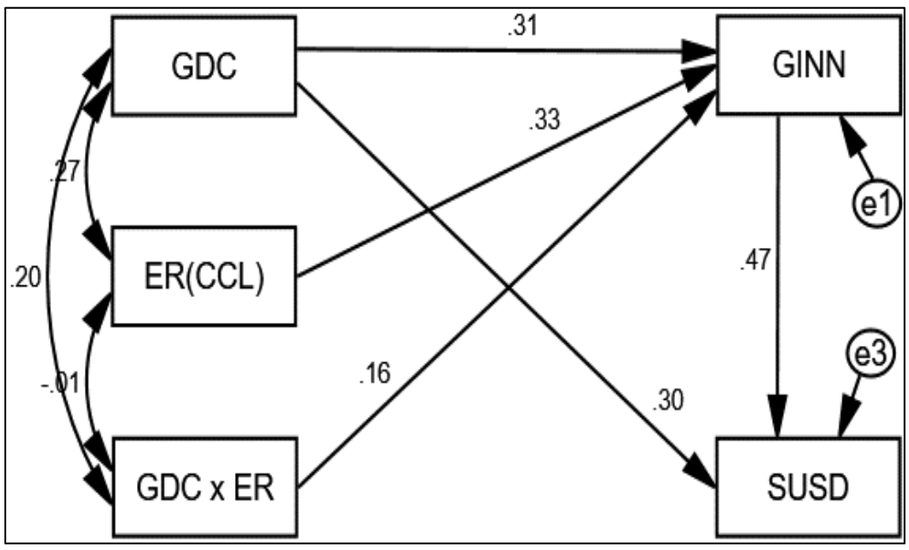
4.3 Mediation Analysis

Despite H4 was approved yet it was not clear that which type of mediation it was. Table 5 showed that direct effect of GDC on SUSD was significant (B = .371, p = .001), therefore this was a case of partial mediation (Baron & Kenny, 1986). This direct effect (B = .371) was increased (B = .514) upon the induction of GINN in the equation, so GINN was able to increase the positive impact of GDC on SUSD, which provided extended support to H4 and established the GINN as partial mediator.

Table No 5: Mediation Analysis

Parameter	Estimate	LB	UB	P	Remarks
GDC → GINN → SUSD					
Direct Effect	0.371	0.219	0.528	.001	Partial Mediation
Indirect Effect	0.143	0.075	0.229	.001	
Total Effect	0.514	0.295	0.745	.001	

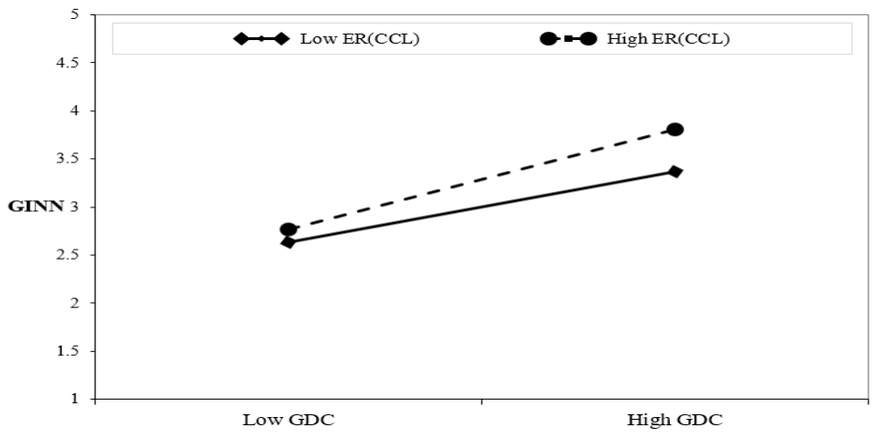
Figure No 3: SEM Path Model



4.4 Moderation Analysis

Similarly, moderation needed to be examined for conditional effects, as it was unclear whether the lower or higher levels of Environmental Regulations ER(CCL) were more or less relevant for the relationship between Green Dynamic Capabilities (GDC) and Green Innovation (GINN). Following (Dawson, 2014), this study utilized simple slopes to test the conditional effects, as shown in Figure 4 that slope for higher GDC was slanting more upward at the higher levels of ER(CCL) (gradient = .520, t = 7.644, p < .001) than the slope for lower levels of ER(CCL) (gradient = .371, t = 6.718, p < .001). Since both slopes for lower and higher levels of ER(CCL) and GINN were statistically significant thus H5 received robust support.

Figure No 4: Simple Slopes – PCS x Gender → ELSS



5. Discussion and Conclusion

This study investigated the process which manufacturing firms can flourish in sustainable developments through GDC. This research formulated a sustainable model built on five hypotheses. Findings proved *H:2* about the positive link between GDC and SUSD (beta value = 0.296, significant). Results revealed that GDC had an optimistic and significant impact on GINN via (B = .307, p = .001). Thus, H: 1 proved. Results revealed that GDC had a positive and significant impact on SUSD via GINN (B = .252, p = .001). Hence, GINN mediation was occurred, meaning that H4 was also proved. Analysis showed that the interaction between GDC and ER(CCL) had a positive and significant impact on GINN (B = .156, p = .009), meaning that moderation of ER(CCL) was occurred in a positive manner, thus H5 received an obvious support.

Manufacturing companies must cultivate distinctive green innovation traits, as emphasized by previous research (Klewitz& Hansen, 2014). This research contributes to the forefront of literature by elucidating the origins and impacts of green innovation within manufacturing enterprises. The principal discoveries emphasize the pivotal role of green dynamic capabilities in driving green innovation within firms. Additionally, the study reveals the significant influence of GDC on fostering SUSD. On the other hand, it highlights the correlation between GDC and sustainable performance through the facilitation of green innovation.

5.1 Implications for Theory

The study's findings enrich dynamic capability theory (Barney, 2001) and stakeholder theory by elucidating sustainability challenges faced by manufacturing firms within the framework of GDC and green financing. In addition to being very successful in explaining human attitudes and actions, the stakeholder theory Approach also promotes great social conduct. The stakeholder theory concept is a powerful tool for describing individual behaviors and mindsets since it is prescriptive, as well as encouraging excellent social behavior. It is particularly useful in managing workers towards implementing socially responsible and environmentally friendly corporate practices. Our research expands the scope of stakeholder theory by applying it to ecological practices. According to stakeholder theory, organizations establish desired behaviors through requirements, and our study adds the stakeholder pressure that assistances to present innovative green methods (Azevedo et al. 2011).

Furthermore, by connecting green dynamic capacities to sustainable development and recognizing them as important precursors to green innovation (Hao et al. 2008), this work adds to the corpus of knowledge. Our study improves on the work of Mills et al. (2013) by providing a comprehensive model for green innovation and highlighting green dynamic capabilities as significant elements impacting sustainable development.

Dynamic capability theory posits that firms must possess unique qualities that are precious, rare, unique, and non-replaceable (Teece 2017). In the context of this study, it is confirmed that specific competencies in the form of GDC constitute part of a firm's capabilities, influencing the successful implementation of sustainability initiatives. Moreover, the provision of adequate capabilities is essential for a firm's operations and leads to green innovation. Dynamic capabilities are crucial which drive innovation for sustainability. Thus, it can be concluded that GINN acts as a mediating force in the advancement of sustainable progress.

In order to maintain long-term company sustainability, it is imperative that enterprises properly manage and answer the expectations and concerns of their stakeholders (Helmig et al., 2016). This management depends on the firm's ability to leverage its exceptional capabilities. The results show that companies are compelled by the Sustainable Development Goals (SDGs) to innovate sustainably. They may do this by carefully updating and reorganizing their Green Dynamic Capabilities (GDC), as earlier studies have shown Chen and Chang (2012) and Zahra et al. (2006). Thus, as supported by other research, our study adds to the continuing conversation in the literature on how modern demands force businesses to implement green efforts in order to stay relevant and competitive in the market (Berrone et al., 2013; Teece et al., 2016).

Finally, various factors contribute to facilitating green innovation. Our study presents a new pathway in which the link between Green Flexible Capabilities (GDC) and Sustainable Development (SUSD)is mediated by Green Innovation (GINN), with Environmental Regulations (ER) acting as a moderator. These findings mark a significant advancement in the literature, demonstrating how green innovation can enhance a manufacturing firm's sustainable development.

Our research shows that an organization's capacity for green innovation is heavily dependent on its GDC, which includes sensing, seizing, and transforming. These capabilities are essential for leveraging current resources and knowledge in a changing corporate environment, as described by (Lin & Chen, 2017). This capacity is crucial for delivering value to customers, as highlighted by (Teece 2017), and for maintaining market competitiveness. Essentially, our study advances the field by integrating Dynamic Capability Theory and Stakeholder Theory to address sustainability challenges faced by firms. It clarifies the relationships among green innovation and sustainable development.

5.2 Practical Implications

The outcomes of this research investigation have significant implications. To begin with, they highlight the necessity for companies to embrace green innovation processes in alignment with the 2015 Sustainable Development Goals (SDGs), thereby promoting sustainable development. This underscores the need for top managers and leaders to develop and implement strategies that prioritize substantial investment in green innovation and sustainable development, with careful attention to environmental regulations to effectively address SDGs and enhance dynamic market performance.

Secondly, the study emphasizes the importance for managers and leaders to allocate considerable organizational resources towards cultivating Green Dynamic Capabilities (GDC). These capabilities are crucial for facilitating green innovation across products and processes, thereby meeting key market demands for sustainability.

Lastly, the study underscores the fundamental purpose of every organization: continuous improvement in market and financial performance. It suggests that manufacturing firms can achieve sustainable development through the successful implementation of green dynamic capabilities to foster green innovation initiatives. Where ERCCL) enhances the green growth. Green innovation emerges as a vital competitive tool, enabling firms to navigate dynamic markets by offering sustainable green products and services.

5.3 Limitations and Directions for Future Study

It is crucial to recognize the limits of our research, even if it has substantial consequences for the intersection of theory and practice. First off, the study's reliance on cross-sectional data suggests that a long term strategy would be required for future research. Additionally, there is potential to enhance the model by incorporating moderating variables such as corporate governance in subsequent studies. We suggest that in order to overcome the drawbacks of each methodology and provide significant implications for theory and practice, future research should combine both qualitative and quantitative approaches.

This research is conducted in Pakistan, and future research could expand to other countries and industries other than manufacturing. By drawing samples from diverse regions, researchers can empirically validate our research framework and develop sustainable green innovation practices applicable to various markets. Despite these limitations, the conclusions have drawn from this study provides insightful information for theory development, researchers, and organizations operating within the manufacturing industry, particularly in markets that contribute to environmental pollution.

6. References

Abrudan, D. B., Rafi, N., Daianu, D. C., & Kalyar, M. N. (2022). Linking green intellectual capital with green innovation: Examining the roles of green dynamic capabilities and'motivation to achieve legitimacy'. *Agricultural Economics, 68*(7), 250-258.

Ahmad, B., Shafique, I., Qammar, A., Ercek, M., & Kalyar, M. N. (2022). Prompting green product and process innovation: Examining the effects of green transformational leadership and dynamic capabilities. *Technology Analysis & Strategic Management*, 1-13.

Akomea-Frimpong, I., Adeabah, D., Ofosu, D., & Tenakwah, E. J. (2021). A review of studies on green finance of banks, research gaps and future directions. *Journal of Sustainable Finance & Investment*, 1-24.

Akomea-Frimpong, I., Adeabah, D., Ofosu, D., & Tenakwah, E. J. (2022). A review of studies on green finance of banks, research gaps and future directions. *Journal of Sustainable Finance & Investment, 12*(4), 1241-1264.

Akter, N., Siddik, A., & Mondal, M. A. (2018). Sustainability reporting on green financing: A study of listed private sustainability reporting on green financing: A study of listed private commercial banks in Bangladesh. *J. Bus. Technol, 12*, 14-27.

Albort-Morant, G., Leal-Rodríguez, A. L., Fernández-Rodríguez, V., & Ariza-Montes, A. (2018). Assessing the origins, evolution and prospects of the literature on dynamic capabilities: A bibliometric analysis. *European Research on Management and Business Economics, 24*(1), 42-52.

Amabile, T. M. (1988). A model of creativity and innovation in organizations. *Research in organizational behavior, 10*(1), 123-167.

Amaranti, R., Govindaraju, R., & Irianto, D. (2019). *Green dynamic capability for enhancing green innovations performance in a manufacturing company: a conceptual framework.* Paper presented at the IOP Conference Series: Materials Science and Engineering.

Aragon-Correa, J. A., Matıas-Reche, F., & Senise-Barrio, M. E. (2004). Managerial discretion and corporate commitment to the natural environment. *Journal of Business Research, 57*(9), 964-975.

Arshad, M., Yu, C. K., Qadir, A., & Rafique, M. (2023). The influence of climate change, green innovation, and aspects of green dynamic capabilities as an approach to achieving sustainable development. *Environmental Science and Pollution Research*, 1-20.

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of management, 17*(1), 99-120.

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. Journal of Personality and Social Psychology, 51, 1173-1182.

Byrne, B. M. (2016). Structural equation modeling with AMOS: Basic concepts, applications, and programming. Routledge.

Bernadeta, I., Patworo, L. H., & Prapti, M. S. (2021). Green Dynamic Capability Analysis: Study on SME Sustainable Fashion in Semarang. *Sustainable Competitive Advantage (SCA), 11*(1).

Boubakri, N., Cosset, J.-C., & Saffar, W. (2013). The role of state and foreign owners in corporate risk-taking: Evidence from privatization. *Journal of Financial Economics, 108*(3), 641-658.

Brundtland, G. H. (1985). World commission on environment and development. *Environmental policy and law, 14*(1), 26-30.

Carmona-Lavado, A., Cuevas-Rodríguez, G., & Cabello-Medina, C. (2010). Social and organizational capital: Building the context for innovation. *Industrial Marketing Management, 39*(4), 681-690.

Cezarino, L. O., Alves, M. F. R., Caldana, A. C. F., & Liboni, L. B. (2019). Dynamic capabilities for sustainability: Revealing the systemic key factors. *Systemic Practice and Action Research, 32*, 93-112.

Chen, Y.-S., & Chang, C.-H. (2013). The determinants of green product development performance: Green dynamic capabilities, green transformational leadership, and green creativity. *Journal of business ethics, 116*, 107-119.

Chen, Y.-S., Chang, T.-W., Lin, C.-Y., Lai, P.-Y., & Wang, K.-H. (2016). The influence of proactive green innovation and reactive green innovation on green product development performance: The mediation role of green creativity. *Sustainability, 8*(10), 966.

Cheng, C. C. (2020). Sustainability orientation, green supplier involvement, and green innovation performance: Evidence from diversifying green entrants. *Journal of business ethics, 161*, 393-414.

Chiou, T.-Y., Chan, H. K., Lettice, F., & Chung, S. H. (2011). The influence of greening the suppliers and green innovation on environmental performance and competitive advantage in Taiwan. *Transportation Research Part E: Logistics and Transportation Review, 47*(6), 822-836.

Chiu, Y.-B., & Lee, C.-C. (2020). Effects of financial development on energy consumption: The role of country risks. *Energy Economics, 90*, 104833.

Dangelico, R. M., Pujari, D., & Pontrandolfo, P. (2017). Green product innovation in manufacturing firms: A sustainability-oriented dynamic capability perspective. *Business Strategy and the Environment, 26*(4), 490-506.

Dean, T. J., & Brown, R. L. (1995). Pollution regulation as a barrier to new firm entry: Initial evidence and implications for future research. *Academy of Management Journal, 38*(1), 288-303.

Dawson, J. F. (2014). Moderation in management research: What, why, when and how. Journal of Business and Psychology, 29, 1-19.

Diesendorf, M. (2000). Sustainability and sustainable development. *Sustainability: The corporate challenge of the 21st century, 2*, 19-37.

Dong, Z., Xu, H., Zhang, Z., Lyu, Y., Lu, Y., & Duan, H. (2022). Whether Green Finance Improves Green Innovation of Listed Companies—Evidence from China. *International Journal of Environmental Research and Public Health, 19*(17), 10882.

Donnellan, J., & Rutledge, W. L. (2019). A case for resource-based view and competitive advantage in banking. *Managerial and Decision Economics, 40*(6), 728-737.

Esteves, A. M., Genus, A., Henfrey, T., Penha-Lopes, G., & East, M. (2021). Sustainable entrepreneurship and the Sustainable Development Goals: Community-led initiatives, the social solidarity economy and commons ecologies. *Business Strategy and the Environment, 30*(3), 1423-1435.

Foss, N. J. (1997). *Resources, firms, and strategies: a reader in the resource-based perspective*: Oxford University Press.

FUND, S. (2015). Sustainable development goals.

Goni, F. A., Gholamzadeh Chofreh, A., Estaki Orakani, Z., Klemeš, J. J., Davoudi, M., & Mardani, A. (2021). Sustainable business model: A review and framework development. *Clean Technologies and Environmental Policy, 23*, 889-897.

Graafland, J., & Smid, H. (2017). Reconsidering the relevance of social license pressure and government regulation for environmental performance of European SMEs. *Journal of Cleaner Production, 141*, 967-977.

Gray, R. (2010). Is accounting for sustainability actually accounting for sustainability… and how would we know? An exploration of narratives of organisations and the planet. *Accounting, organizations and society, 35*(1), 47-62.

George, D., & Mallery, P. (2021). *IBM SPSS statistics 27 step by step: A simple guide and reference.* Routledge.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). Multivariate data analysis.

Horbach, J. (2008). Determinants of environmental innovation—New evidence from German panel data sources. *Research policy, 37*(1), 163-173.

Hung, R. Y. Y., Yang, B., Lien, B. Y.-H., McLean, G. N., & Kuo, Y.-M. (2010). Dynamic capability: Impact of process alignment and organizational learning culture on performance. *Journal of World Business, 45*(3), 285-294.

Irfan, M., Razzaq, A., Sharif, A., & Yang, X. (2022). Influence mechanism between green finance and green innovation: Exploring regional policy intervention effects in China. *Technological Forecasting and Social Change, 182*, 121882.

Kock, N. (2015). Common method bias in PLS-SEM: A full collinearity assessment approach. *International Journal of e-Collaboration (ijec),* 11(4), 1-10.

King, A., (2000). Organizational response to environmental regulation: punctuated change or autogenesis? *Business Strategy and the Environment*, 9, 224e238.

Kareem, M. A., & Alameer, A. A. A. (2019). The impact of dynamic capabilities on organizational effectiveness. *Management & Marketing. Challenges for the Knowledge Society, 14*(4), 402-418.

Li, D., Zheng, M., Cao, C., Chen, X., Ren, S., & Huang, M. (2017). The impact of legitimacy pressure and corporate profitability on green innovation: Evidence from China top 100. *Journal of Cleaner Production, 141*, 41-49.

Li, H. (2022). Green innovation, green dynamic capability, and enterprise performance: evidence from heavy polluting manufacturing enterprises in China. *Complexity, 2(*1), 25-38.

Lin, Y.-H., & Chen, Y.-S. (2017). Determinants of green competitive advantage: the roles of green knowledge sharing, green dynamic capabilities, and green service innovation. *Quality & Quantity, 51*, 1663-1685.

López-Gamero, M. D., Molina-Azorín, J. F., & Claver-Cortés, E. (2010). The potential of environmental regulation to change managerial perception, environmental management, competitiveness and financial performance. *Journal of Cleaner Production, 18*(10-11), 963-974.

Luan, N. T., Hau, D. N. D., & Thu, N. T. A. (2022). The Influence of Green Product Development Performance to Enhance Enterprise Effectiveness and Innovation. *Economies, 10*(5), 113.

Luo, Y., Salman, M., & Lu, Z. (2021). Heterogeneous impacts of environmental regulations and foreign direct investment on green innovation across different regions in China. *Science of the total environment, 759*, 143744.

Ma, L., Ali, A., Shahzad, M., & Khan, A. (2022). Factors of green innovation: The role of dynamic capabilities and knowledge sharing through green creativity. *Kybernetes*(ahead-of-print).

Meirun, T., Makhloufi, L., & Ghozali Hassan, M. (2020). Environmental outcomes of green entrepreneurship harmonization. *Sustainability, 12*(24), 10615.

Mensah, J. (2019). Sustainable development: Meaning, history, principles, pillars, and implications for human action: Literature review. *Cogent Social Sciences, 5*(1), 1653531.

Muganyi, T., Yan, L., & Sun, H.-p. (2021). Green finance, fintech and environmental protection: Evidence from China. *Environmental Science and Ecotechnology, 7*, 100107.

Mulaessa, N., & Lin, L. (2021). How do proactive environmental strategies affect green innovation? The moderating role of environmental regulations and firm performance. *International Journal of Environmental Research and Public Health, 18*(17), 9083.

Naqvi, B., Mirza, N., Rizvi, S. K. A., Porada-Rochoń, M., & Itani, R. (2021). Is there a green fund premium? Evidence from twenty seven emerging markets. *Global Finance Journal, 50*, 100656.

Nassani, A. A., Javed, A., Radulescu, M., Yousaf, Z., Secara, C. G., & Tolea, C. (2022). Achieving Green Innovation in Energy Industry through Social Networks, Green Dynamic Capabilities, and Green Organizational Culture. *Energies, 15*(16), 5925.

Nazarenko, L. S., Tausnev, N., Russell, G. L., Rind, D., Miller, R. L., Schmidt, G. A., . . . Ackerman, A. S. (2022). Future Climate Change under SSP Emission Scenarios with GISS-E2. 1. *Journal of Advances in Modeling Earth Systems, 14*(7), e2021MS002871.

Ouyang, X., Li, Q., & Du, K. (2020). How does environmental regulation promote technological innovations in the industrial sector? Evidence from Chinese provincial panel data. *Energy Policy, 139*, 111310.

Phrampus, B. J., & Hornbach, M. J. (2012). Recent changes to the Gulf Stream causing widespread gas hydrate destabilization. *Nature, 490*(7421), 527-530.

Porter, M. E., & Kramer, M. R. (2011). The big idea: Creating shared value. *Harvard business review, 89*(1), 2.

Porter, M.E., 1991. America's green strategy. Scientific American 264, 168.

Porter, M., Van der Linde, C., 1995. Toward a new conception of the environment-competitiveness relationship. Journal of Economic Perspectives 9, 97e118.

Pulido-Velazquez, D., Renau-Pruñonosa, A., Llopis-Albert, C., Morell, I., Collados-Lara, A.-J., Senent-Aparicio, J., & Baena-Ruiz, L. (2018). Integrated assessment of future potential global change scenarios and their hydrological impacts in coastal aquifers–a new tool to analyse management alternatives in the Plana Oropesa-Torreblanca aquifer. *Hydrology and Earth System Sciences, 22*(5), 3053-3074.

Qiu, L., Jie, X., Wang, Y., & Zhao, M. (2020). Green product innovation, green dynamic capability, and competitive advantage: Evidence from Chinese manufacturing enterprises. *Corporate Social Responsibility and Environmental Management, 27*(1), 146-165.

Rao, P., & Holt, D. (2005). Do green supply chains lead to competitiveness and economic performance? *International journal of operations & production management*.

Ray, G., Barney, J. B., & Muhanna, W. A. (2004). Capabilities, business processes, and competitive advantage: choosing the dependent variable in empirical tests of the resource-based view. *Strategic management journal, 25*(1), 23-37.

Singh, S. K., Del Giudice, M., Chiappetta Jabbour, C. J., Latan, H., & Sohal, A. S. (2021). [Stakeholder pressure, green innovation, and performance in small and medium-sized enterprises: The role of green dynamic capabilities]. 1.

Singh, S. K., Del Giudice, M., Chiappetta Jabbour, C. J., Latan, H., & Sohal, A. S. (2022). Stakeholder pressure, green innovation, and performance in small and medium-sized enterprises: The role of green dynamic capabilities. *Business Strategy and the Environment, 31*(1), 500-514.

Song, W., & Yu, H. (2018). Green innovation strategy and green innovation: The roles of green creativity and green organizational identity. *Corporate Social Responsibility and Environmental Management, 25*(2), 135-150.

Stanovcic, T., Pekovic, S., & Bouziri, A. (2015). The effect of knowledge management on environmental innovation: The empirical evidence from France. *Baltic Journal of management, 10*(4), 413-431.

Teece, D. J. (2014). The foundations of enterprise performance: Dynamic and ordinary capabilities in an (economic) theory of firms. *Academy of management perspectives, 28*(4), 328-352.

Teece, D. J. (2018). Business models and dynamic capabilities. *Long range planning, 51*(1), 40-49.

Tseng, M.-L., Chiu, A. S., Liu, G., & Jantaralolica, T. (2020). Circular economy enables sustainable consumption and production in multi-level supply chain system. *Resources, Conservation and Recycling, 154*, 104601.

Ullah, H., Wang, Z., Mohsin, M., Jiang, W., & Abbas, H. (2022). Multidimensional perspective of green financial innovation between green intellectual capital on sustainable business: the case of Pakistan. *Environmental Science and Pollution Research, 29*(4), 5552-5568.

Wang, X. (2022). Research on the impact mechanism of green finance on the green innovation performance of China's manufacturing industry. *Managerial and Decision Economics, 43*(7), 2678-2703.

Wernerfelt, B. (1984). A Resource--Based View of the Firm, Strategic Management Journal, Vol. 5. *Resource, firms, and Strategies*.

Wing, L. C., & Jin, Z. (2015). Risk management methods applied to renewable and sustainable energy: a review. *Journal of Electrical and Electronic Engineering, 3*(1), 1-12.

Wong, S. K. S. (2013). Environmental requirements, knowledge sharing and green innovation: Empirical evidence from the electronics industry in China. *Business Strategy and the Environment, 22*(5), 321-338.

Xu, X. (2023). Does green finance promote green innovation? Evidence from China. *Environmental Science and Pollution Research, 30*(10), 27948-27964.

Yang, Y., Su, X., & Yao, S. (2022). Can green finance promote green innovation? The moderating effect of environmental regulation. *Environmental Science and Pollution Research, 29*(49), 74540-74553.

Yousaf, Z. (2021). Go for green: green innovation through green dynamic capabilities: accessing the mediating role of green practices and green value co-creation. *Environmental Science and Pollution Research, 28*(39), 54863-54875.

Yousaf, Z., Radulescu, M., Sinisi, C., Nassani, A. A., & Haffar, M. (2022). How do firms achieve green innovation? Investigating the influential factors among the energy sector. *Energies, 15*(7), 2549.

Yu, C.-H., Wu, X., Zhang, D., Chen, S., & Zhao, J. (2021). Demand for green finance: Resolving financing constraints on green innovation in China. *Energy Policy, 153*, 112255.

Yu, D., Tao, S., Hanan, A., Ong, T. S., Latif, B., & Ali, M. (2022). Fostering green innovation adoption through green dynamic capability: The moderating role of environmental dynamism and big data analytic capability. *International Journal of Environmental Research and Public Health, 19*(16), 10336.

Zahid, R., Khurshid, M., & Khan, W. (2022). Do chief executives matter in corporate financial and social responsibility performance nexus? A dynamic model analysis of Chinese firms. *Frontiers in Psychology, 13*, 2420.

Zhai, X., & An, Y. (2020). Analyzing influencing factors of green transformation in China's manufacturing industry under environmental regulation: A structural equation model. *Journal of Cleaner Production, 251*, 119760.

Zhang, D., Zhang, Z., & Managi, S. (2019). A bibliometric analysis on green finance: Current status, development, and future directions. *Finance Research Letters, 29*, 425-430.

Zhang, J., Ouyang, Y., Philbin, S. P., Zhao, X., Ballesteros-Pérez, P., & Li, H. (2020). Green dynamic capability of construction enterprises: Role of the business model and green production. *Corporate Social Responsibility and Environmental Management, 27*(6), 2920-2940.

Zhao, T., Zhou, H., Jiang, J., & Yan, W. (2022). Impact of green finance and environmental regulations on the green innovation efficiency in China. *Sustainability, 14*(6), 3206.