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Investor Perception, Green Innovation, and Financial Performance: Insights from Indian Manufacturing Firms

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Abstract: In this study the complex relationships between sustainability practices and green innovation in Indian manufacturing firms, focusing on quality management, green process innovation, and green product innovation are examined. The aim of the study was to investigate the impact of green technological advancements and quality management on the financial performance and investor-perceived value of manufacturing firms. The green process and green product innovations implication on financial performance and investor perception was also explored. With the help of Pearson correlation and regression analyses, the study assessed the impact of quality management and green innovations on financial performance and investor perception. The findings revealed a significant positive correlation between green product innovation and investor perception, endorsing environmentally responsible companies to attract higher investments and improve financial prospects. However, no significant positive correlation was found between green process innovation and financial performance, which may be influenced by upfront costs and delayed benefits. Green process innovation moderates the relationship between quality management and investor perception, while green product innovation mediates the relationship between green process innovation and investor perception. These insights highlight the importance of prioritising green product innovation to enhance investor perception and integrate environmental considerations into quality management. The study's results align with Sustainable Development Goal 9, promoting sustainable industrialisation, innovation, and infrastructure in the Indian manufacturing industry, fostering a more resilient and environmentally responsible sector.

Keywords: green process innovation, green product innovation, quality management, financial performance, investor perception.

Introduction

In the rapidly evolving business environment, organisations have become more focussed towards the importance of incorporating sustainable practices into their operations (Habib et al., 2023; Okorie et al., 2022; Wu et al., 2023; Yavuz et al., 2023). This shift is a result of the increasing awareness of the profound effects of commercial activities on the ecosystem and society (Ali et al., 2023; Chandra Voumik & Sultana, 2022; Rahman & Alam, 2022; Yang et al., 2022b). As a result, companies are adopting innovative strategies, such as quality management, green process innovation, and green product innovation, to reduce their environmental footprint and enhance their sustainability performance.

Quality management is a strategic approach emphasising the continuous improvement of processes and products to maximize customer satisfaction (Abid et al., 2022; Ahmed et al., 2022; Li et al., 2022; van Doren et al., 2020). In comparison, green process innovation entails adopting cutting-edge technologies and processes that minimize waste, conserve resources, and mitigate the environmental impact (Cheng & Yu, 2023; De Giovanni & Cariola, 2021; Xu et al., 2023; Zhang et al., 2023). Likewise, green product innovation involves developing environmentally friendly products that cater to customer needs and address sustainability concerns (Khan et al., 2022; Majali et al., 2022; Moshood et al., 2022). Both green process and product innovations can boost environmental performance (Wang et al., 2021; Xie et al., 2019; Yuan & Cao, 2022)

Quality management practices can be a foundational basis for green technological innovations. Quality Management principles, such as continuous improvement, customer orientation, and waste reduction, empower organizations in order to identify opportunities for sustainable practices, design eco-friendly products, and establish green processes. (Amin et al., 2023; Huang et al., 2023; Shehzad et al., 2023; Wang et al., 2022) highlighted the importance of quality Management practices in fostering green-innovation development. Integrating quality Management practices can assist organizations in reducing their environmental impact and adhering to regulations. Several researchers (Cheng et al., 2021; Wang et al., 2023b; Zhou et al., 2022) have found that implementing QM practices in industries significantly influences environmental performance, including waste reduction, energy conservation, and emissions reduction. In summary, quality management practices are crucial in promoting and supporting green innovation within organisations. Organisations can achieve environmental and economic benefits by adopting QM practices while fostering green innovation, creating eco-friendly products, and implementing sustainable processes.

Financial performance is an essential metric that evaluates a company's ability to generate profits and create value for its stakeholders (Baah et al., 2021; Karaye et al., 2014; Quintelier & Vock, 2022). Investors often use this measure to assess a firm's prospects and inform investment decisions (Leng et al., 2023; Wen et al., 2021). Various factors influence investors' perceptions of a company, including its financial performance, sustainability practices, and environmental impact (Martin, 2019; Mayoral & Vallelado, 2012; Roccapriore et al., 2021; Triki, 2019). No specific research has explored the relationship between innovation, sustainability practices, and financial performance in Indian manufacturing firms. However, studies by (Duong et al., 2022; Hermundsdottir & Aspelund, 2022; Jagani, 2023; Menne et al., 2022; Wut & Ng, 2015) provide valuable insights into the interplay among these variables and their implications.

Research Problem

Numerous investigations have delved into the association between innovation, sustainability practices, and financial performance; nonetheless, there is a dearth of research specifically targeting Indian manufacturing industries. Asim and Sorooshian, (2019) discovered that innovation catalysts, including quality management and green innovation, propel innovation capabilities and performance. Research conducted by Lee and Suh, (2022) offered valuable insights into green innovation's effect on financial performance and investor perceptions through a stakeholder-centric approach. Xie et al.,

(2019) examined the correlation between green innovation and financial performance by scrutinizing green core competence. Baldassarre et al. (2020) and Bautista-Puig et al. (2022) provided insights into implementing sustainable practices within organisations. Sarkis et al. (2011) deliver insights into the relationship between green supply chain management practices and financial performance through an organisational theoretic review.

The research questions addressed in the study hold great importance in the context of Indian manufacturing firms for several reasons. First, India's rapid development, immense population, and growing demand for goods and services have led to substantial industrialization and manufacturing, resulting in heightened environmental impacts. Consequently, it is imperative for Indian manufacturing firms to adopt sustainable practices, such as green technological advancements, quality management, green process innovation, and green product innovation, to curtail their environmental footprint and bolster their sustainability performance. Second, a company's financial performance is a crucial metric that evaluates its capacity to generate profits and create value for stakeholders. In the Indian manufacturing domain, where competition intensifies and cost reduction pressures mount, examining the influence of sustainable practices on financial performance is essential. The research questions investigated the interplay between quality management, green process innovation, green product innovation, financial performance, and investor-perceived value within Indian manufacturing firms. Third, investor perception is molded by various factors, including financial performance, sustainability practices, and environmental impact. Given the mounting investor interest in sustainable practices among Indian manufacturing firms, exploring the effect of green technological advancements, quality management, green process innovation, and green product innovation on investor perception is of utmost importance.

The research queries explored in this study were exceedingly pertinent and valuable for Indian manufacturing enterprises. They aimed scrutinising the intricate interplay between sustainable practices, financial performance, and investor sentiment, all of which were critical factors for these firms' long-term prosperity and sustenance.

Furthermore, this research holded significant importance concerning SDG 12 (Responsible Consumption and Production) as it endeavored to fathom how ecologically responsible practices, like green processes and product innovation, could shape investor sentiment, thereby fostering sustainable consumption and production patterns. SDG 12 aims to ensure sustainable consumption and production patterns by promoting resource efficiency, reducing waste generation, and minimizing the environmental impact of economic activities. Through an in-depth analysis of the influence of green technological advancements and quality management on financial performance and investor perception, the research provided valuable insights to Indian manufacturing firms on the extent of harmonisation of their business objectives with their environmental goals. By understanding the interplay between sustainability practices, innovation, and financial performance, firms could align their strategies with SDG 12 objectives and contribute to a more sustainable and responsible manufacturing industry."

To achieve the desired outcomes, the study intended to utilise Pearson correlation and regression analyses, enabling a comprehensive examination of the relationship between sustainable practices, financial performance, and investor perception. The research findings provided practical recommendations to managers and policymakers on promoting sustainable practices in the manufacturing domain, enhancing financial gain, and shaping investor sentiment, eventually contributing to SDG 9 (Industry, Innovation, and Infrastructure) by fostering sustainable industrialisation, innovation, and robust infrastructure, as well as SDG 12 (Responsible Consumption and Production) by endorsing sustainable production and consumption practices.

Research Focus

This research paper was part of the domain of Sustainable Business Management economics, particularly focusing on the intersection of sustainability practices, quality management, and financial performance within Indian manufacturing firms. Incorporating elements of Corporate Social Responsibility (CSR) and Business Ethics, the paper investigated the role of green innovations and their impact on investor perception, aligning with Sustainable Development Goals (SDGs). With an emphasis on green product and process innovation's influence on corporate performance and reputation, the paper intersects with Innovation Management. The holistic approach of this research affirmed its significance in contributing to the literature of Sustainable Business Practices and Green Management.

Research Aim and Research Questions

In this investigation was made an attempt to enrich the current literature by meticulously assessing the possible effects of sustainable practices on financial performance and investors' perceptions in the context of Indian Manufacturing companies. Explicitly, this paper strived to address the following research inquiries:

RQ (1) the ramifications of green technological advancements and quality management on a company's financial performance and investor perceived value

RQ (2) the implications of green process innovation on manufacturing firms financial performance and investor's perception

RQ (3) the consequences of green product innovation on a manufacturing firm its financial performance and investor's perception

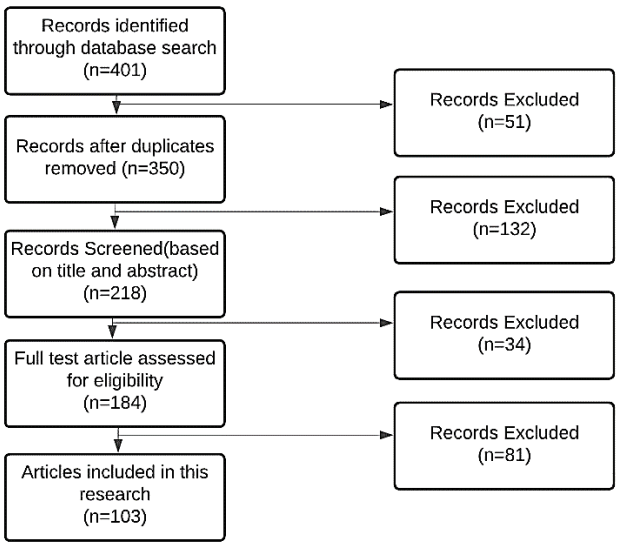
Theoretical Framework and Hypothesis

PRISMA Analysis

The paper conducted an extensive literature review using the PRISMA method as depicted in Figure 1. Keywords like Green process innovations, Green Product Innovation, Quality Management, Financial Performance, Investor Perception, and their combinations were used to search through various libraries like SCOPUS and Open Science Framework (OSF). 356 Papers were objectively selected through searches on different databases, of which 101 were included in this research.

Figure 1

PRISMA analysis



Theoretical Framework

The theoretical foundation of this research paper drew upon several established theories to support the study's hypotheses. Specifically, the Resource-Based View (RBV) theory, Stakeholder theory, Contingency theory, and Ambidexterity theory were employed to deepen the understanding of the complex relationships between green process innovation, green product innovation, quality management, financial performance, and investor perception.

The RBV Theory postulated that firms could attain a sustainable competitive advantage by leveraging their unique and valuable resources (Barney, 2001; Wernerfelt, 1984). Green process innovation is considered a resource, enabling firms to reduce waste, conserve resources, and minimising the environmental impact. This, in turn, could lead to enhanced financial performance by lowering costs and boosting efficiency (Hart, 1995; Russo & Fouts, 1997). The Stakeholder Theory, on the other hand, highlighted the importance of addressing the needs and interests of various stakeholder groups, including investors (Freeman et al., 2021). By engaging in green product innovation, firms could positively influence investors' perception of their commitment to sustainable practices and environmental responsibility (Clarkson, 1995; Post et al., 2002), which was particularly pertinent in today's market, where investors were increasingly concerned about environmental and social performance (Scholtens, 2006).

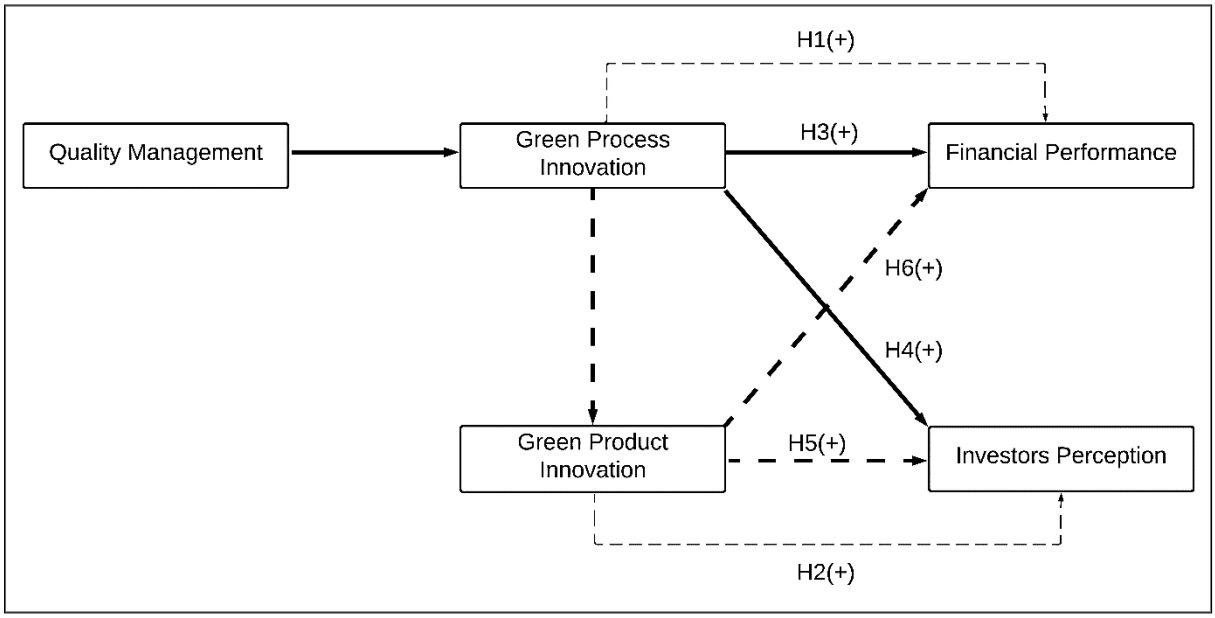
Contingency Theory asserted that the effectiveness of a management practice depends on the fit between the practice and the specific context where it was applied (Lawrence & Lorsch, 1967; Donaldson, 2001). The moderating effect of green process innovation on the relationship between quality management and financial performance implied that the extent to which green process innovation is implemented could influence this relationship. Research has shown that integrating quality management practices with environmental initiatives could improve financial performance (Florida, 1996; King & Lenox, 2009). Integrating RBV Theory and Stakeholder Theory supports the moderating effect of green process innovation between quality management and investor perception. By aligning quality management practices with green process innovation, firms could enhance investors' perception of their commitment to customer satisfaction and environmental responsibility (Hart & Dowell, 2011; Jamali, 2008).

Finally, Ambidexterity Theory emphasised the need to balance exploration (innovation and adaptation) and exploitation (efficiency and control) to achieve long-term success (Tushman & O'Reilly, 1996). The moderating effect of green product innovation between green process innovation and financial performance suggested that firms must develop capabilities in both green process and product innovation to achieve optimal financial outcomes (O'Reilly & Tushman, 2008; Simsek et al., 2009). The integration of RBV Theory, Stakeholder Theory, and Ambidexterity Theory supported the moderating effect of green product innovation between green process innovation and investor perception. This integration illustrated that by combining green processes and product innovation, firms could demonstrate their commitment to a sustainable competitive advantage, address stakeholder concerns, and balance innovation with efficiency (Lavie et al., 2010; Sharma & Vredenburg, 1998).

Integrating these theories provides a solid conceptual framework for the study's hypotheses as depicted in Figure 2. It can be argued that aligning quality management practices and green process innovation could improve investor perception by showcasing a company's commitment to customer satisfaction and environmental responsibility. Furthermore, combining green processes and product innovation could enhance investor perception by illustrating a firm's commitment to a sustainable competitive advantage, addressing stakeholder concerns, and balancing innovation with efficiency.

Figure 2

Conceptual Framework



Green Technological Advancements

Green innovation has become increasingly important for firms due to growing concerns about environmental sustainability and the benefits it can bring in terms of financial performance and investor perception. *Green innovation* is developing and implementing new or improved products, services, processes, or practices that positively impact the environment (Liu et al., 2023; Shobande et al., 2023; Yang et al., 2022a). Green innovation can take two forms: Green Process and Product Innovation. Green Process innovation refers to adopting environmentally friendly practices in a firm's operations, while Green Product innovation involves the development of new or improved environmentally friendly products (Moshood et al., 2022; Rahman, 2023).

The research has shown that Green Process innovation can lead to cost savings, improved operational efficiency, and enhanced reputation, which can positively impact a firm's financial performance (Geng et al., 2017). Similarly, Green Product innovation can positively affect financial performance, increasing sales revenue, market share, and customer loyalty (Chen & Liu, 2020; Fontoura & Coelho, 2022; Liu et al., 2020; Majali et al., 2022). Therefore, firms need to analyze the co-relations between Green Process Innovation and Financial Performance, as well as Green Product Innovation and Investor Perception.

Investor perception is crucial in determining a firm's success and financial performance. Research has shown that firms perceived as environmentally responsible and sustainable are more likely to attract positive investor attention and receive higher levels of investment. Green Product innovation can be crucial in enhancing investor perception, as it can signal a firm's commitment to sustainability and environmental responsibility (Alam & Islam, 2021). Moreover, Green Product innovation can also increase sales revenue and market share, further improving investor perception (Kneipp et al., 2019). Thus we advance the following Hypothesis:

Hypothesis 1. The company's Green Process Innovation level is positively related to its Financial Performance.

Hypothesis 2. The company's Green product Innovation level is positively correlated to the Investor's Perception of the Company.

Moderating Role of Green Process Innovation

The Indian manufacturing industry has been facing increasing pressure to adopt sustainable practices due to environmental concerns, regulatory requirements, and stakeholder demands. Quality management practices are critical drivers of sustainable development in the manufacturing industry. They can enhance operational efficiency, reduce waste and emissions, and improve product quality. However, the relationship between quality management and financial performance or investor perception may be moderated by other factors, such as adopting green process innovation.

Green process innovation involves developing and implementing environmentally friendly technologies, processes, and practices that can reduce the environmental impact of manufacturing operations. Green process innovation can enhance the effectiveness of quality management practices by providing a platform for showcasing the benefits of sustainable practices to stakeholders, improving resource efficiency, and reducing costs.

Therefore, it is essential to examine the moderating effect of green process innovation on the relationship between quality management and financial performance or investor perception in the context of Indian manufacturing industries. By doing so, researchers can gain insights into the factors that influence the effectiveness of quality management practices in achieving sustainable development goals, as well as identify strategies that can be used to enhance the impact of quality management practices on financial performance and investor perception.

Recent studies have highlighted the importance of examining the moderating effect of green process innovation on the relationship between quality management and financial performance or investor perception. For instance, a study by (García-Fernández et al., 2022) found that adopting green process innovation can enhance the positive relationship between quality management practices and financial performance. Similarly, a study by (Shahzad et al., 2022)found that adopting green process innovation can enhance the positive relationship between quality management practices and investor perception in the Pakistani manufacturing industry. Examining the moderating effect of green process innovation on the relationship between quality management and financial performance or investor perception can provide valuable insights into the factors that influence the effectiveness of quality management practices in achieving sustainable development goals in the context of Indian manufacturing industries leading us to the following Hypothesis:

Hypothesis 3. The level of Green Process innovation moderated the relationship between a firm's Quality Management level and Financial Performance.

Hypothesis 4. The level of Green Process innovation moderated the relationship between a firm's Quality Management level and Investor's Perception.

Moderating Role of Green Product Innovation

In recent years, environmental issues have become a significant concern for manufacturing companies worldwide. Green innovations such as Green Process Innovation and Green Product Innovation have been identified as critical drivers for achieving sustainability goals while enhancing company performance. In this context, it is essential to investigate the moderating effect of Green Product Innovation between Green Process Innovation and Financial Performance and Investor's Perception in Indian manufacturing industries.

Studying the moderating effect of Green Product Innovation in the relationship between Green Process Innovation and Financial Performance is crucial because it can help manufacturing companies understand the potential benefits and drawbacks of their sustainability strategies. According to the resource-based view theory, sustainable innovation can create a competitive advantage for firms (Barney, 2001). Therefore, by exploring the moderating effect of Green Product Innovation, firms can

better understand how to enhance their financial performance through sustainable innovation practices.

Moreover, investigating the moderating effect of Green Product Innovation on the relationship between Green Process Innovation and Investor's Perception is also important because investors have shown an increased interest in companies with strong environmental performance (de Freitas Netto et al., 2020). This interest can translate into increased investments, enhancing the company's financial performance. Furthermore, Green Product Innovation can play a crucial role in shaping investors' perception of a firm's environmental responsibility and can be considered a potential competitive advantage.

In the context of Indian manufacturing industries, investigating the moderating effect of Green Product Innovation in these relationships was particularly relevant due to the growing importance of environmental issues in the region (Emre Caglar, 2020). Additionally, the Indian government has launched various initiatives to promote sustainability in the manufacturing sector, such as the National Clean Energy Fund and the National Solar Mission.

Therefore, this study aimed to contribute to the literature on sustainable innovation and performance by exploring the moderating effect of Green Product Innovation in the relationship between Green Process Innovation and Financial Performance and Investor's Perception in the context of Indian manufacturing industries. The results of this Hypothesis could provide valuable insights for firms, policymakers, and investors interested in sustainability issues, ultimately contributing to the achievement of sustainable development goals leading to the development and testing of the following Hypothesis:

Hypothesis 5. The level of Green Product innovation moderates the relationship between the Level of Green Process Innovation and the company's financial performance.

Hypothesis 6. The level of Green Product innovation moderates the relationship between the Level of Green Process Innovation and the Investor's Perception of the company.

Research Methodology

General Background

In this research a quantitative approach to scrutinise the intricate relationship between sustainability practices, financial performance, and investor sentiment in Indian manufacturing firms was employed. The study used primary data collection through the content analysis distributed to a sample of listed manufacturing firms in India. In the study Pearson correlation and regression analyses to test the hypotheses was utilised, allowing for a comprehensive examination of the relationship between sustainable practices, financial performance, and investor perception. These statistical techniques enabled the study to draw meaningful conclusions and provide a robust analysis of the data collected. Furthermore, the research drew upon multiple theoretical perspectives, such as the Resource-Based View theory, Stakeholder theory, Contingency theory, and Ambidexterity theory, to examine the complex relationships between sustainability practices and innovation in Indian manufacturing firms. This methodology employed a rigorous and systematic approach to analyse research questions and test hypotheses, contributing to the theoretical understanding of sustainability practices and innovation in the manufacturing sector.

To scrutinise the formulated hypotheses, a comprehensive array of analytical models was deployed. The assessment of Hypotheses 1 and 2 entailed the utilisation of Pearson correlation tests, unearthing intricate associations between the variables at hand. For the investigation of Hypotheses 3, 4, 5, and 6, a meticulous approach was adopted, employing four distinct moderation analyses, each crafting a bespoke model. Hypothesis 3 delved into the influence of quality management as the independent variable on financial performance as the dependent variable, with green process

innovation serving as the moderating variable. As for Hypothesis 4, the independent variable was quality management, the dependent variable was investors' perception, and the moderating variable was green process innovation. Hypothesis 5 scrutinised the independent variable of green process innovation, the dependent variable of financial performance, and the moderating variable of green product innovation. Lastly, Hypothesis 6 explored the independent variable of green process innovation, the dependent variable of investors' perception, and the moderating variable of green product innovation. Throughout all moderation analyses, age was incorporated as a control variable, meticulously considered to ensure the robustness of the findings.

The present study employed a set of equations to rigorously examine the formulated hypotheses. These equations were carefully constructed to assess the relationships between the variables and to evaluate the validity of the proposed hypotheses. By utilising these equations, we aimed to provide a robust framework for analyzing and interpreting the empirical findings, thereby contributing to the scientific discourse on the research topic.

Hypothesis 3:

$$\text{Financial Performance} = \beta0 + \beta1 * \text{Quality Management} + \beta2 * \text{Green Process Innovation} + \beta3 * \text{Quality Management} * \text{Green Process Innovation} + \beta4 * \text{Age} + \varepsilon$$

Hypothesis 4:

$$\text{Investors' Perception} = \beta0 + \beta1 * \text{Quality Management} + \beta2 * \text{Green Process Innovation} + \beta3 * \text{Quality Management} * \text{Green Process Innovation} + \beta4 * \text{Age} + \varepsilon$$

Hypothesis 5:

$$\text{Financial Performance} = \beta0 + \beta1 * \text{Green Process Innovation} + \beta2 * \text{Green Product Innovation} + \beta3 * \text{Green Process Innovation} * \text{Green Product Innovation} + \beta4 * \text{Age} + \varepsilon$$

Hypothesis 6:

$$\text{Investors' Perception} = \beta0 + \beta1 * \text{Green Process Innovation} + \beta2 * \text{Green Product Innovation} + \beta3 * \text{Green Process Innovation} * \text{Green Product Innovation} + \beta4 * \text{Age} + \varepsilon$$

Sample

The study utilised Quality Management, Green Technological advancements, and Financial data from 237 companies in the Indian manufacturing industry listed on the National Stock Exchange and Bombay Stock Exchange, contributing to nearly 1 lakh crore of market capitalisation out of the industry's 2.5 lakh crore market cap. Initially, a dataset of 378 companies was selected for analysis, but due to data unavailability and company size, the final number of analysed companies was reduced to 237. The study extracted data on Green process innovation, Green product innovation, Quality Management, Financial Performance, and Investor perception from the companies' CSR reports, official websites, and reliable sources such as Financial Times. The data was obtained through content analysis and evaluated using Spearman correlation and linear regression analysis.

Table 1

Variables and Measurements

Variables	Measurements	Data Sources
Firm Age	Number of years listed in the Indian market to the year 2023	Firm's Annual Reports
Green Process Innovation	GPI1 minimizes the use of resources and energy while enhancing efficacy. GPI2 denotes implementing environmental campaigns to promote sustainable practices.	Firm's Corporate Social Responsibility Reports

	GPI3 involves adopting pollution control projects and techniques to curb environmental damage. GPI4 employs sustainable technology, recycled materials, and recycling techniques to mitigate emissions.	
Green Product Innovation	GProdI1 alters the product material to benefit recovery, recycling, and decomposition. GProdI2 enhancing, developing, and embracing eco-friendly packaging practices or usage of bio-degradable plastics GprodI3 modifying product design to boost quality and efficiency and benefit end-of-life product recovery	Firm's Corporate Social Responsibility Reports
Quality Management	If the firm is achieved the latest ISO 9001 certification	Firm's Annual Reports
Green production Linked Incentives	Amount of Green production linked incentives related to environmental protection	Firm's Annual Reports
Financial Performance	Return on Assets	Firm's Annual Reports
Investors Perception	PB ratio	Firm's Financial Data

Dependent Variables

Financial Performance. Return on assets, a standard accounting metric commonly utilised by scholars (Li et al., 2021; Tiwari et al., 2023), is a valid measure of financial performance in this study. As Return on assets reflects a company's profitability concerning its assets and the efficiency of its production processes, it is relevant for the manufacturing industry, capturing asset utilisation and efficiency. Moreover, Return on assets is straightforward to compute and readily available in financial reports, making it a convenient measure to use, capturing essential aspects of a company's profitability and industry relevance.

Investor's Perception. The price-to-book ratio, a widely accepted metric used by investors to assess a company's financial health, growth prospects, and future earnings potential, is a simple and intuitive tool that can be easily calculated and compared across various firms. As it is less influenced by accounting practices and other subjective factors than other measures, it is a more objective indicator of a company's financial performance, thus serving as an appropriate measure for this study.

Past literature provides strong evidence supporting the price-to-book (PB) ratio as a measure of investor perception. Kalra (2007) as well as Baker and Wurgler (2006) found a positive correlation between the PB ratio and investor perception, indicating a willingness to pay a premium for perceived undervalued stocks.

Independent and Moderating Variables

Green Process Innovation. The green process innovation of Indian manufacturing firms was measured using four criteria, as suggested by Wang et al. (2023a) and Xu et al. (2023) (Table 1), taking into account the companies' CSR reports, emission-reducing technologies adopted, and measures taken to improve sustainability, drawing data from credible financial papers like Financial Times and Moneycontrol, demonstrating a reliable and accurate measure.

Green Product Innovation. This study used the content analysis of data from reliable sources such as company websites, CSR reports, and Financial Times articles to evaluate three metrics of green product innovation, providing a comprehensive and well-rounded measure of this variable.

Quality Management. ISO 9001:2015, a variable set out to establish a framework for continually improving organisational processes, was chosen for quality management. It required companies to establish a systematic approach to identify, prioritise, and manage quality-related issues and concerns, making it an appropriate variable for this study (Ingason, 2015; Latan et al., 2020; Nurcahyo et al., 2021; Parra-López et al., 2016; Sumaedi & Yarmen, 2015).

Control Variables

Age. The inclusion of Age as a control variable in this study mitigated the potential influence of generational differences on the relationship between green innovation and financial performance, providing a more accurate and precise analysis of the impact of green innovation on financial performance.

Reliability Test

In the study two separated coders to collect data on green process innovation, green product innovation, and quality management, initially extracting data for 90 companies were used. The inter-code reliability was evaluated using the Bayesian Unidimensional reliability test, which previous researchers demonstrated to be reliable (Rossat et al., 2021; Zhang & Wang, 2018). The computed omega values were above the threshold of 0.70, affirming the reliability of the data and allowing for practical conclusions to be drawn from the analysis.

Research Results

In this study Pearson correlation and regression analyses to test hypotheses regarding the relationship between green product innovations, green process innovation, financial performance, and investor perception were utilised. Table 1 displays the Pearson correlation coefficients of the variables, revealing a significant positive correlation between green product innovation and investor perception, supporting Hypothesis 1. However, no significant positive correlation was found between green process innovation and financial performance, failing to support Hypothesis 2. The reason for this discrepancy may be attributed to several factors. The increasing consumer awareness of environmental impact has resulted in a preference for environmentally responsible companies, leading to higher sales and profits and positively impacting investor perception (Toussaint et al., 2021).

Table 2

Correlation Analysis

	Green Process Innovation	Green Product Innovation	Quality Manage-menu	PB ratio	Financial Performa-nce	Age
Green Process Innovation	1					
Green Product Innovation	0.115	1				
Quality Management	.603***	0.098	1			
PB ratio	-0.055	0.176**	0.102	1		
Financial Performance	0.039	0.063	0.059	0.390***	1	

Age	0.128*	0.316***	0.041	0.226***	0.292***	1

Furthermore, green product innovation can lead to cost savings in the long run, translating into higher profits and positive investor perceptions. Companies with sustainable and innovative products have a competitive advantage in a competitive market, increasing market share and brand recognition (Li et al., 2017). Additionally, companies focusing on green product innovation are better equipped to comply with environmental regulations, reducing legal and financial risks, and thus viewed favorably by investors (Xie et al., 2022b). Conversely, green process innovation often requires a significant upfront investment, impacting short-term profitability (Wesseling et al., 2017). Additionally, the benefits of green process innovation may take time to become apparent in financial metrics, and the impact on financial performance may be influenced by external factors such as market demand and competition (Xie et al., 2022a).

Table 3

Regression results of moderating effects of Green Process Innovation

Variables	**Model 1**	**Model 2**
Age	0.680	0.708
Predictors		
Quality Management	0.047	0.056
Moderators		
Green Process Innovation	0.044	0.036
Green Process Innovation X Quality Management	0.059	0.187***
R Squared	0.004	0.035
Adjusted R squared	0.009	0.023
F-value	0.274	2.82
Change in R square	0.004	0.035
Change in F -statistic	0.274	2.82
		*** p < 0.01
		** p < 0.05
		*p <0.10

Table 3 displays the regression results for hypotheses 3 and 4. Hypothesis 3, which posited that Green Process innovation directly affected Financial Performance, was not supported by the results of model 1. It leaded to the failure of the Hypothesis. On the other hand, the results of model 2 supported Hypothesis 4, which suggests that Green Process innovation moderates the relationship between Quality Management and Investor perception. This finding indicated that implementing environmentally-friendly practices into Quality Management can enhance a firm's perceived value, leading to more positive investor perception. However, the absence of market incentives and regulatory pressures for environmental sustainability practices in India may explain why Green Process innovation did not moderate the relationship between Quality Management and Financial performance. Additionally, green process innovation's high costs and complexity should encourage firms to invest in such initiatives with clear benefits and incentives (Li & Lu, 2023). These findings highlighted the importance of market incentives, regulatory pressures, and clear benefits in driving firms to invest in

environmentally-friendly practices and realised the associated financial and non-financial benefits (Mazaheri et al., 2022)

Table 4

Regression results of moderating effects of Green Product Innovation

Variables	**Model 3**	**Model 4**
Age	0.681	0.709
Predictors		
Green Process Innovation	0.046	-0.025
Moderators		
Green Product Innovation	0.302	0.09
Green Product Innovation X Green Process Innovation	0.115	0.187**
R Squared	0.013	0.039
Adjusted R squared	0.01	0.026
F-value	1.044	3.13
Change in R square	0.013	0.039
Change in F -statistic	1.044	3.13
		*** p < 0.01 ** p < 0.05 *p <0.10

Table 4 presents the regression analysis results for hypotheses 5 and 6, with model 3 and model 4 representing the analyses, respectively. The findings indicate that while the results of model 3 did not support Hypothesis 5, which suggests that Green product innovation moderated the relationship between Green Process Innovation and the Financial Performance of the company, the results of model 4 supported hypothesis 6, which stated that Green product Innovation mediated the relationship between Green Process Innovation and Investors Perception of the company. Possible reasons for the lack of moderation effect of Green Product innovation on the relationship between Green Process Innovation and Financial performance in the context of Indian manufacturing companies could be due to the delayed visibility of benefits in financial terms and the more direct impact of Green Process innovation on operational efficiency and cost savings, which are directly linked to financial performance (Geissdoerfer et al., 2018). However, more research is needed to better understand this phenomenon. On the other hand, there are several reasons why Green Product innovation could moderate the relationship between Green Process Innovation and Investor Perception. For instance, Green product innovation could enhance the company's reputation as environmentally responsible, leading to increased investor interest and positive perception. It could also increase sales revenue and market share, positively impacting investor perception. Additionally, Green Product innovation could enhance the effectiveness of Green Process innovation by providing a platform for showcasing the benefits of green processes to consumers, suppliers, and other stakeholders (Alraja et al., 2022). Nonetheless, further research is needed to explore the complex relationship between Green Product innovation and financial performance, particularly in the context of Indian manufacturing firms.

Discussion & Findings

This study employed advanced statistical techniques, including Pearson correlation and regression analyses, in order to examine the intricate interplay between green product innovation, green process innovation, financial performance, and investor perception. The empirical findings revealed a robust and statistically significant positive correlation between green product innovation and investor perception, thereby providing strong support for Hypothesis 1. However, the analysis did not uncover any significant positive correlation between green process innovation and financial performance, thus failing to substantiate Hypothesis 2. Model 1 failed to lend support to Hypothesis 3, which posits a direct influence of Green Process innovation on Financial Performance. In contrast, Model 2 decisively substantiated Hypothesis 4, demonstrating that Green Process innovation served as a crucial moderating factor in the relationship between Quality Management and Investor perception. Although Model 3 did not find support for Hypothesis 5, which suggests the moderating effect of Green product innovation on the relationship between Green Process Innovation and the Financial Performance of the company, Model 4 offered compelling evidence in favor of Hypothesis 6, indicating that Green product Innovation effectively mediates the relationship between Green Process Innovation and Investors Perception of the company. These results illuminate the complex dynamics between the studied variables, enriching the scholarly discourse and paving the way for further explorations in this domain.

The results showed that there was a robust and statistically significant positive correlation between green product innovation and investor perception, but no significant positive correlation between green product innovation and financial performance. This finding is consistent with the results of other studies, such as a study by Lukitaruna and Sedianingsih (2018), which found that green product innovation was positively associated with investor perception, but not with financial performance.

The study also found that green process innovation moderated the relationship between quality management and investor perception. This means that the effect of quality management on investor perception was stronger when green process innovation was high. This finding is consistent with the results of a study by García-Fernández et al. (2022), which found that green process innovation moderated the relationship between quality management.

Finally, the study found that green product innovation mediated the relationship between green process innovation and investor perception. This means that green product innovation was a mechanism through which green process innovation influenced investor's perception. This finding is consistent with the results of a study by Abu Seman et al. (2019), which found that green product innovation mediated the relationship between green supply chain management and customer satisfaction.

The results of this study provide new insights into the complex dynamics between green product innovation, green process innovation, financial performance, and investor perception. These findings can help companies' better understanding in green innovation use in order to improve their financial performance and investor perception.

Theoretical Contributions

This study generated theoretical contributions of paramount significance. Firstly, it provided a framework for further research exploring the impact of green technological advancements and Quality Management adaptations in the context of Indian Manufacturing firms which has not been significantly explored yet. The considerable sample size made the results more reliable and practical for future research.

Secondly, the study contributed to the existing literature (Dangelico & Pujari, 2010; García-Granero et al., 2018) by examining the integration of Quality Management and Green Technological

Advancements and their effect on financial and firm performance. The results highlighted the need for more external implementation of green product innovation and the lack of motivation for consumers to buy expensive green products, resulting in no influence on financial performance. However, the results revealed a significant positive moderation effect of Green Technological Advancements on investors' perception, which sheded light on the contingent mechanism that Green Technological Advancements boost investors' Confidence.

Lastly, the study aligned with SDG 9 (Industry, Innovation, and Infrastructure) by providing valuable insights to policymakers and managers seeking to endorse sustainable industrialisation, foster innovation, and establish robust infrastructure in the manufacturing industry. SDG 9 aims to promote sustainable industrialisation, foster innovation, and build resilient infrastructure. This goal was relevant to the study because it focused on the need to reduce the environmental impact of manufacturing and consumption.

The study also highlighted the importance of environmentally responsible products in shaping investor sentiment, which was crucial for promoting sustainable consumption and production patterns in line with SDG 12 (Responsible Consumption and Production). SDG 12 aimed to ensure sustainable consumption and production patterns. This goal was relevant to the study because it focused on the need to reduce the environmental impact of products and services.

Managerial Implications

The findings have crucial managerial implications. Firstly, companies should allocate resources toward green product innovation, which can elicit a favorable perception from investors. To enhance this perception, managers must effectively communicate their organisation's endeavors in green product innovation. Secondly, although the study did not find a significant correlation between green process innovation and financial performance, managers should weigh the costs and benefits of investing in such initiatives.

Thirdly, the significant moderation effect of green process innovation between quality management and customers' perception and the existence of a significant moderation effect of green product innovation between green process innovation and customers' perception suggests that improving the quality of green processes can positively affect customers' perception of the company. Therefore, managers should prioritize improving green processes' quality to boost customers' perception. Additionally, managers should concentrate on enhancing the quality of green products to augment customers' perception of the company's green endeavors.

Lastly, no significant moderation effect of green product innovation between green process innovation and financial performance was found. Therefore, managers should carefully evaluate the costs and benefits of investing in green product innovation initiatives.

Conclusions and Implications

The primary objective of this research paper was to explore the interrelationships between sustainability practices, innovation and financial performance in Indian manufacturing firms, with a specific focus on green process innovation, green product innovation, and quality management. The study yielded insightful findings relevant to policymakers and managers seeking to promote sustainability practices and innovation in the manufacturing industry. Notably, the results underscored the critical role of green product innovation in shaping investor perception, highlighting the importance of prioritising developing and marketing eco-friendly products to enhance a firm's reputation and attract investment. Additionally, the study emphasised the moderating effect of green process innovation in the relationship between quality management and investor perception, underscoring the significance of integrating environmentally responsible practices into quality management systems to boost investor perception and long-term financial performance.

Despite the valuable insights yielded by this research, certain limitations should be noted, such as the cross-sectional data used in the study and the exclusive focus on the Indian manufacturing sector. Future research should address these limitations by exploring these relationships longitudinally and across diverse industry contexts in order to gain a deeper understanding of the generalisability of these findings. Moreover, future research could examine other potential moderating and mediating variables influencing the links between sustainability practices, innovation, and firm performance.

The present research findings underscored the significance of green product in shaping the investment attitude, which is imperative for promoting sustainable consumption and production practices in the manufacturing domain in line with SDG 12 (Responsible Consumption and Production). The research scrutinised the influence of green processes and green product innovation on financial gain, thereby highlighting the hurdles faced by Indian manufacturing organisations while executing and achieving the benefits of these initiatives. This was in accordance with SDG 12's objective of endorsing sustainable production and consumption practices.

The research aligned with SDG 9 (Industry, Innovation, and Infrastructure) and analysed the intricate associations between sustainability approaches and innovation in Indian manufacturing enterprises by focusing on quality management, green process innovation, and green product innovation. The research examined the impact of green technological advancements and quality management on fiscal yield and investor perception, providing valuable insights to administrators and policymakers seeking to endorse sustainable industrialisation and nourish innovation. Therefore, this research aligned with SDG 9's goal of promoting sustainable industrialisation, fostering innovation, and establishing robust infrastructure.

Overall, this study advanced the knowledge of the intricate interplay between sustainability practices, innovation and financial performance in manufacturing firms. By adopting green product and process innovations and integrating them with quality management practices, manufacturing firms can enhance their financial performance and investor perception, ultimately contributing to a more sustainable and competitive manufacturing industry.

Suggestion for Future Research

Although the study provided essential insights into green technological advancements in the Indian manufacturing industry, some limitations need addressing. Firstly, the green process and product innovation measurements solely rely on the content in the firms' reports and relevant and reliable information pieces. Future research should seek more valid measurements and collect panel data to measure these variables to explore better the dynamic relationship between green technological innovations and firms' financial performance.

Secondly, due to limited data, the effects of green processes and product innovation were only examined. Green management innovation, another kind of green innovation, is also of great importance (Adomako & Nguyen, 2023; Gao et al., 2022). Future research can investigate the interdependence of these three green innovations to provide further insights into green innovations. Despite these limitations, this research is vital for both firms and government agencies, as the desire for greener industries for sustainable development seems likely to continue unabated.

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Conflict of Interest

None.

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Appendix

Table A

The data for the statistical testing has been obtained from the following reports and data available on companies official website

Variables	Data Sources
Firm Age	Firm's Annual Reports
Green Process Innovation	Firm's Corporate Social Responsibility Reports
Green Product Innovation	Firm's Corporate Social Responsibility Reports
Quality Management	Firm's Annual Reports
Green production Linked Incentives	Firm's Annual Reports
Financial Performance	Firm's Annual Reports
Investors Perception	Firm's Financial Data

Table B

Descriptive statistics

	Quality Management Dummy	Green Process Dummy	Green Product Dummy	PB ratio	Age	ROA
Valid	237	237	237	237	237	237
Missing	0	0	0	0	0	0
Mean	0.895	2.342	1.114	6.140	30.954	8.478
Std. Deviation	0.308	0.629	1.105	8.475	28.342	6.393
Minimum	0.000	1.000	0.000	0.430	1.000	21.210
Maximum	1.000	3.000	3.000	79.580	197.000	32.640