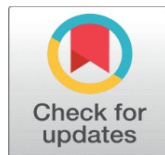
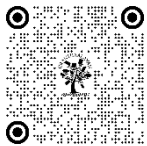


IMPACT OF GREEN INNOVATION (GI) PERFORMANCE ON COMPETITIVE ADVANTAGE OF FIRMS IN INDIA

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ABSTRACT

Green Innovation (GI) is increasingly recognized as a critical factor in enhancing the competitive advantage of firms globally, and this trend is evident in India as well. This article explores how the performance of Green Innovation contributes to a firm's competitive edge in the Indian context. Key drivers such as regulatory compliance, market demand, cost-reduction opportunities, and corporate social responsibility (CSR) mandates are examined. The article highlights various GI performance metrics, including resource efficiency and green product development, and discusses how these can translate into competitive advantages such as brand reputation, differentiation, cost leadership, and access to new markets. Case studies of Indian companies like Tata Motors, ITC Limited, and Mahindra & Mahindra demonstrate the real-world impact of GI on business success. Finally, the challenges that firms face in implementing Green Innovation, including high initial costs and supply chain constraints, are considered.

Keywords: Green Innovation (GI), Competitive Advantage, Sustainability, Indian Firms, Environmental Regulations, Resource Efficiency and Corporate Social Responsibility (CSR)

1. INTRODUCTION

The emphasis on sustainability has emerged as a critical differentiator among firms in the swiftly changing business environment of today. Green Innovation has the capacity to not only enhance a company's competitive advantage but also decrease its environmental footprint. Green Innovation is the term used to describe innovations that promote sustainable development by minimising the environmental impact of production processes and products. It

encompasses a diverse range of practices, including the implementation of energy-efficient technologies, the utilisation of renewable energy sources, the implementation of waste minimisation strategies, and the establishment of sustainable supply chain management. A combination of regulatory pressures, stakeholder expectations, and market opportunities is the driving force behind Green Innovation on a global scale. Companies are progressively implementing environmentally sustainable practices in order to satisfy the increasing demand for eco-friendly products and adhere to regulations. Additionally, governments are providing subsidies, grants, and incentives to encourage sustainability. The transition to Green Innovation is also acquiring momentum in India. Market demand for sustainable products and services is on the rise, despite the fact that regulatory pressure has been a significant promoter of environmental practices. India has undergone rapid industrialisation, as it is one of the fastest-growing economies. The environmental degradation that has resulted from this industrial expansion has prompted policymakers to prioritise sustainable development. The adoption of green innovations by firms has been strongly encouraged initiatives such as the National Action Plan on Climate Change and a variety of renewable energy policies. Toyota's lean manufacturing system exemplifies capability-driven competitive advantage. Companies with advanced green technologies, robust environmental credentials, and the ability to incorporate sustainability into their business models are strategically positioned to excel in a dynamic global marketplace.

GREEN INNOVATION ON COMPETITIVE ADVANTAGE

Companies that excel in Green Innovation are likely to accrue numerous advantages that enhance their competitive edge. Improved Brand Image: A more favourable brand image is typically associated with organisations that are actively involved in sustainable practices. Customers are inclined to favour organisations that are perceived as environmentally responsible in India, where environmental concerns are becoming increasingly prevalent. A thriving sustainability reputation can result in a larger market share, positive word-of-mouth, and increased consumer loyalty. In industries such as FMCG (fast-moving consumer goods), automotive, and textiles, eco-friendly products can establish a distinctive selling proposition that resonates with environmentally conscious consumers. Firms can offer competitive pricing without forsaking margins by reducing operational expenses through the efficient use of energy, water, and basic materials. In the long term, these practices may result in market cost leadership. Firms mitigate the likelihood of noncompliance with environmental regulations by proactively implementing Green Innovation. This can assist in the prevention of legal penalties, product recalls, or reputational harm, all of which could be detrimental to a company's competitive position. Particularly in export markets, compliance with international environmental standards can also generate new market opportunities. Companies that prioritise sustainability are more likely to access new market segments when they invest in GI. For example, in order to be considered as preferable suppliers, global supply chains are increasingly mandating that companies exhibit robust environmental credentials. Companies that demonstrate exceptional GI performance have the opportunity to capitalise on these markets and forge strategic partnerships. The Indian workforce, like many other regions worldwide, is increasingly environmentally aware. Employees who prioritise sustainability frequently gravitate towards organisations that prioritise green innovation. A more motivated and productive workforce can be achieved by a strong commitment to environmental stewardship, which can also improve employee satisfaction and retention.

Figure: 1

The Conceptual Framework

Below is the conceptual framework obtained based on the above literature:

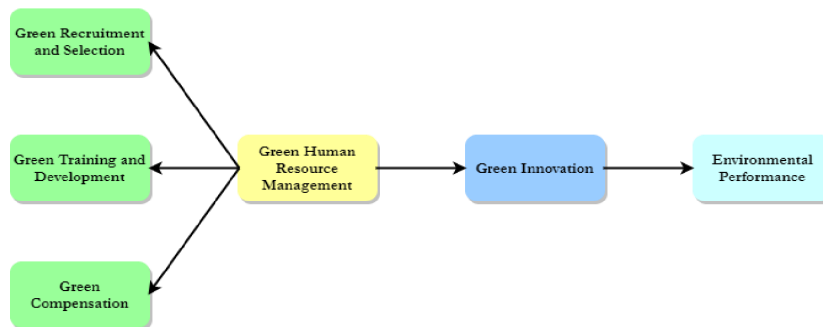


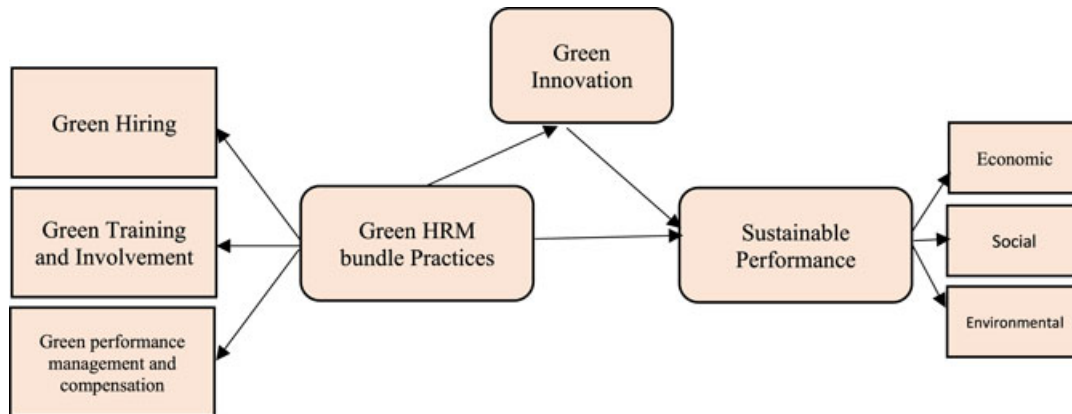
Figure 1: Conceptual framework

TATA MOTORS: PROMOTING GREEN INNOVATION IN INDIA

Sustainable development and Green Innovation (GI) have been at the vanguard of the automotive sector in India, with Tata Motors being one of the largest and most prominent automobile manufacturers. Tata Motors has strategically incorporated green practices into its operations, from vehicle design to manufacturing processes, as environmental

concerns and regulatory pressures continue to escalate. The company has been able to secure a competitive advantage in the evolving automotive market and reduce its environmental footprint as a result of this approach.

Figure: 2



2. DEDICATION TO ELECTRIC MOBILITY

Tata Motors' dedication to electric mobility is its most noteworthy contribution to Green Innovation. The company has been a pioneer in the Indian electric vehicle (EV) market, which is essential to the nation's endeavours to reduce carbon emissions and transition to sustainable transportation. The Tata Nexon EV, which has become one of the most popular electric automobiles in India, is among the electric vehicles that Tata Motors has developed and launched. The Nexon EV is a critical milestone in the organization's transition to sustainability. It provides Indian consumers with a sustainable alternative to conventional gasoline-powered vehicles by integrating high performance with eco-friendliness. Tata Motors has increased the accessibility of electric vehicles (EVs) to the Indian middle class by utilising advanced battery technology and rapid charging capabilities. This initiative addresses both environmental concerns and affordability. Tata Motors intends to broaden its electric portfolio to encompass electric versions of popular models, including the Altroz and Harrier, in addition to the Nexon EV. The company's long-term vision of transitioning away from fossil fuel-powered vehicles is illustrated by this aggressive drive into electric mobility. This initiative is designed to stimulate the adoption of electric vehicles.

3. MANUFACTURING METHODS THAT PROMOTE SUSTAINABILITY

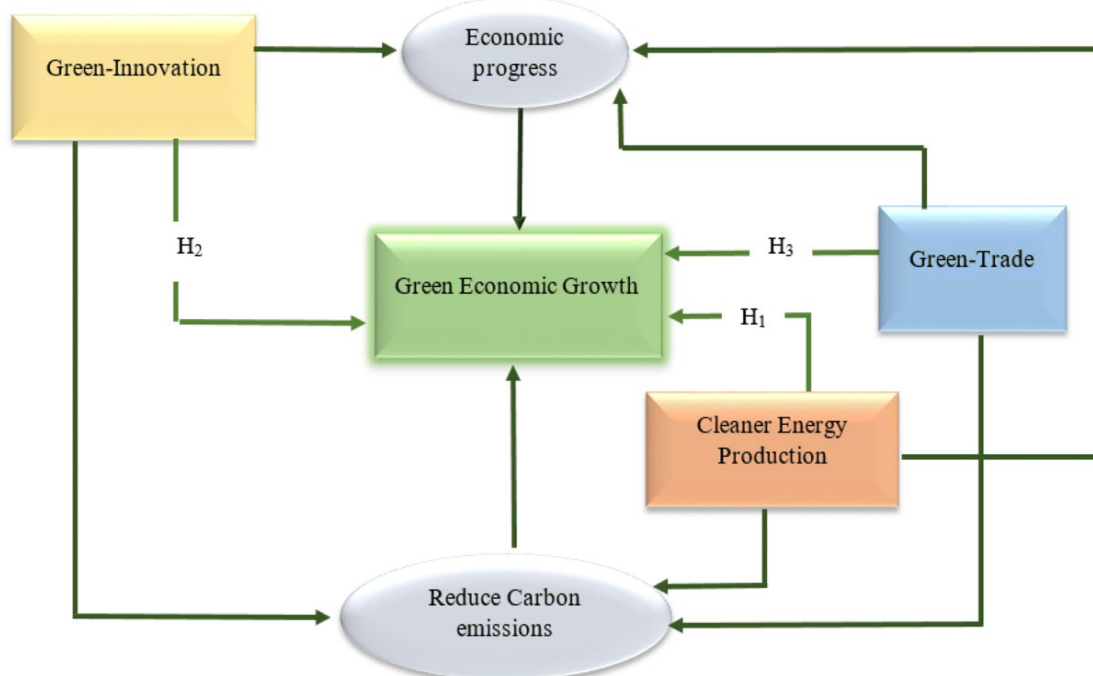
The company has instituted a variety of initiatives to decrease the consumption of energy, water, and pollution in its facilities. Tata Motors' Pune and Jamshedpur facilities have implemented energy-efficient technologies that mitigate their carbon footprint. In order to satisfy its energy needs, the organisation has implemented renewable energy sources, including solar and wind power. Tata Motors had successfully procured approximately 16% of its energy requirements from renewable sources by 2020, and it has expressed a desire to further increase this percentage in the years ahead. Tata Motors is also actively engaged in water conservation and waste management. It has implemented processes to recycle refuse generated during vehicle production and has made substantial efforts to reduce water usage in its facilities. The company has become more environmentally benign and resource-efficient as a result of the implementation of effluent recycling and precipitation harvesting systems.

4. ENVIRONMENTAL INITIATIVES AND CORPORATE SOCIAL RESPONSIBILITY

Tata Motors' commitment to Green Innovation is not restricted to its products and processes; it also encompasses its Corporate Social Responsibility (CSR) initiatives. The organisation has been proactive in its efforts to foster environmental sustainability by interacting with communities. Its environmental credentials have been further fortified by its community initiatives that promote environmental awareness and tree plantation campaigns in the vicinity of manufacturing facilities. Furthermore, the company's Sustainability Report, which is issued annually, offers transparency with respect to its sustainability objectives and environmental impact. The company's objectives are in alignment with the global movement towards sustainable business practices, and this dedication to transparency fosters trust among stakeholders. The expensive expense of EV production, particularly the cost of batteries, continues to be a challenge. Furthermore, the universal adoption of electric vehicles may be restricted by the underdeveloped charging

infrastructure that exists throughout India. Nevertheless, Tata Motors is confronting these obstacles by forging strategic partnerships and implementing innovative solutions. The company is investing in battery technology to enhance efficiency and reduce costs, and its partnership with Tata Power is designed to broaden the EV charging network. Additionally, the company is working to develop affordable electric vehicle models that are accessible to a broader segment of the Indian population. Tata Motors has become a pioneer in the automotive sector of India with respect to green innovation. The company is establishing new standards for environmental stewardship by focussing on sustainable manufacturing practices, corporate social responsibility initiatives, and electric mobility. Tata Motors is not only securing a competitive advantage in a swiftly evolving market but also contributing to India's environmental objectives by aligning its business strategy with the increasing demand for sustainable products and practices. The company is on the brink of a significant impact on the future of sustainable mobility in India as it continues to expand its green initiatives and innovate.

Figure: 3



5. MAHINDRA & MAHINDRA: A LEADER IN GREEN INNOVATION IN INDIA

Mahindra & Mahindra, a multinational conglomerate that is one of the largest in India, is renowned for its dedication to sustainability and its influence in a variety of industries, such as automotive, agriculture, and information technology. The company has established itself as a pioneer in Green Innovation (GI) by incorporating eco-friendly practices into all of its business verticals. Mahindra & Mahindra has not only improved its competitive advantage in a swiftly evolving market but also reduced its environmental footprint by concentrating on sustainable mobility, energy efficiency, renewable energy, and green agriculture.

6. ELECTRIC VEHICLES AND SUSTAINABLE MOBILITY

Mahindra & Mahindra's leadership in electric mobility is one of its most significant contributions to Green Innovation. The company has been a significant participant in the Indian electric vehicle (EV) market, having early recognized the potential of EVs to address the environmental challenges associated with fossil fuel consumption. The Mahindra Treo is a groundbreaking product in the electric vehicle (EV) industry, specifically engineered to meet the increasing demand for affordable, environmentally friendly, and efficient urban mobility solutions. This electric rickshaw provides a zero-emission alternative to conventional auto-rickshaws, which are infamous for their contribution to air pollution in Indian cities. The Treo has been extensively adopted throughout India and is increasing in popularity as a result of its low operating costs and environmental benefits. Mahindra's long-term vision for electric mobility is not limited to passenger vehicles. In addition to diversifying its green portfolio, the organisation is also conducting research on electric solutions for commercial vehicles and forklifts. For example, the electric tractor is considered a game-changer in the agricultural sector, as it provides a sustainable alternative to diesel-powered tractors and reduces farm operating costs.

7. INITIATIVES FOR RENEWABLE ENERGY

Mahindra & Mahindra's dedication to sustainability extends beyond electric vehicles; the company has been actively engaged in the pursuit of renewable energy solutions for both its operations and its consumers. Mahindra Susten, a subsidiary of the Mahindra Group, is a significant participant in the renewable energy sector of India, providing solutions for green building construction, energy storage, and solar power. Mahindra Susten has been engaged in large-scale solar energy initiatives throughout India, with an emphasis on both utility-scale solar arrays and distributed solar solutions. The organisation has facilitated the transition of industries and businesses to solar energy, thereby decreasing their dependence on non-renewable energy sources. This has established Mahindra as a significant participant in the renewable energy transition in India, which is consistent with the government's objective to increase the proportion of renewable energy sources in the nation's energy matrix. Mahindra's dedication to renewable energy is also commendable. In order to mitigate their ecological footprint, the organisation has implemented solar energy systems at their automotive manufacturing facilities in Haridwar and Nagpur. One of the first Indian conglomerates to establish such ambitious sustainability objectives is the Mahindra Group, which has embarked on an audacious mission to achieve carbon neutrality by 2040. Mahindra has implemented numerous environmentally favourable technologies in the agricultural sector to enhance the sustainability of cultivation, as part of its commitment to Green Innovation. Mahindra is a significant influence on the future of agriculture in India and around the globe, as it is the world's largest manufacturer of tractors by volume. Mahindra & Mahindra has introduced energy-efficient, low-emission tractors and agricultural equipment that assist farmers in enhancing productivity and mitigating environmental damage. The Mahindra Swaraj tractors manufactured by the company are engineered to be fuel-efficient, thereby enabling farmers to decrease their carbon emissions and fuel consumption. Furthermore, Mahindra's commitment to sustainable agriculture is not restricted to machinery. Mahindra Samriddhi, a program that provides farmers with training and advisory services, is an example of how the organisation has actively advocated for climate-smart agricultural practices. Mahindra is facilitating the adoption of more sustainable agricultural practices by farmers through the implementation of precision farming techniques, water conservation methods, and organic farming practices. This approach guarantees the rural economy and the environment long-term benefits.

8. ENVIRONMENTAL LEADERSHIP AND CORPORATE SOCIAL RESPONSIBILITY

Mahindra & Mahindra's commitment to sustainability is also evident in its Corporate Social Responsibility (CSR) initiatives, which prioritise environmental stewardship. The company has implemented a variety of initiatives to enhance the quality of life for local communities and mitigate its environmental impact. Project Hariyali, a large-scale tree plantation initiative that seeks to increase verdant cover in India, is one of the flagship programs. Mahindra had planted more than 16 million trees under this initiative by 2021, which made a substantial contribution to the conservation of biodiversity and the sequestration of carbon. Mahindra is also dedicated to water conservation, with a particular emphasis on drought-prone regions. The company has implemented watershed management initiatives that have had a beneficial effect on local communities and producers by increasing the availability of water for irrigation and other purposes. The objectives of these initiatives are consistent with Mahindra's overarching objective of promoting sustainable development in rural India. Additionally, Mahindra has exhibited a dedication to transparency and accountability in its environmental initiatives. In 2016, the company established a precedent for other corporations to follow by becoming the first Indian company to announce an internal carbon price. This internal carbon price enables Mahindra to incorporate the environmental costs of its business decisions into its financial planning, thereby guaranteeing that sustainability remains a fundamental aspect of all of its operations. Mahindra & Mahindra is confronted with numerous obstacles, despite its accomplishments in Green Innovation. In a price-sensitive market such as India, the high cost of developing and scaling electric vehicle technologies is one of the primary obstacles. Furthermore, the absence of a robust charging infrastructure continues to impede the widespread adoption of electric vehicles (EVs), despite the fact that Mahindra has implemented initiatives to resolve this issue through partnerships and collaborations. Additionally, Mahindra must confront obstacles in the agriculture sector, including the gradual adoption of new technologies by farmers and the necessity of extensive training and capacity development to encourage sustainable agricultural practices. Nevertheless, Mahindra & Mahindra's dedication to sustainability and forward-thinking approach position it to effectively address these obstacles. The company is well-positioned to lead India's green revolution and contribute significantly to the development of a more sustainable future through its ongoing innovation in sustainable agriculture, renewable energy, and electric mobility. Mahindra & Mahindra is a leader in green innovation

in India, thanks to its investments in sustainable agriculture, renewable energy, and electric mobility. The company's comprehensive sustainability strategy not only strengthens its competitive edge but also supports India's overarching environmental objectives. Mahindra & Mahindra is poised to continue its role as a critical participant in the global effort to transition to a more sustainable and environmentally friendly economy as a result of its unwavering commitment to innovation and visionary leadership.

9. REVIEW OF LITERATURE

Zameer et al. (2022) examined the interplay between business analytics, environmental orientation, and green competitive advantage, with green innovation acting as a mediating variable. The authors propose that companies utilizing business analytics and implementing an environmentally orientated strategy are more inclined to innovate in green technologies and processes. Green innovation serves as a mediator that enhances a firm's competitive advantage by enabling the provision of sustainable products, decreasing operational costs, and ensuring compliance with environmental regulations. The findings emphasised the necessity of combining data analytics with environmental objectives to promote innovation and sustain long-term competitiveness. Zhang (2019) evaluated the relationship between the adoption of green innovations, including energy-efficient technologies. The findings indicate that companies implementing green innovations typically achieve better financial outcomes and greater market competitiveness. The research highlights the significance of governmental policies and regulations in promoting the adoption of environmentally sustainable practices by firms, which in turn supports their long-term success. Xue et al. (2019) investigated the impact of green innovation (GI) on firm performance, emphasizing the significance of absorptive capacity and managerial environmental concern. The authors contend that a firm's capacity to absorb and implement external knowledge is essential for optimizing the advantages of GI. Furthermore, the environmental considerations of managers are crucial in promoting green initiatives and guaranteeing their effectiveness. The research indicates that companies exhibiting high absorptive capacity and managers with environmental awareness are more effectively equipped to adopt green innovations, leading to enhanced financial and environmental outcomes.

10. PROBLEM STATEMENT

With the escalation of global environmental concerns, businesses face increasing pressure to implement sustainable practices and minimise their carbon footprints. In India, rapid industrialisation and urbanisation have resulted in considerable environmental degradation, necessitating a transition by firms to eco-friendly operations. Despite the evident environmental and long-term economic advantages of Green Innovation (GI), numerous firms encounter obstacles in its implementation, such as elevated costs, insufficient expertise, and inadequate infrastructure.

11. OBJECTIVES

1. To examine the key drivers of Green Innovation adoption in Indian firms.
2. To explore the impact of Green Innovation performance on the competitive advantage of firms.
3. To identify the challenges faced by Indian firms in implementing Green Innovation.

12. METHODOLOGY

Convenient sampling method is used for the study. Kendall's ranking method was used to measure the Impact of Green Innovation (GI) Performance on Competitive Advantage of Firms in India. Green Innovation has the potential to generate a competitive advantage, the connection between GI performance and business competitiveness is still inadequately examined within the Indian context. This study seeks to investigate how Indian firms, particularly in the automotive and manufacturing sectors, can utilise GI to improve their competitive advantage while addressing the challenges associated with sustainable innovation.

13. FINDINGS, PRESENTATION AND ANALYSIS OF DATA

The notion of sustained competitive advantage is fundamentally grounded in the Resource-Based View (RBV) of the firm, which posits that a company's capacity for long-term success is contingent upon its distinctive resources and capabilities. The Resource-Based View (RBV) posits that firms can achieve sustained competitive advantage through the possession of resources that are valuable, rare, inimitable, and non-substitutable, commonly known as the VRIN framework. Resources may be categorised as tangible, including physical assets and financial capital, or intangible, encompassing intellectual property, brand reputation, organisational culture, and technological expertise.

Table 1 Factors Driving Green Innovation in Indian Firms

Variables	Mean	Std. Deviation	Mean Rank
Regulatory Compliance	3.62	1.244	4.10
Corporate Social Responsibility Mandates	3.30	1.233	3.53
Market Demand	3.04	1.160	2.97
Cost-Reduction Opportunities	3.44	1.567	3.86
Investor Interest	3.10	1.055	3.08
No .of Respondents	50		
Kendall's Coefficient of Concordance	0.216		
Chi-Square	518.959		
difference	4		
Sig.	0.000		

Table 2 presents the results of the test. The Chi-Square statistic is 518.959 with 4 degrees of freedom. This is significant at the 1% level ($p < 0.0001$). The results indicate that the rankings assigned to the purposes are significant. Adhering to these regulations can mitigate legal penalties and enhance the firm's reputation. The Companies Act of 2013 in India requires firms meeting specific revenue, profit, or net worth thresholds to allocate 2% of their profits to Corporate Social Responsibility (CSR) activities, frequently encompassing environmental initiatives. Market Demand: Increasing awareness and preference for sustainable products is evident among Indian consumers, especially in urban regions. Consequently, companies that respond to this demand by offering green products and services are likely to achieve a competitive advantage. Cost-reduction opportunities through green innovation, especially in resource management and energy efficiency, can result in substantial savings. Companies that invest in energy-efficient technologies and waste reduction can achieve a reduction in operational costs over time. Investor interest is growing as environmental, social, and governance (ESG) factors are increasingly integrated into decision-making processes. Organisations exhibiting a robust dedication to sustainability frequently garner increased investment.

14. DISCUSSION

The company's capacity to enhance efficiency and reduce waste via Just-In-Time (JIT) production and continuous improvement (Kaizen) methodologies has enabled it to sustain a leadership role in the global automotive sector for decades. The operational excellence achieved by Toyota is challenging for competitors to duplicate, thereby securing the company's long-term advantage. In recent years, sustainability-related resources have become essential for firms aiming to achieve a long-term competitive advantage. Organisations that engage in Green Innovation (GI)—including the creation of eco-friendly products, implementation of energy-efficient processes, or establishment of sustainable supply chains—may achieve a competitive edge in markets where consumer and regulatory focus on environmental impact is intensifying. Tangible resources refer to the physical assets that a firm possesses, encompassing financial assets, manufacturing facilities, raw materials, and infrastructure. In sectors like manufacturing and automotive, companies possessing advanced machinery, robust supply chain networks, or strong financial resources frequently achieve superior performance relative to their competitors. Firms that invest in advanced technology and automation can realise economies of scale, lower production costs, and improve product quality, thereby maintaining market leadership. Intangible resources frequently offer a more significant and enduring competitive advantage. Intangible assets such as a company's reputation for quality, customer loyalty, patents, proprietary technologies, and distinctive organisational culture are significantly more challenging for competitors to replicate or obtain. Companies such as Apple and Google succeed due to their technological advancements, established brand equity, innovative cultures, and capacity to attract and retain top talent. An organization's innovation capability enables the development of new products, processes, or business models that respond to evolving market demands more rapidly than those of competitors. This agility may result in a sustained competitive advantage, particularly in dynamic sectors such as technology or pharmaceuticals. Tesla's competitive advantage arises from the integration of its intangible resources, including brand image and technological expertise in electric vehicles and renewable energy, with its tangible assets, such as its Gigafactories. Tesla's resources facilitate ongoing innovation in sustainable transportation, posing challenges for traditional automotive manufacturers in terms of competition.

15. CONCLUSION

A firm's capabilities, defined as its proficiency in effectively utilising its resources, are essential for attaining sustained competitive advantage. Capabilities denote a firm's competence in performing essential activities, including innovation, marketing, and customer service. Tangible assets, including technology and capital, hold significance; however, intangible assets—such as innovation capabilities, brand equity, and organisational culture—frequently offer more enduring advantages. In the contemporary business landscape, sustainability and green innovation are increasingly vital resources, providing firms with new opportunities for differentiation and the maintenance of a competitive advantage over the long term. To maintain a competitive advantage over time, firms must ensure that their resources and capabilities are challenging to replicate. Resources safeguarded by patents, trade secrets, or intricate internal processes exhibit greater security against competitors. Conversely, readily replicable resources, including fundamental technology or commoditised products, provide only transient advantages. The path dependency, unique historical circumstances, and social complexity associated with the development of specific capabilities, such as organisational culture or stakeholder relationships, can establish barriers to imitation. The innovation culture at companies such as Google and 3M, which promotes experimentation and collaboration among employees, is challenging for competitors to imitate due to its deep integration within the organization's operations and historical context.

CONFLICT OF INTERESTS

None

ACKNOWLEDGMENTS

None

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