

Research on Green Technology Innovation in Manufacturing Firms from ESG Perspective

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Abstract: This study investigates the research of manufacturing enterprises in green technology innovation from the ESG (Environmental, Social, Governance) perspective. Green technology innovation is one of the key factors to promote enterprises to realize environmentally sustainable development. Based on previous research on: first, manufacturing companies should conduct environmental impact assessment and management to assess the environmental impact of product life cycle and take measures to reduce the negative impact. Second, renewable energy applications are an important direction for green technology innovation, and manufacturing companies can shift to renewable energy sources such as solar and wind to reduce their dependence on traditional energy sources. Third, circular economy and product design are also the focus of research, through product design to reduce resource use and waste, and introduce the concept of circular economy to promote the recycling of materials and energy. Fourth, supply chain sustainability is also a key area of green technology innovation, where manufacturing companies need to consider aspects such as partner selection, raw material sourcing and transportation to ensure a sustainable and environmentally friendly supply chain. Finally, data-driven and smart manufacturing can optimize the production process through the application of technologies such as data analytics and artificial intelligence to improve resource utilization efficiency and energy consumption efficiency, and reduce carbon emissions and waste generation.

Keywords: ESG; Green Technology; Sustainable Development.

1. Introduction

In recent years, there has been an increasing concern for environmental sustainability on a global scale. As an important part of the manufacturing industry, manufacturing enterprises bear important responsibilities in environmental protection and sustainable development. In this context, the ESG (Environmental, Social, Governance) perspective has been widely used to measure corporate sustainability performance and has become one of the key indicators of concern to investors, consumers and government regulators. Green technology innovation, as one of the key strategies to drive enterprises to achieve environmental sustainability, has attracted extensive attention from both academia and the industry. Green technological innovation can not only reduce an enterprise's dependence on limited resources and minimize its negative impact on the environment, but also improve its competitiveness and brand image. Therefore, it is of great theoretical and practical significance to explore the research on green technology innovation of manufacturing enterprises under the ESG perspective. Through the study of green technological innovation in manufacturing enterprises under the ESG perspective, we can provide useful suggestions and guidance for enterprises, promote their performance in environmental protection and sustainable development, and realize the balance between economic growth and environmental friendliness.

2. Overview of Green Technology Innovation in Manufacturing Enterprises under ESG perspective

2.1. ESG Information

ESG refers to the operation and management indicators of Environment, Social and Governance, which are used to assess the performance of enterprises in environmental

protection, social responsibility and corporate governance. The following is a detailed explanation of ESG information:

2.1.1. Environment

Environmental factors include a company's use of natural resources, its impact on ecosystems, and its response to environmental issues such as climate change and pollution. In terms of the environment, companies are asked to focus on energy efficiency, reducing greenhouse gas emissions, promoting the use of renewable energy, water resource management, waste management and environmental protection.

2.1.2. Social

Social factors relate to the relationship between a business and its employees, suppliers, customers and other stakeholders. Enterprises should be committed to providing fair treatment and a safe working environment, respecting human rights, labor rights and diversity, and focusing on social issues such as community development, philanthropy and social responsibility.

2.1.3. Governance

Governance refers to the internal management structure and operation mechanism of an enterprise, including corporate governance, risk management, compliance and transparency. Enterprises need to establish a sound governance structure to protect shareholders' rights and interests, strengthen internal control and risk management, and comply with laws and regulations, disclose information and maintain transparency.

ESG information is an important basis for investors, consumers and other stakeholders to consider corporate sustainability and responsibility. More and more institutions and investors are incorporating ESG considerations into their investment decisions and encouraging companies to achieve positive results in ESG in order to realize long-term economic value and social impact. At the same time, ESG information

can help companies optimize operations, enhance brand image, reduce environmental risks and increase stakeholder trust.

2.2. Manufacturing Enterprises

A manufacturing enterprise is a business whose primary objective is the transformation and processing of matter. Manufacturing firms can cover a variety of industries including, but not limited to, automobile manufacturing, electronics manufacturing, food processing, textile manufacturing, and chemical manufacturing. Manufacturing firms play an important role in the economy, as they are responsible for transforming raw materials into finished products that fulfill people's daily needs. Manufacturing companies usually have production equipment, production lines and skilled workers to process, assemble and produce raw materials through a series of production processes, resulting in value-added products.

In the modern economy, manufacturing companies face many challenges and opportunities. With the development of globalization, manufacturing enterprises need to face the pressure of international competition and continuously improve production efficiency and product quality. At the same time, environmental protection and sustainable development have become important issues of concern for manufacturing enterprises, pushing them to adopt green technology innovation and sustainable business practices. The development of manufacturing enterprises cannot be separated from technological progress and innovation. With the continuous application of technologies such as smart manufacturing, Internet of Things and artificial intelligence, manufacturing enterprises can automate and intellectualize the production process, improve productivity, reduce costs and adapt to changes in the market. Under the ESG perspective, manufacturing enterprises need to focus on their performance in environmental protection, social responsibility and corporate governance, focusing on reducing resource consumption and emissions, paying attention to employee welfare and safety, and strengthening internal management and transparency. By actively addressing these challenges, manufacturing enterprises can realize sustainable development, improve competitiveness, and contribute to society and the environment.

2.3. Green Technology

Green technology refers to technologies and innovations that are environmentally friendly and sustainable. It combines economic growth with environmental protection and aims to reduce resource consumption, lower carbon emissions and environmental pollution, and promote sustainable development. The following are some of the areas of green technology that can be integrated with manufacturing:

2.3.1. Renewable Energy

Including solar, wind, hydro and other forms of energy, utilizing natural resources for power generation and energy supply, reducing dependence on traditional fossil energy sources, and lowering carbon emissions and air pollution.

2.3.2. Energy Storage and Distribution Technologies

In view of the instability and discrete nature of renewable energy sources, develop efficient energy storage and distribution technologies so that energy can be continuously supplied when needed.

2.3.3. Energy-saving Technologies

Realize optimal utilization of resources by improving energy utilization efficiency and reducing energy consumption, including building energy conservation, transportation energy conservation, and industrial production process energy conservation.

The application of green technologies can bring multiple benefits, including reducing energy consumption, lowering carbon footprints, improving air and water quality, promoting sustainable development, and creating employment opportunities. As global concern for the environment increases, green technologies will play an increasingly important role in driving the economic shift toward sustainable development. Manufacturing companies, the energy industry, the construction industry, transportation and other sectors can use green technology to achieve sustainable development and contribute to a greener future.

3. Research Significance

3.1. Explore the Application of Various Green Technologies

Different manufacturing enterprises face different environmental and production problems, which require targeted research and application of different green technologies. For example, certain enterprises may need to combine renewable energy with traditional energy sources to reduce carbon emissions and energy costs, while certain enterprises need to improve production processes and raw materials to reduce waste and pollutants. Therefore, the application of green technology innovation is an important research task for different manufacturing companies.

3.2. Explore Innovation Models and Business Models

Green technology innovation in manufacturing enterprises needs to meet the requirements of environmental protection and sustainable development, and also needs to consider commercial feasibility and economic benefits. Therefore, it is necessary to explore innovation modes and business models that are suitable for different manufacturing enterprises in order to realize a win-win situation in terms of environmental friendliness and economic benefits.

3.3. Research on the Application of Green Technology in the Supply Chain

The supply chain of a manufacturing enterprise involves a number of links such as raw material procurement, production process, product distribution, etc., all of which may have an impact on the environment. Therefore, studying the application of green technology in the supply chain can realize the environmental control of the whole supply chain and promote the whole industrial chain to develop in a more environmentally friendly and sustainable direction.

3.4. Research on ESG Performance of Manufacturing Enterprises

In addition to studying the innovation and application of green technology, it is also necessary to study the ESG performance of manufacturing enterprises. By evaluating environmental protection, social responsibility and corporate governance, the ESG performance of manufacturing enterprises can be improved and gain more social recognition

and capital market support.

In conclusion, it is important to study green technology innovation in manufacturing companies to realize sustainable development, improve productivity and reduce costs. With the continuous popularization and reinforcement of ESG investment, manufacturing enterprises will face higher ESG standards and greater environmental protection pressure, and need to actively carry out green technological innovation to achieve sustainable development and promote the whole industry to move forward in a more environmentally friendly and sustainable direction.

4. Research Content

4.1. Environment-related Research

The research content of manufacturing enterprises in the environment mainly includes reducing energy consumption, reducing carbon emissions, optimizing waste management and treatment, and improving resource utilization efficiency. Specific research content can include: developing and applying clean energy technology; improving the production process to reduce pollutant emissions; researching and promoting the circular economy model to achieve waste reuse and recycling; optimizing supply chain management to reduce logistics emissions and so on.

4.2. Social-related Research

The research content of manufacturing enterprises in the social aspect mainly includes labor rights and interests protection, community participation, product safety and so on. Specific research can include: improving employee training and welfare treatment to ensure labor rights and interests; actively participating in community affairs to fulfill corporate social responsibility; focusing on product quality and safety to protect consumer rights and interests; promoting fair competition and preventing unfair competition practices, etc.

4.3. Corporate Governance Related Research

Research on corporate governance in manufacturing enterprises mainly includes transparency and accountability, board structure and independence, and information disclosure. Specific research can include: establishing a sound accountability mechanism to promote corporate executives to pay attention to environmental and social responsibility; optimizing the board structure to improve the science and fairness of decision-making; and strengthening information disclosure to increase investors' understanding and assessment of corporate ESG performance.

4.4. Research on Innovation Models and Business Models

Manufacturing enterprises need to explore innovation models and business models suitable for green technological innovation in order to realize a win-win situation in terms of environmental friendliness and economic benefits. Specific research can include: developing new green products and services to meet the market demand for environmental protection; building a circular economy business model to maximize the use of resources; exploring a sharing economy model to reduce resource waste, etc.

In summary, from the ESG perspective, the research contents of green technology innovation of manufacturing enterprises cover various aspects such as environment, society, corporate governance and business model. These research

contents aim to promote manufacturing enterprises to realize sustainable development and improve their environmental, social and economic performance, and to promote the development of the whole industry in a more environmentally friendly and sustainable direction.

5. Difficulties in the Research Process

5.1. Technological Difficulties

Green technology innovation often requires interdisciplinary cooperation and technological breakthroughs. In the research process, technical difficulties may be faced, such as feasibility verification of new technologies, high technology costs, and technology risks. Solving these technical difficulties requires sufficient R&D investment and innovative spirit.

5.2. Lack of Financial Support

Green technology innovation requires a large amount of funds for R&D, testing and promotion. During the research process, it may face the problem of insufficient financial support, which affects the research progress and the transformation of results. This problem can be solved by attracting investment, applying for research project grants, and cooperating with enterprises to obtain financial support.

5.3. Restrictions of Regulations and Policies

Green technology innovation needs to comply with environmental regulations and policy requirements. The research process may be subject to some regulatory and policy restrictions or regulatory requirements, such as environmental emission standards and waste disposal regulations. Researchers need to understand and comply with the relevant regulations and policies, as well as actively participate in the discussions and suggestions on the development of relevant policies.

5.4. Industry and Market Factors

Green technology innovation needs to match the actual industry and market demand. In the research process, it may face the uncertainty of industrial and market factors, such as unclear market demand and insufficient industrial adaptability. In order to solve this problem, researchers can cooperate with enterprises to fully understand the market demand and industrial development trend, and combine research results with practical applications.

5.5. Social Recognition and Participation

Green technology innovation needs to be recognized and supported by society. In the research process, it may encounter public doubts, questions or resistance, such as protests by environmental groups and public opinion pressure. This problem can be solved by strengthening communication and participation with the public, improving the transparency and credibility of the research, and ensuring that the research results can be accepted and supported by the society.

In conclusion, the research process of green technology innovation in manufacturing enterprises may face problems in technology, funding, regulations and policies, industrial market and social recognition. Through interdisciplinary cooperation, actively seeking financial support, complying with regulations and policies, understanding market demand, and effectively communicating with and participating in society, these problems can be gradually solved to promote

the progress of green technology innovation.

6. Solutions Proposed for Problems

6.1. Technical Difficulties

Formulate technology research and development plans, focus on key technical difficulties, establish innovation teams, carry out interdisciplinary cooperation, recruit excellent researchers, introduce domestic and foreign experts, and cooperate with universities and research institutions to solve the problems.

6.2. Financial Support

Actively strive for government funding for science and technology innovation projects, seek corporate investment, participate in investment, and make long-term sustainable financial planning; also actively apply for bank loans, use crowdfunding and other ways to get financial support.

6.3. Regulatory and Policy Restrictions

Strengthen the awareness of environmental protection, and strictly abide by the requirements of environmental protection regulations and policies; and actively participate in the discussion during the process of policy making, and provide suggestions and opinions for environmental protection policies. At the same time, it is also possible to formulate the enterprise's own environmental protection standards and measures, exceeding the policy requirements and demonstrating the enterprise's environmental responsibility and image.

6.4. Industrial and Market Factors

Through research, we understand the current market demand and future trends, choose the research direction in combination with the actual demand, and cooperate with related industrial enterprises to form a close combination of technological innovation and industrial application, and jointly promote the development of green economy.

6.5. Social Recognition and Participation

Strengthen communication and interaction with the public, popularize the enterprise's environmental protection concepts and practices to the public through popular science activities, open days, etc., to establish a good image of the enterprise, and guide the public to actively participate in environmental protection, so that all walks of life will support the enterprise's green technological innovation.

Targeted problem solving will promote the innovation process of green technology more efficiently.

7. Suggestions

For the problems of green technology innovation in manufacturing enterprises, I have the following suggestions:

7.1. Formulate a Clear Green Technology Innovation Strategy

Manufacturing enterprises should clarify their green technology development goals and formulate corresponding strategies and plans. This includes identifying research focus areas, cooperation with supply chains, and technology investment plans. A clear strategy can guide the direction of the enterprise's green technology innovation, and improve the efficiency of R&D and the success rate of results

transformation.

7.2. Strengthen Interdisciplinary Cooperation and Technological Innovation Capacity

Green technology innovation often requires cooperation between different disciplines. Manufacturing enterprises can actively cooperate with colleges and universities, research institutions and other organizations to share resources, experience and technology, and form a collaborative innovation atmosphere among teams. At the same time, enterprises should also focus on cultivating their own technological innovation ability, and improving the professional quality and innovation ability of the R&D team.

7.3. Seek Policy Support and Cooperation Opportunities

Manufacturing enterprises can actively apply for government funding for science and technology innovation projects, understand relevant policies and regulations, and fulfill their environmental obligations in accordance with the regulations. In addition, they can seek opportunities to cooperate with the government, industry associations and other organizations to participate in the formulation and optimization of relevant policies and strive for more support and resources.

7.4. Strengthen Environmental Management and Monitoring Capabilities

Manufacturing enterprises should establish a sound environmental management system, formulate and implement strict environmental protection measures, and monitor and evaluate their environmental performance. Through the introduction of advanced monitoring technologies, they can improve their understanding of environmental impacts, identify and solve problems in a timely manner, and continuously improve and optimize the environmental management of their enterprises.

7.5. Increase Publicity and Communication

Manufacturing enterprises should actively publicize their green technology innovation achievements and show the public their environmental protection efforts and achievements. By organizing open days, participating in environmental exhibitions and other activities, they can strengthen interaction and communication with the public, establish a good image of the enterprise, and obtain public recognition and support.

In summary, when promoting green technology innovation, manufacturing enterprises should clarify their strategies, strengthen cooperation, seek policy support, strengthen their environmental management capabilities, and actively publicize and communicate in order to promote the development and application of green technology.

8. Summary

Manufacturing enterprises need to further strengthen green technology innovation in the future, and the relevant policies and market environment should be more supportive and encouraging of relevant innovations. Enterprises themselves should focus on introducing and cultivating high-end talents and strengthening internal and external cooperation to promote the continuous progress and implementation of green technology innovation. At the same time, enterprises should

also pay attention to establishing a good communication mechanism with all sectors of society, responding to the needs of stakeholders, improving ESG performance, and realizing more sustainable and robust development.

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