

Enterprise's Environmental Cost Management under Stakeholders' Game

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Abstract: *With the intensification of global environmental problems and the enhancement of environmental awareness, the environmental impact of enterprise economic activities has been paid more and more attention by the international community. How to realize the coordinated development of environment, economy and society has become the key issue in the development of the world today. But the effect of enterprise environmental cost management is still not satisfactory. This is due to the environmental impact of enterprise environmental management by many factors. Therefore, based on the stakeholder perspective, chooses the behavior subject - the consumer, which is closely related to the enterprise's interest, and constructs the enterprise and the consumer model to study the key influencing factors of the enterprise environmental cost management, and provides an effective solution to the current problem of governance failure Strategy recommendations.*

Keywords: Enterprise Environmental Cost Stakeholder Game Proposal

1. Introduction

As early as the 18th century, with the improvement of Jenny spinning machines and steam engines, the industrial revolution broke out rapidly around the world. It gives people the daily life and ideas to bring the impact of change. But at the same time, with the deepening of industrialization, new social problems are also emerging. With the rapid development of the global economy, we are facing excessive resource consumption, serious industrial pollution and deterioration of the ecological environment and other serious problems. Research shows that environmental pollution is mainly from the production and business activities. Wastewater, waste gas and waste from the production of enterprise products contain a large number of toxic gases, poisons and bacteria, which in the natural environment caused serious pollution, but also to people's living space and life caused a grave threat. So how to balance the various groups through effective mechanisms to do environmental protection has always been the world's attention. Today, countries around the world have introduced the relevant laws and regulations, accounting for economic impact of environmental activities and environmental costs of accounting, while the collection of high sewage charges and environmental taxes to effectively manage the environmental costs of enterprises. But pollution control and environmental protection effect is still not satisfactory. This is because the corporate governance of environmental pollution involves multiple interests, there are multiple entities between the complex behavior of the interaction.

To sum up, accurately accounting for the environmental costs of enterprises and assessing corporate environmental performance has become an essential consideration to help countries develop supportive policies and long-term strategies. At the same time, business managers have to assess potential environmental costs and environmental benefits when developing net profit targets. But also to

consider whether there is a comprehensive cost accounting method. The contribution of this research is to analyze the relationship between enterprises and consumers through game theory and study the factors influencing the environmental cost management of enterprises. Based on this, the author puts forward the management suggestions for the enterprise environmental cost. And ultimately to enhance the level of corporate environmental cost management and environmental protection.

2. Review of Literatures

2.1 Define the Environmental Costs

Environmental costs are an important part of environmental management accounting. With the development of environmental management accounting theory and practice, the effective confirmation and disclosure of environmental costs is becoming more and more important to the company, shareholders and as the whole society. However, the reality of many developing countries and some developed countries is that part of the environmental costs are not recognized and measured, which results in an erroneous assessment of environmental costs and lack of knowledge. Therefore, in recent years, environmental costs have become a social concern and hot topic.

There is currently no internationally recognized environmental accounting standards to define environmental costs. But internationally recognized environmental costs are defined from the United Nations Group of Experts on International Accounting and Reporting Standards (ISAR): "Environmental costs refer to a cost that is environmentally responsible, including the costs of managing the environmental impact of business activities, the cost of the action required, and other costs incurred by the enterprise in implementing environmental objectives and requirements".^[1] Lawrence & Cerf(1995) divided environmental accounting research into the perspective of management

cost accounting, and the perspective of financial accounting reports. The difference between the two is that the cost management perspective focuses on the use of internal information and the control of environmental costs, while external financial reporting focuses on disclosing information to shareholders or the public. But environmental cost management did not play its real role in the early stages of development, and most of their data was retained by management rather than disclosed to shareholders (Mathews, 2000). Christine Jasch^[2] pointed out that enterprises should establish a framework for environmental cost assessment, the assessment framework includes raw materials, energy and industrial water flow and the cost of such aspects. At the same time, he based on the production characteristics of manufacturing enterprises, and built the environmental cost input-output model. In addition, we should be aware that many environmental cost management literatures are designed to improve corporate profits rather than improve the environment, but even so they can still play a role in preventing environmental costs and losses (Mylonakis&Tahinakis,2006).^[3] In recent years, more and more scholars have recognized the importance of environmental cost management. Burritt&Saka(2006) believe that environmental cost management is a relatively new environmental management tool that can be used to trace and track environmental costs and the flow of natural (physical) environments.^[4] In the UK, Prince Charles also launched the Accounting for Sustainability Project (ICAEW, 2008) to systematically study the long-term sustainability of the business and how it can continued development issues into the enterprise management. Schaltegger&Burritt (2010) They also made clear the concept of " Sustainability accounting", and pointed out that sustainable accounting is a branch of accounting. It is accounting for ecosystems and social services. And as an information management tool and method, sustainable accounting can promote the sustainability of enterprises and the development of corporate responsibility.^[5]

Another important condition for environmental cost management is to classify environmental costs. Common classification method according to the production process, the formation of cost, cost-sharing period, etc. Here, we choose according to the production process will be divided into environmental costs: Pre-environmental costs (the cost of spending in advance to mitigate environmental pollution), period of environmental costs (environmental costs incurred in the production process, including cost reductions and cost savings), after environmental costs (including recovery costs and regeneration costs).

2.2 Definitions of Stakeholder

In the 1960s, in the United States, Britain and other countries have long pursued the "shareholder first" corporate governance model, in this context, the theory of stakeholders gradually developed. Stakeholders have different definitions, including Freeman's definition:"The classic definition of a broad stakeholder is that an enterprise stakeholder refers to an individual or group that can

influence the achievement of an enterprise's goal or is influenced by the achievement of an enterprise's goals". In 1984, Freeman published the "Strategic Management: Stakeholder Management Analytical Approach", which clearly put forward the stakeholder management theory. It is pointed out that the theory of stakeholder management refers to the management activities of the managers of the enterprises to balance the interests of all stakeholders. Mitchell, R. K. ^[6](1997) think that the three attributes that corporate stakeholders may have are legitimacy, power, and urgency. Luk^[7](2005) et al studied the relationship between stakeholder relationships and firm performance (including social performance, market performance, and financial performance), and discussed the interaction between firm performance and different stakeholder relationships. Ultimately, they found that the combination of customers, competitors and employees had a positive impact on business performance.

2.3 The Rationality of Game Theory

Game refers to a process that a person or an organization rely on available information, select and implement an action or policy under certain environmental conditions and rules of constraints, finally to. get the corresponding results or earnings. ^[11] Game theory is a mathematical theory and method used to study the phenomenon of struggle or competitive nature, aimed at abstracting complex relationships, and used to make the development of things to change the logic and law more accurate, finally to provide guidance and recommendations to solve practical problems.^[12]

In a certain sense, the game theory is the existence of mutual externalities under the conditions of individual choice. And because of the environmental resources have some characteristics, like it is public goods and it's property rights are not clear. So that there are a lot of external diseconomies in the procedures of using environmental resources. Which led to environmental problems, In the process of environmental protection and environmental protection investment, enterprises and consumers mainly represent different interests, influences each other in decision-making and mutual restraint.

3. Stakeholder Game Process—Between Business and Consumers

3.1 The choice of the main game

How to manage the environmental cost of the enterprise environment, it needs to analyze the motivations of the management environment, the selection of the management methods, the expectations of the management results, and the degree of implementation of the management mode. Although, directly, the enterprise is the most relevant person in environmental cost management, the confirmation of environmental costs will eventually be part of the economic behavior of the enterprise in a specific content and manner, so as to be confirmed and disclosed. But we also need to be

clear that the ownership of environmental cost management is not only the enterprise, but should be plural, it includes the government, business and the public, where each subject should bear the corresponding responsibility for environmental cost management.

To the consumer, it is the main source of purchasing power. Consumers and enterprises have a close relationship, their behavior and decision-making will be affected each other. Here, we must first know that consumers as the economic subject, under normal circumstances, they tend to choose to buy their own interests to maximize the product. It is for these reasons that consumers will be the direct victims of environmental pollution and the direct beneficiaries of the general low price of non-environmentally friendly products; both the direct beneficiaries of environmental investment and the direct victims of high environmental protection products. Consumer behavior is the maximization of personal utility, and their behavioral preferences affect business decisions to a large extent. Second, as a member of the public, the consumer also corporate environmental cost management of the supervisor. If the enterprise does not carry out environmental cost management, laissez-faire pollution, undermine the public's living environment, consumers have rights to sue enterprises, claim compensation, or through a strong public opinion on the formation of constraints. The enterprises who has an excellent environmental cost management will enhance the reputation of enterprises, affecting consumer choice because of its contribution to society. Finally, with the economic development and improvement of living standards, people's awareness of environmental protection is constantly awakening, in their own interests did not receive violations, consumers will be more inclined to choose environmentally friendly products.

Through the above research on the content, we will find that consumers on the enterprise environmental cost management of the direct impact will be more clearly reflected in the consumer behavior preferences. Therefore, in the game analysis of this paper, we do not consider its social supervision function, but only analyze the impact of consumer behavior preferences on corporate investment. At the same time, the process of enterprise environmental cost management is also bound to be affected by government regulation, including the government's incentive for

corporate environmental cost management, and the imposition of environmental cost management. But in this paper, we only use it as one of the factors, and not specifically discuss the game between the government and the enterprise.

3.2 Game between business and consumers

Before, we have discussed the main reasons for the consumer's impact on enterprise environmental cost management. So, we here to choose the following several most relevant factors with business and consumers' behavior for conduct the game between business and consumers.

- 1) R is enterprise benefits obtained through environmental cost managements, C is the cost;
- 2) R' is enterprise benefits obtained without environmental cost managements, C' is the cost;
- 3) F is the government of the enterprise fines when the enterprise does not carry out environmental cost management;
- 4) T is the revenue from the government when the enterprise completes the environmental cost management;
- 5) P is the probability of government regulation, 1-P is the probability of non-regulation;
- 6) μ is the probability of consumers to buy environmentally friendly products; $1 - \mu$ is the probability of non-purchase;
- 7) K is the utility of environmentally friendly products for consumers, K' is the utility of general products.

Note: environmentally friendly products are such a product that product after the enterprise carry out environmental cost management

Here we analyze the behavior of the enterprise (whether the firm invests in the environment and produces environmentally friendly products) and consumers (whether they buy environmentally friendly products). Assuming that the firm maximizes the choice based on net income, the consumer maximizes the choice of utility. While assuming that the government is regulated as a stakeholder. Under these conditions, the income matrix of the firm and the consumer is shown in Figure 1:

		Consumer	
		Purchase μ	Do not purchase $1 - \mu$
Enterprise	Environmentally friendly products φ	R+T, K-P	-C+T, 0
	General product $1 - \varphi$	R'-F-t, K'-P'	-C'-F, 0

Figure 1: Business and consumer game

After the game, we get the following results:

The expected return for the business is:

$$E_{\varphi}(\varphi, 0) = \varphi[\mu(R + T) + (1 - \mu)(-C + T)] + (1 - \varphi)[\mu(R' - F - t) + (1 - \mu)(-C' - F)] \quad (1)$$

Therefore, the benefits of enterprise environmental cost management and the benefits of non-environmental cost management are:

$$E_e(1, \mu) = \mu(R + T) + (1 - \mu)(-C + T) \quad (2)$$

$$E_e(0, \mu) = \mu(R' - F - t) + (1 - \mu)(-C' - F) \quad (3)$$

Consumers expect earnings:

$$E_c(\varphi, 0) = \mu[\varphi(K - P) + (1 - \varphi)(K' - P')] + (1 - \mu)[\varphi 0 + (1 - \varphi)0] \quad (5)$$

Therefore, consumers want to maximize returns, you need to make $E_c(\varphi, 1) = E_c(\varphi, 0)$, can get the result:

$$\varphi^* = \frac{P' - K'}{K - K' + P' - P} \quad (6)$$

From this we can get, business and consumer game Nash equilibrium conditions:

$$(\mu^*, \varphi^*) = \left(\frac{C - C' - T - F}{R - R' + C - C' - t}, \frac{P' - K'}{K - K' + P' - P} \right) \quad (7)$$

At the same time, the above game is explained as follows:

If the probability of consumers to buy environmentally

friendly products $\mu > \mu^* = \frac{C - C'}{R - R' + C - C'}$, Enterprises will

choose to enhance the level of environmental cost management; when $\mu^* \rightarrow 0$, scilicet, $C \rightarrow C' + F + T$, when

the cost of producing environmentally friendly products is close to the production of general products plus government subsidies and the cost of government fines, companies will choose to produce environmentally friendly products. If the probability of production of environmentally friendly

products $\varphi > \varphi^* = \frac{P' - K'}{K - K' + P' - P}$, the best choice for consumers

is to buy environmentally friendly products. When $\varphi^* \rightarrow 1$,

scilicet $(K - P) \rightarrow 0$, the utility bonuses consumers gain from general products are approaching 0. Their motivation of purchase general products will decline. While the motivation of purchase environmentally friendly products will rise.

Under this condition, the motivation of enterprises to produce environmentally friendly products increases, and the power of enterprises to enhance the level of environmental cost management will increase.

To maximize corporate earnings, need to make $E_e(1, \mu) = E_e(0, \mu)$, can get the result:

$$\mu^* = \frac{C - C' - T - F}{R - R' + C - C' - t} \quad (4)$$

3.3 The Conclusion of the Game

Through the game can be seen, the impact of consumer business environment cost management mainly comes from the consumer's tendency to purchase environmentally friendly products. Whether consumers choose to buy environmentally friendly products, determines whether the production of environmentally friendly products, thus determining whether the enterprise to optimize their own environmental cost management level.

Therefore, in order to protect the ecological environment, promote enterprise environmental investment, to achieve sustainable development, the first thing to do is to maintain long-term balance of environmental products market. This shows that to strengthen the enterprise environmental cost management must also start from both the government and the consumer. On the one hand, it is necessary to increase the government's policy support. Improve consumer purchasing power of environmentally friendly products through environmental protection subsidies; and encourage enterprises to produce environmentally friendly products through environmental subsidies, optimize the environmental cost management. On the other hand, because the effectiveness of environmentally friendly products will directly affect the purchase behavior of consumers, so companies must continue to innovate environmental technology, and constantly optimize the environmental cost management, thereby enhancing consumer desire.

4. Suggestions to Enhance the Level of Enterprise Environmental Cost Management

Professor Li (2005) analyzed the main features of environmental cost in depth, and put forward the environmental cost control system and accounting method, established the processing method and basic principles of each stage, and introduced the enterprise environment cost control and accounting processes. This study provides a lot of suggestions for the practical application of enterprise environmental cost management, but does not make a way to carry out environmental cost management, and another drawback is that pay more attention to value than manage in this case.^[13]Tang (2013) pointed out: At present, governments are using their own methods to carry out

remediation of environmental damage, the traditional model of economic development in exchange for resources and destroying the environment has been abandoned.

But the former cost of environmental protection is borne by the society to the enterprise; Environmental protection to promote the "internalization of external environmental costs", so that the green costs of enterprises continue to increase, and into the increasing trend, Therefore, environmental costs have a major impact on the competitiveness of enterprises.

^[14]Li et al. (2012) argue that the developing low-carbon economy has put forward new demands on the current environmental cost management in the world, it is necessary to apply the theory of low-carbon economy to enterprise environmental cost control. And through analyze the impact of low-carbon economy on the enterprise, they put forward some measures to control the environmental costs in the background of low-carbon economy.^[15]

4.1 Guided by government environmental regulation

The government has a dual identity in environmental protection, which is both a regulator of environmental investment and a stakeholder. It is related to the enterprise's environmental investment directly. So the government's control and policy support is the key to enterprise environmental cost management.

To strengthen the local government in the enterprise environmental cost management in the guiding role. First of all to improve the local government's awareness of environmental protection, establish a scientific concept of development and achievements, aware of the environmental protection for human survival and social development of the important significance. And from a long-term perspective, recognizing that the protection of the environment is means protection of productivity, improve the environment also means the development of productive forces, GDP is not the only measure of performance. Establish a good atmosphere of environmental protection. Second, we must improve the construction of laws and regulations, establish and improve the corresponding laws and regulations, making environmental can be protected in law. So that illegal pollution enterprises must be severely punished by the law, and to pay a huge cost (such as fines, etc.); at the same time to improve the quality of law enforcement officers, strengthen collaboration among departments, establish a powerful law enforcement team, and intensify law enforcement. The formation of a strong law enforcement team, increase law enforcement efforts. Protect the environment by law, promote environmental protection work further legalization and standardization. Finally, it is necessary to provide policy support, to improve the enthusiasm of corporate environmental investment. For example, the government can led the establishment of enterprises and scientific research units Union, on major issues to tackle key issues; the government can also provide enterprises with preferential investment in environmental

investment loans, through the form of subsidies in order to encourage enterprises to update environmental protection equipment; Environmental products can be tax deductible or tax free; Environmental protection equipment can accelerate depreciation and so on.

4.2 Enterprises clear environmental cost management objectives

Environmental cost management objectives determine the future direction of business development, it's the direction of the enterprise environmental cost management direction, and it made the overall environmental protection requirements of the enterprise. Therefore, in order to achieve cost management, we must first of its objectives to adapt to the definition. Traditional environmental cost management is the first pollution control, it has high investment, high cost, less significant environmental effects, and less economic benefits. They resulting in the lack of entrepreneurial enthusiasm, and the imbalance between social and environmental benefits.

In today's environment, companies need to establish the following three goals:

- 1) Using natural resources reasonably
Companies want to minimize the material and resource consumption, to achieve the greatest economic benefits, but in order to achieve this goal is not so easy. This is a need for long-term business research, it is related to the future of enterprises and global environmental protection, enterprises should try to do: the cycle and the conservation of energy; use green raw materials; the development of clean green energy; make waste into useful substances; enhance ecological technology.
- 2) Make the minimum cost of production, and realize the largest economic benefits
The purpose and conditions of continuous operation of enterprises are profit, enterprises will reduce production costs and improve their own production efficiency and other ways to achieve maximum economic benefits. Therefore, in the context of low-carbon economy, enterprises in order to achieve economic and environmental benefits of a win-win situation, we must continue to improve production efficiency. They should do: reduce the use of raw materials and energy; improve the level of science and technology and ecological processes; transform wastes into resources; balanced investment and income, planning production and production activities reasonably.
- 3) Minimize the harm of environment and human
Enterprises to enhance the level of environmental cost management, and ultimately to achieve the advanced goal is to protect the environment and achieve green development. Therefore, enterprises in environmental cost management should also set the following objectives: to reduce harmful substances and carbon dioxide emissions; the use of clean production technology; recycling waste; use of raw materials can be degraded.

4.3 Environmental cost management based on ABC.

Enterprise environmental cost management first to deal with the problem is how to externalized environmental costs into internalization. This is because the external environmental costs are caused by the production activities of the enterprise, but the enterprise does not actually pay this part of the environmental costs. Although the destruction of the environment did not result in direct outflow of corporate funds, but cause great harm to society.

In the current enterprise environment cost management process, because there is no reasonable measurement method choose to measure the external environmental costs, so it cannot be measured accurately. Externally generated environmental costs are difficult to confirm, difficult to measure and not easy to aggregate features. Because of these characteristics of external environmental costs, the current cost accounting system does not calculate the external environmental costs of the enterprise. According to the situation to develop, will condone the enterprises continue pollute environment and damage to environmental. From the above, we can see that the deep-seated causes of economic development and environmental protection are that the externalities of environmental costs cause product price distortions and market failures. The best way to correct externality is to implement internal costs of environmental costs.^[16]

First, the internalization of environmental costs emphasizes the "polluter pays principle", and polluters pay the full cost for their actions. This will solve many problems in the traditional situation, also can eliminate the externalities of environmental costs, optimize the allocation of resources, and promote sustainable development.^[8] Secondly, the environmental cost internalization stressed, enterprises always measure the cost of natural resources for development and utilization, so that the reserves of natural resources to reduce the cost of resources, and corporate emissions of various hazardous substances costs. While accounting the activities of the material, property damage and the cost of loss into the enterprise cost. Thirdly, the internalization of environmental cost should first analyze the economic feasibility of project investment, analyze the factors of internal investment evaluation of environmental cost, and construct a multi-stage evaluation model to evaluate the internal cost of project investment.^[9] We need to clearly understand that many times the production process of pollution is often a certain degree of economic waste. Therefore, enterprises need to carry out technological innovation, improve production, in this process will improve the efficiency of resource use, and at the same time improve the competitiveness of enterprises.^[10] In the short term, the internalization of environmental costs increases the cost of enterprises and weakens the competitiveness of enterprises. However, in the long run, the internalization of environmental costs is consistent with the maintenance and promotion of our own productivity and competitiveness.^[17]

On this basis, we use ABC for enterprise environmental cost

management. ABC (Activity—Based Cost) is a method that based on the theory of "cost motive theory". It works as the core, according to the causal logical relationship of "product consumption operations, operating consumption of resources", allocate the consumed resources to the corresponding jobs, and distribute the costs of the operations to the product through cost drivers.

Using ABC for environmental cost management can be divided into the following four steps: The first step, the collection of environmental costs, that is, to confirm the environmental costs; The second step, according to the environment cost of simple and complex circumstances to determine the environmental operation, and according to the similarities and differences in operating attributes to establish environmental operating costs; The third step, to determine the enterprise environmental cost drivers, the choice of cost drivers is the key to operational cost management and focus; The fourth step is to calculate the environmental cost allocation rate of the enterprise and assign the cost of the operating cost database to each product. In this process, on the one hand, enterprises should be based on the production process to determine the internal operating value chain, focusing on assessment of value-added operations and non-value-added operations, necessary and unnecessary operations. To eliminate unnecessary operations as much as possible, to eliminate the impact of non-value-added operations, and reduce unnecessary operations. Through the reasonable expansion of the scale of production and operation to improve the efficiency of value-added operations, reduce environmental costs and then improve the profitability of enterprises, give full play to operating costs as a strategic management decision-making tool role; On the other hand, enterprises need to use the operational cost management to provide resources to consume information, improve the operating process and product production process, reconstruct enterprise value, improve resource allocation efficiency. At the same time, we need pay attention to operating ABC and other management systems combined (such as total quality management, etc.). This is consistent with the enterprise environmental cost management objectives, and it will be with the enterprise environmental cost management objectives to promote each other.

4.4 Consumers assist in corporate environmental cost management

First, it is useful to enhance environmental awareness among consumers, carry out environmental awareness and environmental education. During this process, we can make full use of television, newspapers, new media and other media to promote environmental protection facing the grim situation and importance. Government and enterprises also can put public service ads to subtle care to enhance consumer awareness of environmental protection. So that environmental protection gains popular support, everyone concerned about the environment, everyone supports the situation of environmental protection. Second, we should cultivate the market of environmental protection products,

promote the demand of environmental protection products, and guide the green consumption fashion. In the modern market, the consumer is God, consumer preferences and demand determines the decision of the commodity production enterprises. Enterprises should actively guide consumers to environmental protection and their own health in the first place; Consumers should actively purchase products that are beneficial to the environment, as far as possible in the consumption of green shopping, so as to promote the production of environmentally friendly products, improve the level of environmental cost management. Third, it is necessary to establish and improve the system of environmental information disclosure to ensure that consumers have the right to know the environment and protect the rights of consumers to obtain the necessary environmental information. For example, the government can regularly publish a number of environmental quality standards, like pollutant discharge standards, environmental standards, environmental standards, environmental standards and material standards etc.. Also need to release of environmental monitoring information and investigation reports, such as environmental bulletin timely. To publish a list of heavily polluting enterprises to update a large number of emissions of pollutants exceeding the prescribed limit. The enterprise should disclosure of environmental governance and investment projects may lead to environmental pollution timely. So that consumers can fully and timely access to information and information about the environment, and ultimately reduce the cost of consumer participation in environmental protection, improve consumer participation.

5. Conclusion

Experience on it, people and businesses have a misunderstanding of the meaning and purpose of the enterprise for a long time. They often regard the business as a purely economic organization, only want to get the maximum return on capital from the enterprise, but not concern with the production and operation of environmental pollution and damage. The development of mankind has been followed by anthropocentric thinking logic, put the surrounding ecology and environment in an objective position, regardless of the laws of nature and large-scale exploitation of resources, regardless of ecological vulnerability and excessive demand. Resulting in the destruction of many local environments, the destruction of ecology and the disappearance of ecological species.

Now, although the countries have more and more attention to environmental protection, but on the whole we are still faced with serious environmental status quo. Therefore, we must learn from the lessons learned, and should pay more attention to environmental issues. During this process requires cooperation of the entire society, including business, government, consumers and so on. We must coordinate the development of environment and economy as an important basis for evaluating the feasibility of economic projects. While establishing long-term protection mechanism, make the enterprise environmental cost management and

environmental protection integrated closely. Promote of corporate performance while protecting the environment, and ultimately promote economic and social sustainable development.

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