Research on Measurement Methods of Enterprise's Environmental Costs[1]

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Abstract. With the rapid increasing of nature resource exhausting and environment pollution, how to control and reduce the resources consumption effectively from the accounting angle, measure environmental costs objectively and accurately, which has obtained the concerns of domestic and foreign accounting academics and enterprises. .The enterprise environmental cost's measurement is the prerequisite of modem enterprise transforming the economic developing way, developing low-carbon economy and innovating developing thoughts. This paper defines the enterprise environmental cost's definition, characteristic and classification from time and goals firstly; then puts forward methods in environmental cost's measurement.

Introduction

In recent years, the contradiction between rapid economic development and environmental pollution coexist is very obvious in China, traditional development ways that pursuit economic benefits mainly is facing competitive challenges. Because of the influence of the concept of sustainable development and the goal, economic development model gradually evolved into the pursuit of balance development ideas among the economic benefits, social benefits and ecological benefits from "mass exploitation of resources -- mass production -- mass consumption -- a lot of waste (waste gas, waste water, waste residue)", Environmental factors were paid more attention in economic development, so the Environmental Accounting arose. From the perspective of environmental accounting, how to measure the economic losses caused by environmental pollution and resource destruction appropriately is the focus and difficulty of the research on environmental accounting, but also is the basis that the enterprises provide the real and objective accounting information to management and society.

The Definition and the Characteristics of Environmental Costs

The Definition of Environmental Costs. According to the file "The Stand Statement of Environmental Costs and Financial Statements" approved in the fifteenth meeting of United Nations international accounting and reporting standards intergovernmental experts Working Group, environmental cost refers to the management measures cost that the enterprises take or are required to take for the impact on environment caused by enterprise's activities, and other cost because the enterprises implement environmental objectives and requirements based on the principle of environmental responsibility. However, the notice did not put the fine, damages and a series of expenditure into environmental cost.[1] The key idea of the UN definition is the enterprise should put itself and environment into consideration. This definition is also accepted generally in the domestic.
The author thinks that the enterprise's environment costs not only in the internal phase, but also extended to the whole supply chain, including the upstream link, downstream link, and the expenditure of enterprise's environmental protection, such as: natural resources depletion costs, environmental management costs, environmental operation costs.
The Characteristics of Environmental Costs. Environmental costs have the following characteristics compared to the traditional production cost:

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Hysteresis. Unlike other environmental expenditure cost items (such as production materials) that occurred in the production process evenly and directly, this makes the environment costs have a certain “vacuum" in time and space. But once the quantitative change converts into qualitative change, the damage to the environment is inevitable.

Continuity. Environmental costs measurement should be carried out throughout the life cycle of a product, not just in the production process or the sales process. So the environment cost measurement has continuity.

Potentiality. Environmental activities has particularity, the current enterprises activities’ effect on the environment may release and show gradually after a period of time, which will not be immediately obvious accompanied by the occurrence of economic activity.

The Classification of Environmental Costs

Classification of environmental cost is the premise of accurate measurement of environmental costs. From a different point of view, environmental costs have different classification.

According to the two dimensions of time and purpose, the environmental costs of enterprises are classified as the follows: According to the length of influence time, cross stage or not, environmental costs are divided into long-term environmental costs and short-term environmental costs; According to the relationship between the environmental cost and relevant user, environmental costs are divided into internal use costs and external use costs.[2] Specific categories as shown in table 1:

Table 1 Classification of Environmental Costs

Time	Goal	
	Internal use	External use
Long-term	Environmental prevention costs	Environmental contingent costs
Short-term	Environmental operation costs	Environmental compensation costs

Environmental Defense Costs. Enterprise environmental defense costs, refers to all expenditures related to environmental protection in order to prevent, reduce environmental pollution in the production process, raw material inputs and equipment investment in advance, because the enterprises comply with environmental protection laws and regulations. This is a voluntary active expenditure of the enterprise, is a long-term environmental cost. The preliminary environmental defense costs include: supplier selection, investment in environmental protection equipment, environmental protection product design of enterprises, waste recycling and R & D cost of reuse, and etc; Education and training cost about new laws and regulations of environmental protection, environmental load monitoring measurement cost, environmental management system construction and certification costs. The environmental defense costs in the process of production and operation include: Waste treatment cost, recycling system operation cost, substitute cost of environmental pollution material, energy-saving facilities cost; "Green" package cost of products, recycling utilizing cost of used package.

Environmental Operation Costs. Environmental operation costs are a series of environmental costs of raw material and labor that occurred in the process of production, raw material inputs and equipment operation in order to avoid or reduce the possibility of enterprise environmental consequences of bad appearance when the enterprise comply with environmental protection laws and regulations in the production process. It mainly includes the following several kinds of forms: the human resource cost of environmental protection, equipment repair expenses, audit expenses to the enterprise environment and the costs to maintain environmental equipment operation and the opportunity cost of these funds and so on.

Although the environmental costs are recognized as period expenses in the traditional financial accounting, but these can not deny that it is one of the reasons why the enterprise can cause greater influence to enterprise product cost.

Environmental Compensation Costs. Environmental compensation costs are a kind of post costs in order to make up for the loss caused by environmental pollution or improve corporate image in the public mind in accordance with the relevant legal, which generally occur after the production process or in the production process. The main contents include: Firstly, the cost of environmental damage, which is the extra investment to buy production equipment and products for environmental protection based on requirements of laws and regulations. A series of laws, regulations of various departments and various industries specify the confirmation and measurement of the cost, such as: sewage charges, bodily injury compensation of special type workers, the penalty due to violation of the provisions of relevant laws and regulations of environmental protection, compensation for the ecological environment damage. Secondly, PR cost. It refers to the expenditure in order to maintain and enhance the image in public mind or establish and develop better social relationships with the local government, investors, creditors and consumers. It includes the following contents: the green fee in the enterprise location, incentive expenditures to the people who contributes to environmental protection, goodwill expenditures of holding or participating, advertising expenditures on environmental protection.

Environmental Contingent Costs. Environmental contingent cost is an uncertain cost, which may occur or may not happen, it shall be determined by the future events, specifically refers to a kind of future cost expenses caused by management or production management matters, is a hidden probability cost. It mainly includes: compensation expenses caused by some environmental accidents, fine expenditures required by the relevant departments, compensation and remedial expenditures of environmental accidents' injury to body and property, excessive pollutants fine of violation of the provisions of laws and regulations.

Measurement Method of Environmental Cost

Environmental cost has potential, hysteresis and continuity, the measurement should combine with the existing accounting measurement methods and environmental economics method based on environmental standards. Based on the classification of enterprise environmental costs, this paper uses different methods to measure all kinds of environmental costs.[3]

The Difference Cost Method Measures Environmental Defense Costs. The difference cost refers to the difference between two projects' expected cost. The difference cost method takes environmental defense cost as an important difference factor, measures the environmental difference cost occurred in the enterprise in order to reduce the pollution before production and in the process of production. Given the factors of the difference cost are very large, and some factors are difficult to measure comprehensively and reliably. So the enterprise can use the difference cost method to measure the expenditure difference in the case of different investment in environmental protection, and thus can obtain the environmental defense cost indirectly. The calculating formula of difference cost method as follows:

$$C_d = \sum_{i-1}^{n} (C_i - C_0) \tag{1}$$

Let C_d as environmental defense cost; C_i as environmental protection investment expenditure; C_0 as original investment expenditure; two kinds of investment expenditures may be measured in fair value or historical cost.

The Market Approach Measures Environmental Operation Costs. Enterprise's environmental protection manpower costs, repair maintenance costs, storage costs, annual environmental reports and audit fees can be measured by the market price based on the actual payment. However, because of the great differences in resources' rich degree and the exploitation between the different regions, materials and energy costs have much difference; this causes the resources market prices seriously deviate from the true value. So, the environmental resource costs should be measured by calculating the adjustment coefficient of environmental resource price according to the real difference degree and the different influence factors. Correction coefficient of environment resource costs should be determined according to the difference between the enterprise consumption prices of environmental

resources and environmental resources industry standard price and expenditure per unit of factors can not be eliminated, the calculation formula is as follows:

$$K=\frac{C_n}{P} \tag{2}$$

Let K as price correction coefficient; P as price of environmental resources consumed by enterprises; C_n as expenditure per unit of factors can not be eliminated.

So the formula of adjusted environmental resource price as follows:

$$P'=(1+K)P_0 \tag{3}$$

Let P ' as the adjusted environmental resource price; P_0 as the industry standard price.

Therefore, the environmental operation costs can be expressed as:

$$C_o = C_h + C_m + C_s + C_a + ... + P' \tag{4}$$

Let C_o as environmental operation costs; C_h as environmental protection human cost; C_m as maintenance cost; C_s as storage cost; C_a as environmental auditing and report cost; P' as adjusted environmental resources cost.

Recovery expense method measures environmental compensation costs. Recovery cost method uses the expenditure of compensating or restoring the damaged environment to calculate the losses of natural resources. Because the human explore the natural resources wantonly, the recovery rate of ecological resources lags far behind the development speed, the human must help to restore the natural resources, the expenditure is called "compensation costs".[4] Environmental compensation costs mainly include the cost of environmental damage and public relationship cost. The cost of environmental damage is the outflow of economic benefits mainly according to the provisions of the state environmental protection laws and industry regulations, so it can be measured based on the standards of laws and regulations. PR cost's measurement is mainly based on historic cost or the market price. Characteristics of compensation cost determines the application of recovery expense method to measure the compensation cost, the basic measurement formula is as follows:

$$C_c = \sum_{i=1}^{n} C_i \times Q_i + C_{pr} \tag{5}$$

Let C_c as environmental compensation costs; C_i as unit expenditure of compensating or restoring original resources; Q_i as the pollution quantity; C_{pr} as PR cost.

The expert evaluation method measures environmental contingent costs. Because it is difficult to research the market data of environmental contingent cost, the author thinks that the expert evaluation method can measure the environmental contingent cost objectively. The method firstly set up the evaluation experts group composed of experts and scholars, experienced business managers and employees (usually more than 10), then evaluate the enterprise contingent costs according to the basic data of firms and industries and data on the environmental protection.[5]The specific steps are:

First, inquiry and count the items related with enterprise contingent cost by letter, telephone, conference, and etc. Then make the possibility statistics table after collecting back the statistical results and issue them to experts again, please experts make judgments independently for various items' possibility according to their own occupation judgment and possibility.（see table 2）. Second, collect back the statistical tables and summarize, classify and screen each expert opinion: If more than 50% (including 50%) members of evaluation expert group judge as "high possibility", the matters can be regarded as related factors with enterprises contingent costs; the factors that more than 50% (including 50%) evaluation members judged as "little posibility"or"certain"[2]can be eliminated, calculate probability average of retention factors. Third, evaluate the possibility based on the results of the analysis: Firstly, make the evaluation table of the enterprise contingent costs to experts according to the analysis information (Table 3). Secondly, collect the evaluation tables for statistical

[2] Basic certain: 95%<Probability<100%; High possibility:50%< Probability≤95%; Little possibility: 0< Probability≤50%

analysis (Table 4). Finally, calculate total contingent costs according to each average value of contingent costs and the probability average. The calculation formula is as follows:

$$C_p = \sum_{i=1}^{n} C_i \times P_i \tag{6}$$

Let C_p as environmental contingent costs; C_i as average of contingent costs; P_i as probability average.

Table 2 Contingencies Statistics

Expert:

Serial Number	Contingencies	Possibility （Little possibility, High possibility, Certain）	Probability （%）	Explain
……				

Table 3 Evaluation Table of the Enterprise Contingent Costs

Expert:

Serial Number	Contingencies	Pessimistic Value (A)	Optimistic Value （B）	Most Probable Value （C）
……				

Table 4 Evaluation Table of Contingent Costs for XX Factor

Serial Number	Pessimistic Value （A）	Optimistic Value （B）	Most Probable Value （C）	Expectation Value {D=（A+B+4C）/6}
……				
Average				

Summary

The premise of the enterprises' environmental costs is comprehensive, accurate understanding of environmental cost. Based on the definition and characteristics of environmental costs, according to two dimensions -- time and goal, this paper divides environmental costs into four kinds: defense cost, operation cost, compensation cost and contingent cost. On this basis, puts forward that should use difference cost method, market method, recovery expense method and expert evaluation method to measure environmental costs respectively according to the characteristics of environmental costs.

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