Analysis of Aviation Equipment Maintenance Cost Estimating Method

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KEYWORDS	ABSTRACT
Aviation equipment, Maintenance cost, Estimating method	Maintenance cost estimating methods for aviation equipment can be sorted into basic method and normal method. The article analyzes the application area of these methods and contracts the advantages and disadvantages of these methods. The article also discusses the problem in this field and forecasts the development trend. It can provide a useful methodology for estimating maintenance cost of aviation equipment.

Introduction

Aviation equipment maintenance management cost is called aviation equipment maintenance cost. It is the cost which used to hold a well condition of aviation equipment frequently by maintaining, repairing, and purchasing of maintenance equipment. It is an important support base to keep the battle effectiveness of aviation equipment.

It has become an important part to research the rational using and plan of maintenance cost. The maintenance cost is 50%~80% of the LCC [1], a series of maintenance cost will be brought after obtaining the equipment, and that the paying time is long, the amount of cost is high. Now it has happened that the aviation equipment could not take on normal combat-ready task because of lack of maintenance cost. It has crucial influence to reduce LCC that how to make a correct decision and use the maintenance cost rationally. So, it is very significant to research the estimating method of aviation equipment maintenance cost.

The research of Life Cycle Cost in theory and engineering application has achieved marked development and progress since 1980' such as data accumulation and analysis, cost estimating method and forecast model, technology and policy of management. But the modeling of traditional cost estimating method is difficult to put in practice, so, it is necessary to analyze and discuss the actuality of maintenance cost estimating method.

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1 Maintenance Cost Estimating Method

1.1 Basic method

The estimating methods of weapon equipment LCC such as engineering method, parametric method, analogy method and expert estimation method are introduced particularly in GJBZ 20517. They are also the basic method of aviation equipment maintenance cost estimating.

1.1.1 Engineering method

Engineering method counts the cost of every item by using of work breakdown structure from bottom to top, and the cost estimating value is gained by accumulating all cost items in the whole maintenance work. It counts and adds the all kinds of cost of every parts or subsystem in every phase of development, production, operating and support, and then, obtains the overall cost of whole system based on Cost Breakdown Structure (CBS) [2] [3]. This method has high accuracy, but it is complexity, fussy and time-consuming as a traditional method of cost estimating.

1.1.2 Parametric method

Parametric method is a widely applied and mature cost estimating method. It builds the cost estimating formula to count the cost value by history cost data or statistical data according to the principle of similarity and correlation. The exact degree of this method mainly depends on the reliability of model, so most research on cost parametric estimating pays attention to the research on the modeling method. The parameter could be the structure parameter or capability parameter. This method is simple but the accuracy is lower.

1.1.3 Analogy method

Analogy method compares the using and support manner between new equipment and benchmark equipment which has exact maintenance cost data and technology file, analyzes their similarities and differences and the influence to cost, considers their diversity of function, structure, and capability, and then, corrects the cost estimating of benchmark equipment, finally, accounts the maintenance cost of new equipment.

Analogy method is always used when the new system has the similar function to the old system, and the structure and capability are comparable to the old system. The cost of new system could be give through amending the each cost of old system pertinently. This method is hardly used by itself because of the error.

1.1.4 Expert estimation method

Expert estimation method is a method that estimating equipment LCC based on experts' experience. Firstly, some experts estimate the cost independently, and then integrate the result to improve the accuracy. It is always used when the data or statistical swatch is lack, or it is difficulty to make certain the connection mode between parameter and cost.

1.2 Normal method

As the appearance of new theory and the development of compute software, many precise and effective estimating methods are proposed.

1.2.1 Partial least squares regression

By dint of extracting main element, partial least squares regression extracts the most interpretative synthesized information for system effectively to reduce dimension of higher dimension data space. It can solve the blight in system modeling of interactive correlation among the independent variables [4] [5]. It is always used to the system in which the independent variable is interactive correlation and the amount of sample is less than the amount of independent variable.

1.2.2 Grey model estimating method

The existing mathematical statistical methods such as regression analysis method, variance analysis method are not adjusted to the condition for small sample and untypical distribution, and the grey model has higher accuracy comparing the normal regression analysis method. The basic process of grey model estimating is: creating original data with grey method to weaken the random factors, establishing differential equation with creating data, finding the result, and then creating a digressive data to gained the estimating value [6] [7]. It is suitably used to solve the problem of little samples which is a difficult point in the research of cost estimating and forecasting.

1.2.3 Neural network method

Neural network method includes Back Propagation (BP) neural network and Radial Basis Function (RBF) neural network. The BP neural network method usually adopts three layer BP network. The input of the neural network is the tactics, technique index or structure parameter, and the output is cost. The network is trained with adequate sample, and can be used as an effective tool to estimating cost of new type equipment after training [8].

RBF neural network method is a typical local approximation neural network. The gradient descent method is used to adjust the weight of BP neural network, but this method exists the deficiency of local minim and slow convergence speed. The RBF neural network method is superior to BP neural network in approximation ability, sort ability and study speed.

It can supplement the information and make rational decision to complicated problem by continually study to the insufficiency of cost data and error cost component.

1.2.4 Support vector machine estimating method

SVM method has complete statistical study theory and excellent study ability as a new study arithmetic based on statistical study theory. It solves the convex quadratic programming problem, gains a global optimization, and can avoid the registration process from sticking into local extremes. The algorithmic complexity of this method has not relation to the dimension of sample. It is preferably applied to the field of mode identify, cost estimating, text sorting, manuscript identifying and biology information because of its nicer characteristic [9] [10].

2 The Main Problem and Development Trend

2.1 Data problem

The data problem is a very important basic work of estimating aviation equipment maintenance cost. The estimating could not continue without data. It is difficulty to collect and deal with the data because there are lots of cost cell based on CBS of aviation equipment maintenance cost.

2.2 Modeling problem

Now there are all kinds of cost estimating models, but most of them are used to estimate development cost and production cost, few of them are used to estimate operating and maintenance cost. The model for estimating aviation equipment maintenance cost is few. So, the main approach is choosing proper estimating method for modeling on the base of the research result in existence. The machine study arithmetic such as Neural network method and SVM have better estimating effect from foregoing analysis and it is a development direction for estimating aviation equipment maintenance cost.

2.3 System research

We could estimate the maintenance cost by establishing maintenance cost estimating model of particular type aviation equipment, and then, research the estimating method of maintenance cost systemically.

Then, we could estimate the maintenance cost of different type aviation equipment on the base of estimating particular type equipment. In addition, we could research how to account the maintenance cost of different type aviation equipment with the subrogation of aviation equipment to find out the maintenance cost of aviation equipment in a period. At the end, we could estimate the gross maintenance cost and development trend scientifically to save the limited defense outlay.

On the other hand, we could account the optimization scale (the matching of type and number) of the aviation equipment when the maintenance cost is assured, and then make sure the rational distribution from the view of economic affordability.

3 Conclusion

Aviation equipment maintenance cost is the important part of LCC, and estimating the cost well and truly is an effective measure to control the aviation equipment LCC. Now there is lots of cost estimating models, but few of them are used to estimate maintenance cost. The machine study method will be an important study filed because the higher estimating accuracy. We need to lucubrate the cost estimating method of aviation equipment.

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