Analysis of the Demonstration of the Target Cost of Aviation Equipment Repair Under the New Bargaining Rules

Qianghui Zhong, Ming Li*, Mingchi Lin,
e-mail address: 18537438@qq.com, 746835468@qq.com, 1276181@qq.com

Dept of Management Engineering and Equipment Economics, Naval University of Engineering Wuhan, Hubei, China

Abstract—The new military bargaining rules have been greatly innovated, and the repair of aviation equipment is also implemented with reference to the rules. For aircraft repair, the repair target price is the core element of incentive and restraint bargaining. In order to determine a scientific and reasonable target price, the change of aviation equipment repair bargaining mode and the importance of the first batch repair target cost of new aviation equipment are analyzed. For the problems faced by the trial maintenance target cost demonstration of new aviation equipment, through the trial maintenance target cost demonstration method based on cost law and engineering decomposition, the repair cost regression model is established and applied to the trial maintenance target cost calculation case of type a aircraft.

Keywords-bargaining rules, aviation equipment, repair target cost, regression model

1 INTRODUCTION

In 2019, new military product price regulations have been promulgated and implemented one after another, which has a great impact on the price of equipment repair. In order to better adapt to the changes in the new military product bargaining rules, this article analyzes the changes in the bargaining mode of aviation equipment repair and compares different stages The difference in the determination of the target cost of aviation equipment repair, in view of the difficulty in calculating the target cost of the trial repair of new aviation equipment, a feasible solution is proposed, and an application case is given.

2 CHANGES IN THE BARGAINING MODE OF AVIATION EQUIPMENT REPAIR

In the past, the batch repair price was determined by the military and the contractor before the first batch of repairs to negotiate and determine the temporary repair price. This temporary price is generally determined roughly according to a certain percentage of the purchase price. After a number of trial repairs and repair costs stabilize, the military will organize the price review of these trial repairs, comprehensively consider the law of trial repair cost changes, determine the approved repair price, and compare it with the tentative repair price. Make up the corresponding repair costs [1]. This pricing method makes up for all the costs of the repair unit, but because

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the repair price is closely related to the trial repair cost, the repair unit is not motivated to control the cost during the trial repair stage, and it is likely to incur more or more costs during the trial repair stage. , It is prone to exceed the scope of the repair project, and ultimately cause the repair price to be much higher than the actual repair cost in the future, making it difficult to effectively control the repair price of aviation equipment [2].

The newly promulgated military product bargaining rules have made great innovations in the bargaining model. They mainly move the price control work forward and clarify new equipment price formation mechanisms such as order target price argumentation, process cost monitoring, and incentive and restraint bargaining. It mainly regulates the work in the order stage of equipment scientific research, but the rules clarify that equipment repairs shall be implemented in accordance with the rules. Therefore, the price of equipment repairs should generally be calculated in accordance with the repair target price calculation, repair contract agreement, bargaining cost confirmation, price negotiation and other procedures. After the repair target price argumentation is determined, the military and the repair unit sign a temporary price contract based on the target price. After the equipment repair project is completed for one year or the batch equipment trial repair work is completed, the repair unit should prepare an equipment repair price plan. And provide cost data, the military organizes cost audit work, and determines the bargaining cost of equipment repair [3]. If there are incentive and restraint bargaining clauses, according to the bargaining cost compared with the target cost, the incentive and restraint profit is negotiated to determine the equipment repair price plan, in which the incentive restraint profit is 50% to 70% of the difference between the actual cost and the target cost; no incentives For binding clauses, the target price is usually multiplied by the adjustment coefficient as the upper limit of the price, and the price is negotiated based on the bargaining cost and 5% of the profit [4].

It can be seen that for the repair of aviation equipment, especially the new type of aviation equipment, the repair target price is the core factor that runs through it, and it has a significant impact on the formation of the final repair price. Since the repair target price is composed of the repair target cost and the target profit calculated at 5% of the target cost, the focus of interest of the military and the contractor is actually the target cost of repair. Under the new bargaining rules, repair The feasibility and rationality of the target cost demonstration are related to the quality and efficiency of the equipment repair price work [5].

3 DIFFERENCE IN DETERMINING THE TARGET COST OF AVIATION EQUIPMENT REPAIR AT DIFFERENT STAGES

The uncertainty of aviation equipment repair varies significantly from stage to stage. Under the new rules, the target price needs to be established before each batch of aviation equipment repair. Airborne equipment is the first stage of repair of uncertainty, high risk, to try to fix the ChengXiu unit, the maintenance of equipment fault diagnosis technology is still belong to grope and adjustment stage, the need to be maintained by an inquest, study to determine the scope of the repair and specific repair measures, and gradually improve in the process of actual repair repair technology solutions, repair experience [6]. Along with the increase in repair vehicles, more in-depth understanding of equipment fault rule, repair technology solutions is also gradually perfect, the factory repair ability gradually improve, the utilization rate of raw materials increase

thereby, there is less working hours reduced, other consumable costs, repair costs to reduce gradually, finally with technical proficiency reaches a certain bottlenecks, the repair cost begins to flatten out. Since the repair cost of different flights in the new aviation trial repair stage varies greatly, showing a process from high to low and tends to be flat, but lack of historical repair cost data, it is difficult to determine a reasonable target repair cost range and then determine a reasonable target repair cost.

After the first try repairing during the subsequent batch repair, the content of repair, repair process has been relatively mature and stable, repair costs are relatively stable, in the early target cost and try to fix on the basis of actual cost data, can more easily determine repair target cost, only when approaching retirement scrap stage, repair cost as the equipment failure rate rises, The expenditure of materials and labor will be significantly increased. Considering that the repair cost of aviation equipment in subsequent batches is relatively stable, and there are historical target cost and actual cost data for reference, it is relatively easy to demonstrate the target cost of aviation equipment in subsequent batches.

In terms of the importance of repair target cost at different stages, since the target cost of trial repair will have a large indirect impact on the actual cost of the first repair, it will also have a significant impact on the determination of the price of the first repair, and then affect the target cost and actual cost of subsequent batches. Therefore, compared with the subsequent batch repair, new type of aviation equipment is more important to try to fix target cost, and the first repair target cost prediction is difficult, need comprehensive parameter method, analogy method, engineering method and the method of combining engineering content changes in the process of equipment repair, repair factors such as constraints, repairs and batch to carry out the argument. This paper focuses on the argumentation of the target cost for the trial repair of new aviation equipment.

4 DEMONSTRATION OF THE FIRST BATCH OF REPAIR TARGET COST BASED ON COST LAW AND ENGINEERING DECOMPOSITION

When demonstrating the repair target cost, because the amount of information obtained is different, the consideration factors are different, so the technical methods used are also different [8]. There are three commonly used methods: parameter method, engineering method and analogy method [7]. The parameter method selects several main physical and performance characteristic parameters sensitive to repair costs based on the historical cost data of multiple similar equipment, and uses regression analysis or time series analysis to establish the mathematical relationship between the cost and these parameters to estimate the equipment Repair cost or the cost of a major unit; the engineering estimation method is a method of accumulating all the cost units of the entire equipment system item by item from the basic cost unit according to the cost breakdown structure to get the repair cost; analogy estimation The method is to compare the equipment to be estimated with a benchmark comparison system with accurate cost data and technical information in terms of structure, technology, etc., analyze the similarities and differences between the two and their impact on costs, and use empirical judgment to find the relative value of the equipment to be estimated. A method of calculating

the cost estimate of the equipment to be estimated based on the cost correction method of the benchmark comparison system.

Foreign countries have started to study cost analysis theories and methods very early, and put forward some basic analysis methods, such as cost estimation relations, cost learning curves, etc., which laid the foundation for cost forecasting. However, the development of my country's aviation equipment, especially military aviation equipment, started late, with fewer models and quantities, and limited accumulation of sample data such as design parameters and maintenance costs. It is difficult to establish a cost parameter model based on aviation equipment design parameters. Foreign advanced experience and The existing results are difficult to apply, and it is difficult to have a good prediction effect by using the engineering estimation method and the analogy method of similar products alone. At present, there is a lack of forecasts for the repair costs of military aviation equipment in China, and there is no targeted and in-depth study on the cost forecasting of the trial repair stage. Considering that domestic aircraft repairs started late, there are few empirical data, and the conditions for fully adopting the parameter method are not sufficient. More often, the engineering estimation method and the analogy method of similar products are mainly used. However, the engineering estimation method requires a large amount of data and workload, and analogous products are analogous. The method cannot be applied to brand-new equipment, and the predictability is poor. Therefore, it is necessary to combine the characteristics of aviation equipment repair, integrate three methods, and conduct a comprehensive analysis of the target cost of trial repair to improve the feasibility of the research results.

The demonstration of the first batch of repair target prices is completed before the first batch of repairs. For new types of aviation equipment, it is basically difficult to obtain the relevant repair cost data, and it is difficult to determine the first batch of repair target costs through a separate analysis of the change law of trial repair costs. In view of this situation, considering that the repair cost and purchase price data of previous models of aviation equipment can be obtained, the feasible path is to analyze the change law of the trial repair cost of similar or similar aviation equipment, and compare it to the new type of aviation equipment being studied. For example, by analyzing the curve of similar trial repair cost of mature aviation equipment with the number of repairs, the law of trial repair cost of new aviation equipment can be obtained approximately, which is used as the basis for estimating the target cost of the first batch of repairs. At the same time, as the repair cost of mature aviation equipment has stabilized, by analyzing the relationship between the repair cost of mature aviation equipment and the purchase price, the interval ratio between the repair cost and the purchase price is obtained, and the repair cost of new aviation equipment is estimated.

For the first repair cost of a new type of aviation equipment, such as the repair cost of the first aircraft, since the repair technical plan has been formed, the repair plan and repair cost data of similar equipment can be used to estimate through analysis and comparison, and the method of engineering combined with analogy. First, according to the repair plan, the repair items are broken down by profession, and the trial repair cost is divided into several cost units to estimate using the engineering method, and then based on the differences in the structure, materials, and maintenance of similar equipment, the parts that are different from similar equipment are analyzed. Correction and adjustment of costs.

On the basis of the trial repair cost law of the new aviation equipment, stable batch repair cost, and the trial repair cost of the first aircraft, the specific function of the trial repair cost change can be solved, and the reasonable trial repair cost can be determined. Repair target cost.

5 APPLICATION CASES

The Type A aircraft is based on the Type B aircraft, with reference to the new type of aircraft developed and developed by the Type C aircraft. The existing Type A aircraft in service is expected to be repaired for the first time in 2021. According to the new military product bargaining rules, the target price for the first batch of repairs It has become the focus of attention of both the military and the local government. As my country's first type A aircraft, Type A aircraft lacks repair experience and data, and it is difficult to predict its target cost.

According to the method proposed in this paper, the calculation of the target cost of the A-type aircraft test and repair is carried out. First, the test cost data and the purchase cost of the D-type aircraft and the E-type aircraft are obtained through separate investigations, and the parameter method is used to select the repair sequence and purchase The cost is analyzed as a parameter of the trial repair cost.

Suppose that there are m influencing factors affecting the trial repair cost y, that is, establish the regression model f between the trial repair cost and the influencing factors.

$$y = f(x_1, x_2, ..., x_m) + \varepsilon \tag{1}$$

ε is the random error

After establishing the trial repair cost regression model, the unknown parameters of the model are estimated by using the collected and sorted trial repair cost data. For the univariate linear regression model $y = b_1 + b_2 x$, assuming n groups of variables, the regression coefficient obtained by the least square method is

$$b_2 = \frac{\sum_{i=1}^{n} x_i y_i - \frac{1}{n}\sum_{i=1}^{n} x_i \sum_{i=1}^{n} y_i}{\sum_{i=1}^{n} x^2 - \frac{1}{n}(\sum_{i=1}^{n} x_i)^2} \tag{2}$$

$$b_1 = \bar{y} - b_2 \bar{x} \tag{3}$$

After the regression estimation equation is obtained, the regression equation needs to be tested by statistical methods to determine whether the regression model is reasonable and excellent. We use the F-test method to judge the significance of the regression equation by comparing the corresponding test statistics with the critical value.

Finally two general laws about the trial repair cost of aviation equipment are obtained, as well as the proportional relationship between the repair cost and the purchase cost please refer to figure 1 and figure 2:

The Type D aircraft: y=19720000+8973061/x (4)

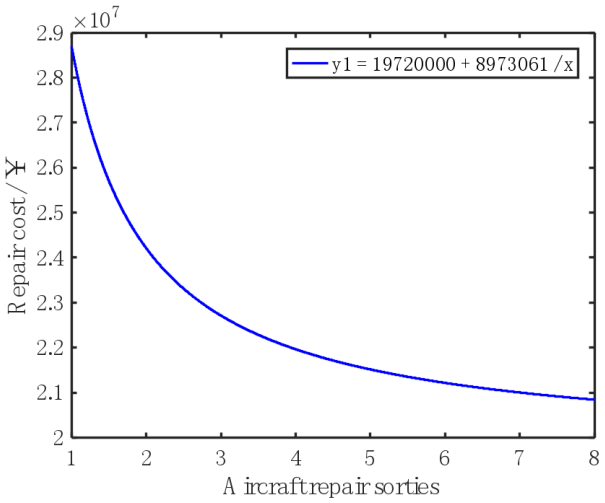

Figure 1 The Type D aircraft

The Type E aircraft:

y=19130000+23800000/x (5)

or

y=42060000-12590000lnx (6)

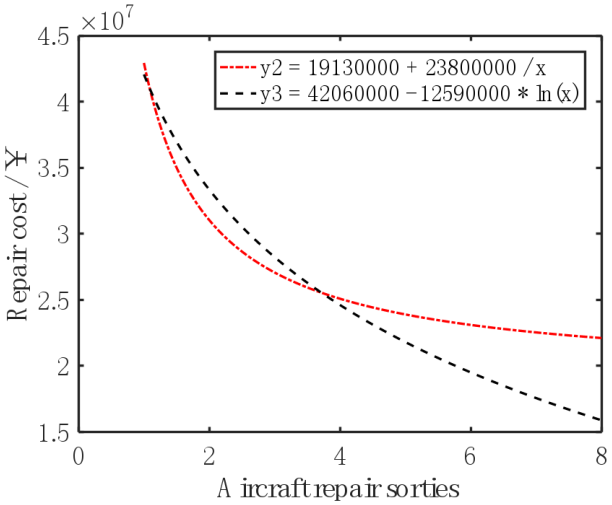

Figure 2 The Type E aircraft

First, determine the functional form of the first batch of repair target cost and the batch repair target cost. After modeling and analysis, the repair cost shows a monotonous decreasing trend as the repair sequence increases, and the decreasing trend gradually slows down, presenting a logarithmic curve or reciprocal function. However, the logarithmic function fits the E-type aircraft test repair cost Good, but the degree of fit for the D aircraft is not high, and the reciprocal function form has good universality, and it has a good fit for the test repair costs of the two types of aircraft, and the number of repairs reaches 5-7. The shelf tends to stabilize. Considering that an aircraft repair shop is the only aircraft repair shop of its counterpart, and the work of the aviation equipment it undertook is consistent, it is expected that the test repair cost of Type A aircraft will show the same trend. Secondly, the relationship between the average repair cost and purchase price of D-type aircraft and E-type aircraft can be calculated according to the main military product cost table obtained from the survey. Through analysis, for aircraft with mature repair technology, the actual maintenance cost to purchase price ratio is maintained at a low level (13%-16%), then we can multiply the average maintenance purchase ratio by the A-type aircraft The purchase price of is used as the target cost after the factory repair is stabilized, that is, the target cost of approval.

Then use the method of engineering decomposition and analogy to demonstrate the cost of the first aircraft test repair. Since the structure and repair characteristics of the B aircraft and the A aircraft are the closest, the cost of the A aircraft can be decomposed by referring to the repair status of the B aircraft, and the calculations The materials, labor, and expenses of the expense unit are accumulated and summarized for each expense unit to obtain each itemized cost, and then the proportion of each expense unit to the manufacturing cost is calculated separately, and compared with the corresponding data of the first Type B aircraft. If it is relatively close, it can be considered The estimation result of this cost unit is relatively reasonable; if the difference is large, analyze the source of the difference, and recognize the difference caused by reasonable factors such as new equipment and higher material quality requirements, and consider whether the estimation method is the difference without a reasonable reason. There are loopholes. Combined with the analysis of the difference between the A and B aircraft and the trial repair situation, the repair cost of the first aircraft of the A aircraft is probably increased by 20%-40% on the basis of the B aircraft, and finally determined by a 30% increase ratio. The repair cost of the first A-type aircraft.

Finally, according to the type A aircraft trial repair cost function form, the first trial repair cost and the batch repair target cost, the specific function of the type A aircraft trial repair cost with the number of repairs can be solved, so as to estimate the trial repairs of each type in the trial phase. Then, the arithmetic average of the trial repair costs of each flight can be used as the target cost of the trial repair, or the value at which the trial cost tends to be stable is used as the target cost of the trial repair. For example, the trial repair cost of the next flight is higher than that of the previous one. The trial repair cost of the sorties is lower than a certain percentage (such as 5%), and the trial repair cost of the previous sorties can be selected as the target cost of the trial repair.

6 CONCLUSION

In view of the importance and difficulties faced by the demonstration of the target cost of trial repair of new aviation equipment under the new bargaining rules, a general rule of parametric method to study trial repair costs is proposed, and engineering combined with analogy method to study the estimated cost of repair of the first aircraft, combining the two The author makes predictions on the aviation equipment trial repair cost curve and applies it to the estimation of the target cost of the first batch of repairs and repairs for the A-type aircraft. Because this article is limited by the types of aircraft that can be referenced and the number of related data, when the calculation method of the first batch of repair costs for the A-type aircraft is studied in the case, the specific parameters obtained from the general law may not be well in line with the first-stage A-type aircraft. The actual situation of batch repairs, but with the gradual development of A-type aircraft repair work and the gradual increase in repair sorts, the actual cost of new repair sorts can be used continuously. Refer to the method researched in this paper to compare the trial repair cost curve of the first batch of repairs. Make corrections to achieve estimates that are closer to reality.

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