A Cost-based Method for Formulating Military and Civilian Joint Insurance Inventory Standards for Aviation Equipment

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***Abstract*—How to scientifically determine the inventory of aviation equipment is a key issue that needs to be solved by military and civilian joint service manufacturers. For the aviation equipment with joint service, the influencing factors of the joint protection of aviation equipment between the military and the civilian are firstly analyzed in detail. On this basis, based on the guarantee cost, the ideas and methods for determining the inventory quantity of aviation equipment are given.**

***Index Terms*—aviation equipment; guarantee cost; influencing factors; inventory quantity**

I. Analysis of Factors Affecting Aviation Equipment Inventory

The standards for the storage of equipment in the aviation equipment units are the basis for the financing, storage and supply of aviation equipment. The following factors are mainly considered in the development of the standards for the guaranteed storage of military equipment manufactures:

(1)The consumption rules of equipment. The consumption rules of aviation equipment of different equipments and different units are different, and the guarantee standards must be formulated according to actual conditions.

(2)Equipment repair rules. Different equipment maintenance levels and maintenance cycle are different, and the protection standards should be formulated according to actual conditions.

(3) Equipment production cycle. Different aviation equipment production cycle and production rules are different, and the guarantee standards must be formulated according to actual conditions.

(4)Guarantee fees. Different types of aviation equipment support costs are different, and the guarantee standards must be formulated according to actual conditions.

II. Guarantee Cost Symbol Analysis

The cost of military and civilian joint support for aviation equipment is relatively high, mainly including financing costs (mainly for procurement costs), inventory expenses, transportation costs, backlog costs and out-of-stock expenses. The relevant symbols describing the problem are shown in Table 1 and Table 2.

Table 1. Symbol Table of Aviation Equipment Force Manufacturer's Guarantee Cost

symbols	meaning and description
a	purchase prices
b_1	inventory costs
c_1	backlog loss
d_1	shortage costs
e	equipment weight
f	tonnage of equipment costs
g_{1k}	distance between the factory and station K
h	freight
l_1	other expenses

Table 2. Symbol Table of Local Manufacturers' Maintenance Costs for Aviation Equipment

symbols	meaning and description
a	purchase prices
b_2	inventory costs
c_2	backlog loss
d_2	shortage costs
e	equipment weight
f	tonnage of equipment costs
g_{2k}	distance between the factory and station K
h	freight
l_2	other expenses

Table 3. The Relevant Symbols Describing the Joint Maintenance Cost Model for Aviation Equipment

symbols	meaning and description
S_1	The number of aviation equipment stored by the Force manufacturer

$f_1(u_1)$	Annual equipment total demand density function of the station supported by the Force manufacturer
S_2	The storage quantity of aviation equipment of local manufacturers
$f_2(u_2)$	Annual equipment total demand density function of the station in charge of the local manufacturer
Y_k	Kth station annual equipment demand
γ_k	Determine which manufacturer's parameters are guaranteed for the Kth station

If the Kth station is guaranteed by the force manufacturer, let $\gamma_k = 1$; if the Kth station is guaranteed by the local manufacturer, let $\gamma_k = 0$.

III. FORCE MANUFACTURER'S TOTAL COST CALCULATION

Since the unit price of aviation equipment purchase is a, the number of aviation equipment stored by the force manufacturer S_1, the total cost of procurement for the unit manufacturer is:

$$P_{11} = aS_1$$

Since the cost of aviation equipment inventory is b_1, the number of aviation equipment stored by the force manufacturer is S_1, and the total inventory cost of the unit manufacturer is:

$$P_{12} = b_1 S_1$$

Since the cost of backlog loss of aviation equipment is c_1, the number of aviation equipment stored by the force manufacturer is S_1, and the total demand density function is $f_1(u_1)$, the total cost of backlog losses of the force manufacturers is:

$$P_{13} = c_1 \int_0^{S_1} (S_1 - u_1) f_1(u_1) \mathrm{d}u_1$$

Due to the shortage of aviation equipment, the cost is d_1. The number of aviation equipment stored by the force manufacturer is S_1, and the total demand density function is $f_1(u_1)$, and the total cost of the shortage of military manufacturers is:

$$P_{14} = d_1 \int_{S_1}^{+\infty} (u_1 - S_1) f_1(u_1) \mathrm{d}u_1$$

According to the freight rate of the car, the transportation cost of the force manufacturer is:

$$P_{15} = fE\left(\sum_{k=1}^{n} \gamma_k Y_k \right) e + hE\left(\sum_{k=1}^{n} \gamma_k Y_k g_{1k} \right) e$$

Other costs are:

$$P_{16} = l_1$$

Therefore, the total cost of the force manufacturer is:

$$P_1 = P_{11} + P_{12} + P_{13} + P_{14} + P_{15} + P_{16} = \sum_{i=1}^{6} P_{1i} \quad (1)$$

IV. LOCAL MANUFACTURER GUARANTEE COST CALCULATION

Since the aviation equipment purchase is a, the number of aviation equipment stored by local manufacturers is S_2, and the total cost of procurement by local manufacturers is:

$$P_{21} = aS_2$$

Since the cost of aviation equipment inventory is b_2, the number of aviation equipment stored by local manufacturers is S_2, and the total inventory cost of local manufacturers is:

$$P_{22} = b_2 S_2$$

Since the cost of backlog loss of aviation equipment is c_2, the number of aviation equipment stored by local manufacturers is S_2, and the total demand density function is $f_2(u_2)$. The total cost of backlog of local manufacturers is:

$$P_{23} = c_2 \int_0^{S_2} (S_2 - u_2) f_2(u_2) \mathrm{d}u_2$$

Due to the shortage of aviation equipment, the cost is d_2, the local manufacturer stores the number of aviation equipment S_2, the total demand density function is $f_2(u_2)$, and the total cost of local manufacturers is insufficient:

$$P_{24} = d_2 \int_{S_2}^{+\infty} (u_2 - S_2) f_2(u_2) \mathrm{d}u_2$$

According to the freight rate of the car, the transportation cost of the local manufacturer is:

$$P_{23} = fE\left(\sum_{k=1}^{n} \gamma_k Y_k \right) e + hE\left(\sum_{k=1}^{n} \gamma_k Y_k g_{2k} \right) e$$

Other costs are:

$$P_{26} = l_2$$

Therefore, the total cost of local manufacturers is:

$$P_2 = P_{21} + P_{22} + P_{23} + P_{24} + P_{25} + P_{26} = \sum_{i=1}^{6} P_{2i} \quad (2)$$

V. CALCULATION OF MILITARY AND CIVILIAN GUARANTEE COSTS

Since the total cost of the force manufacturer is $P_1 = \sum_{i=1}^{6} P_{1i}$ and the total cost of the local manufacturer is $P_2 = \sum_{i=1}^{6} P_{2i}$, the total cost of the joint maintenance of the aviation equipment is:

$$P = P_1 + P_2 = \sum_{i=1}^{6} P_{1i} + \sum_{i=1}^{6} P_{2i} \qquad (3)$$

The cost-guarantee coupling model is used to determine the optimal guarantee strategy, the optimal storage capacity of the aviation equipment of the military manufacturers and the optimal storage capacity of the aviation equipment of the local manufacturers are calculated. The obtained protection strategy is the optimal strategy.

This type of standard setting method is applicable to the usual aviation equipment support.

VI. CONCLUSION

Through the analysis of the joint maintenance system of aviation equipment and the simplification of the problem, on the basis of analyzing the influencing factors of the joint support of the equipment, the operation method is adopted, and the model for determining the joint maintenance standard of the aviation equipment between the military and the civilian is first established; The optional storage capacity of aviation equipment by force manufacturers and local manufacturers can be calculated separately. The military fully utilizes the advantages of local manufacturers to implement joint support for aviation equipment, which can further improve the military economic benefits of equipment maintenance and support.

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