"APISAT2014", 2014 Asia-Pacific International Symposium on Aerospace Technology, APISAT2014

Development and Production Costs Estimating For Aviation Equipment Based on Uncertainty Design

Huang Zhaodong[a],*, Luo Rongxuan[a], Jin Jing[b]

[a]*Finance Research Division, Aviation Industry Development Research Center of China, Beijing 100029, China*
[b]*Reliability Research Division, AVIC Chengdu CAIC Electronics co.,LTD, Chengdu 610000, China*

Abstract

The estimation accuracy of aviation equipment development and production cost has very important significance on program budget management. At the beginning of aviation equipment development, the requirement has many unknown factors and the equipment design has uncertainty problem. That lead to the uncertainty of equipment's cost. Many researches usually assume the uncertainty in equipment design to certainty, ignoring the uncertainty of the system itself essentially. Theoretically, the efficiency of aviation equipment is an important factor which affects cost. To improve equipment's efficiency, the development needs more advanced processing equipment, more advanced materials and more system test and so on, which will cause higher cost. Therefore, in view of uncertainty, this study takes equipment effectiveness index as a new variable and an impact factor to research its reflection on development and the production cost. At the beginning, this paper shows the engineering practice of aviation equipment design uncertainty. Considering the reflection of equipment's effectiveness on development and production cost, cost estimation model based on effectiveness has been established. Using mathematical theories such as Monte Carlo Simulation and interval number, an evaluation model of development and production cost for aviation equipment is established under the condition of uncertainty design.

■   * Corresponding author. Tel.:+86-010-57827706
■   *E-mail address:*hzdong2000@163.com

1. Introduction

The accurate estimation of aviation equipment development and production cost has very important significance for defense budget management[1]. But because the initial user requirement design is not clear, with many unknown factors which causes the equipment cost uncertainty, so that the cost estimate under the conditions of uncertainty has strong practical significance.

There are many researches on cost estimation. Generally, the system uncertainties are assumed to be certainty [2] [3] [4], and does not take the uncertainty of aviation equipment design into account. Which is essentially ignored that the system itself has the uncertainty, the results of the estimation is too different from the actual in such assumptions. Theoretically, the equipment efficiency is an important factor affecting the cost[5]. Therefore, the estimation of aviation equipment development and production costs, combined with equipment design uncertainty, trying to establish an efficiency index as the index of estimation model, reflect the development of equipment efficiency and production cost, provide a useful reference for aviation equipment development and production cost estimation.

2. Uncertain information form distribution based on interval number

In practice, many cases using a single numerical variables will lead to loss of information, because of the influence of other factors lead to variable is not a certain amount but within a range of values, such as the error of measurement instrument in floating product parameter values. In addition, due to the lack of information, some of the variables cannot be precisely obtained numerically, but in order to get a numerical estimate, a simple interval. Therefore, people found that the use of interval number can effectively represent variables of this uncertainty.

Interval number can be divided into general interval number and extended interval number. The extended interval number can be expressed as:

$$A = \left\{ \left[\underline{x}, \overline{x} \right], AI \right\} \tag{1}$$

The interval number adding supplementary information AI on the basis of the general interval number AI can be a value, a special position of the cumulative distribution, reliability, membership degree. If the auxiliary information to increase the distribution of information, it is called the interval.

In the development and production, costs are estimated for aviation equipment, due to the uncertainty of design, leading to some parameters that cannot be described by deterministic values, but changes in a certain range, and to the parameters is more accurate, can be obtained by fuzzy statistical parameters in the context of the law, so as to the interval based on the number of random distribution information, plus auxiliary, use the distribution interval number parameter.

3. Establish the research and production cost estimation model

3.1. The construction of equipment effectiveness index

USA industry equipment effectiveness Advisory Committee agreed that the system efficiency is expected a system satisfies the metric a specific set of tasks required degree of, is the availability of the system, the credibility and the intrinsic ability of the function [5]. This is the expression system. One of the most widely used its reliability, maintainability and the inherent ability index comprehensive efficiency for usability, dependability, capacity three comprehensive efficiency indexes. The equipment has large number of risk factors in the development process, leading to the equipment efficiency is affected, in the estimation of the equipment efficiency, must consider these risk factors. According to the theory, aviation equipment comprehensive efficiency index can be expressed as follows:

There, F_E is the integrated combat capability index capability on behalf of equipment, equipment for equipment development; P is risk index; ε_A is the availability of the system, while the calculation can be simplified to the