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Research on Missile Combat Plan Proposal and Optimization Evaluation

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Abstract. In the modern warfare under the conditions of informationization, the conventional force of the conventional missile units is more diverse, and the target combat requirements are more complicated. The commander needs to make scientific and optimal decisions on the missile combat plan when conducting operational command. The missile combat scheme is proposed, the advantages and disadvantages of the common scheme optimization method are evaluated, and the missile combat scheme evaluation problem is characterized by multi-constrained multi-objective optimization problem. The cost and effectiveness evaluation index of the combat scheme is studied and the cost-effectiveness analysis method is established. The evaluation model of the combat plan is preferred. The model has strong adaptability. After scientific and reasonable combat plan optimization, it can effectively improve the combat capability of conventional missile units.

Keywords: Combat plan; Evaluation; Cost-effectiveness; Optimization.

1. Introduction

With the continuous development of science and technology and its wide application in the military field, the conventional missile force wants to achieve one or more established combat missions, and can generate multiple feasible operational solutions. The cost of each combat plan is high or low, and the combat effectiveness is also good and bad. How to choose the best combat performance, and the lowest cost plan requires a comprehensive evaluation by the commander.

At present, there are many researches on the effectiveness of a certain weapon and equipment. However, for the conventional missile operations plan, based on the target physical and functional operational performance indicators, the operational plan risk, weapon and equipment cost and other cost indicators are comprehensively effective for the operational plan. The fee-based assessment and the study of the preferred operational plan did not reveal public information.

The missile combat plan is the core foundation for the use of missile firepower, and is also the data basis for determining the binding data information such as the missile aiming point and target characteristic parameters. It is planned to make a war plan, based on the operational standards for specific targets, the operational level of the operational standards, comprehensive consideration of the missile tactics, target characteristics and operational effects, and determine the target's aiming point, demand volume and time parameters. And estimate the target combat effectiveness and extent.

2. Research Status of Combat Assessment Methods

2.1 Analysis of Advantages and Disadvantages of Commonly used Evaluation Methods

The Delphi method, also known as the Expert Survey, was first produced in the 1940s by O. Holm and N. Dalke, and further improved and developed by T. J. Gordon and Rand. The Delphi method adopts the basic style of the expert meeting, and in the form of anonymous comments, after many inquiries, and comprehensive and revised, the final consensus expert opinion is formed as the evaluation result. The advantage is that it can effectively avoid the situation of sound attachment, stubbornness and swearing when the conference decision is discussed. At the same time, the operation is simple, the opinion collection statistics are faster, and the participants are more acceptable. This method is mainly suitable for the evaluation of problems that lack data and empirical knowledge and is difficult to establish mathematical models. However, this method has higher requirements for the

quality of the experts, and the evaluation results depend on the ability level of the experts and are subjective.

Analytic Hierarchy Process (AHP) is a combination of qualitative and quantitative analysis methods. It uses the analytic hierarchy process to first establish an evaluation model with a hierarchical structure based on the nature and purpose of the computational problem and the logical relationship between its internal elements. The weight values of the constituent elements of each level are then calculated layer by layer on the basis of obtaining the data of the lowest level elements, and finally the calculation result of the problem is obtained. The analytic hierarchy process has clear ideas and simple application, which helps the commander to identify and grasp the main conditional factors affecting the calculation problem as a whole. The shortcoming is that the new scheme cannot be proposed, the normative requirements for the analyzed problems are high, and the analysis results are subject to people. The experience and subjective preferences have a large impact and insufficient accuracy.

The statistical test method is based on the probabilistic statistical theory method, and the method of obtaining the result data by using random experiment or simulation technology is also known as the Monte Carlo method. The statistical test method is widely used in the military field. Based on a large amount of statistical data obtained in actual combat, exercises and experiments, it establishes corresponding inference rule models and mathematical models for quantitative analysis. The random number is used to simulate the random factors in the calculation conditions, and the probability distribution describing the random calculation conditions is numerically generated. Through multiple field tests or computer simulation tests, the result data with the accuracy meeting the requirements can be obtained. In theory, this method is mainly applicable to the quantitative analysis of problems with more random factors. Using computer technology, statistical test methods have two advantages: one is to eliminate the complicated calculation and derivation process, and the other is the time-consuming and labor-intensive field simulation experiment, which is replaced by computer simulation, and the result can be obtained quickly. However, when this method is used to evaluate the combat plan, there are problems. First, the requirements for evaluation indicators are high, the decision variables and condition variables involved are more, the adaptability and feasibility are not strong; the second is that computer simulation programming is more complicated. It usually takes a lot of time.

In quantitative analysis, mathematical analytic method is a general term for a class of mathematical methods, including various algebra, functions, equations and other methods. The mathematical analytical method reveals the intrinsic quantitative relationship of the calculated problem by establishing a suitable mathematical formula, and based on the quantitative operation relationship between the calculation target and the calculation condition, and then analytically solves it. At present, mathematical analytical methods have a wide range of applications in military program optimization, especially in terms of measuring support requirements, optimizing force grouping, calculating action duration, and command and control time limits. The advantage is that under certain conditions, mathematical analytic methods can make complex problems into simple functions or equation calculations, more rigorous description of the problem, and easier to operate. However, it also has limitations in application. The calculation conditions considered by this method are usually relatively simple, or an ideal situation. In addition, when solving some relatively complicated calculation problems, the calculation amount is usually large and the calculation takes a long time.

The confrontation deduction method, also known as the game simulation deduction method, is a method of deriving the imitation of the game confrontation process based on the assumed or known data and conditions. The commander uses the anti-simulation deduction method in the planning scheme optimization, which not only helps predict the operational progress, operational effectiveness and operational loss, reduces the risk and uncertainty of the operation, but also helps to evaluate, compare and further deepen and refine the plan. Program. Under the conditions of informationization, with the extensive use of computer technology in combat command, the use of computer simulation combat program against deduction and computer war chess simulation deduction has become a very common analytical calculation method in the planning scheme optimization. However, using the

confrontation deduction method, the preparation process is relatively complicated, and the deduction rules and process decisions are difficult to grasp, and the model development cost of the war chess deduction is relatively high.

The fuzzy comprehensive evaluation method is a comprehensive evaluation method based on fuzzy mathematics proposed by Professor Chad in the United States in 1965. In the late 1980s, Japan promoted the development of fuzzy comprehensive evaluation methods in many fields, such as fuzzy technology application, robot development, automated process control, and transportation medical treatment. Using the fuzzy comprehensive evaluation method, some uncertain factors in the evaluation index can be uniformly quantified by the membership degree theory. The advantage is that it can effectively cope with the situation that is difficult to quantify in qualitative analysis, and the level of evaluation results is clear. The disadvantage is that the weighted assignment of evaluation indicators is more subjective.

2.2 Research Status of Foreign Evaluation Methods.

The above assessment methods have already been widely applied in many fields such as economy and military, and gradually progressed toward specialization, which has formed many academic achievements. In 1953, the Management Science Journal, which was published by the American Institute of Management Sciences, was designed to "establish, expand, and apply scientific knowledge that helps to understand management practices. Due to technical blockades, the available literature on combat assessment studies is very limited. However, there are more applications for evaluation of resource optimization.

Kagazyo [2] uses the analytic hierarchy process to analyze the technical indicators in the energy plan, and comprehensively considers the influence of social and resource indicators, constructs a reasonable hierarchical structure model, and conducts a preferred study of the energy plan.

Uzay Kayam [3] is aimed at the characteristics of fuzzy comprehensive evaluation method. When the weight is introduced, sensitivity analysis method is added to improve the performance of multi-objective fuzzy evaluation method.

Ishibuchi [4] classifies the optimal decision of the scheme as the classification choice problem. When the scheme is optimized, the relevant theory of soft decision is analyzed, and the neural network method is applied to the preferred evaluation.

Carlos K.H. Wong [5] used a mathematical analytical formula method to use a computer for modeling verification to study the probability of suffering from a certain disease.

2.3 Research Status of Domestic Assessment Methods.

The application of assessment methods in China started relatively late. In the 1980s and 1990s, it was the era of modern scientific assessment in the depth of development in China, mainly in the combined application of various assessment methods. At present, according to the information reviewed, there are few studies on the assessment of combat programs in China, but there are many studies on the effectiveness evaluation of combat programs and the evaluation of weapon equipment effectiveness.

Hua Jiang [6] used the basic theory of analytic hierarchy process to discuss the evaluation of missile equipment design scheme from the perspective of engineering application design, and provided auxiliary decision-making basis for the design and demonstration of the scheme.

Shirong Yang [7] based on the actual battlefield environment background, comprehensively consider the relevant situation of weapon attack and defense confrontation, optimize and improve the ADC evaluation method, and analyze the operational effectiveness evaluation of the conventional missile weapon system.

Xiaoming Ma [8] used the statistical test method to conduct a hit probability test on a certain type of missile target, and analyzed the calculated probability of the test, and gave a quantitative analysis of the combat effectiveness of a certain type of missile weapon.

Yongjie Wang [9] first used the computer to exhaust a certain type of missile firepower distribution plan. On this basis, considering the operational requirements and targets in different situations, the optimization model was established to select the optimal firepower distribution plan.

3. Optimization of Combat Plan based on Cost-Benefit Analysis

3.1 Cost-effectiveness Analysis.

The cost-effectiveness ratio, also known as the cost-effectiveness ratio (ROI), refers to the ratio of output efficiency to input cost, which can be used to measure the effectiveness of marketing activities. Usually, the ratio of program efficiency to investment cost is called Cost-effectiveness. The cost-effectiveness ratio is a relatively core concept in the benefit theory. Although the benefits in the military field are characterized by multiple, comprehensive and quantitative difficulties, it is also necessary to maximize the cost-effectiveness ratio. The combat plan designed by the commander, in accordance with the established decision-making objectives, will also pay a considerable cost while achieving the combat benefit. Obviously, the plan of "killing the enemy 800, self-destruction of one thousand" is generally not a good solution. A combat plan with excessive operational risk is not necessarily a preferred combat plan. Therefore, the cost-effectiveness ratio of the combat plan is analyzed and calculated, and the feasible solution with the highest cost-effectiveness is selected as the optimal combat plan.

3.2 Cost-effectiveness Evaluation Index.

The selection of combat assessment indicators is based on a combination of operational intentions, operational missions, and combat effects on the target. The combat effect of conventional missiles on the target is mainly composed of two parts: physical combat effect and functional combat effect. The target physical combat effect indicator mainly evaluates the average number of hits, the number of reliable hits, and the average relative combat area. The more the average number of hits is set, the more the number of reliable hits and the larger the average relative combat area, the better the combat effect. The target function combat effect indicator mainly evaluates the target function reduction percentage, the target combat power reduction rate, the target reaction delay time, and the target function recovery time. The higher the target function reduction percentage, the greater the target combat power reduction rate, the longer the target reaction delay time and the target function recovery time, the better the combat effect.

In the cost assessment study of the combat plan, the concept of “cost” does not refer to the cost of weapons and equipment in the usual sense, but is a general term for the difficulty of organizing the implementation of the combat plan in terms of combat operations and the risk of achieving combat tasks. It mainly analyzes the three aspects of warfare command coordination costs, combat risk costs, and weapons and equipment costs. The cost of combat command coordination is mainly evaluated by selecting different areas of the launching position, different types of units, and different lengths of time. The cost of combat to the program is mainly based on the probability of the missile's penetration, the probability of a successful explosion of the warhead, and the assessment of the target's combat. Weapons and equipment costs mainly consider three aspects of equipment production capacity and inventory, maintenance capacity and technical support, and spare parts conditions. The lower the production cost, the more inventory, the sparer parts, the lower the cost, the stronger the maintenance capability, the lower the technical support and the lower the cost.

3.3 Research on Optimization Method of Conventional Missile Combat Plan.

As mentioned earlier, there are usually several combat scenarios for targets, and based on their effectiveness-cost studies, comprehensive selection of combat scenarios is required. Under different operational objectives and operational environment conditions, there are differences in the selection of indicators, such as the priority to use the most cost-effective combat program, or the use of the most effective combat program under the condition that the cost is less than a certain value. Based on the analysis of the operational use environment, a combat model optimization model is established.

In theory, the most feasible solution to obtain the maximum combat effect at the lowest cost is the optimal combat plan. To this end, the method of the maximum expected cost-effectiveness criterion can be adopted to assess the degree of optimization of each feasible scheme and use it as a basic basis for the optimization of the combat scheme. In practice, the scheme with the highest cost-effectiveness ratio and the least risk is often absent. In many cases, the commander will further study and analyze the risk-avoiding as needed after evaluating the cost-effectiveness ratio of the scheme. And feasible countermeasures to reduce risks. Moreover, the real-time changes of the superior intention and the battlefield environment will also increase the difficulty of the scheme optimization. Moreover, the characteristics of the commander's command style are different, and the weights of the indicators are different, and the final preferred scheme will be different.

4. Summary

The conventional missile combat scheme is preferred. It is the process in which the commander compares and analyzes several feasible combat schemes to determine the best solution with the assistance of the command authority. From the imitation of the combat plan to the preferred whole process, the preferred essence of the combat plan is that the commander fully exerts his subjective initiative and designs, adjusts, selects and decides on the plan, although the process relies more on the individual commander. Experience and talent, but still need to comprehensively use qualitative analysis and quantitative analysis thinking, and make scientific decisions on the optimal combat plan in a realistic way. This paper analyzes the missile combat plan preparation process, studies the cost and effectiveness evaluation index of the combat plan, and uses the cost-benefit analysis method to establish the optimal evaluation model of the combat plan. The model has strong adaptability and is optimized by scientific and reasonable combat plan. Evaluation can effectively improve the combat capability of conventional missile units.

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