

Efficiency Evaluation Research of Missile Weapon System Based on the ADC - II Model

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Abstract. In order to improve the whole effectiveness evaluation of the missile weapon system with stage character of flight course, put forwards the ADC system effectiveness evaluation method by stage, and improved the ADC model by using coefficient of operators' level of missile weapon system (K) and battlefield confrontation coefficient (Q). The effectiveness evaluation index system of missile weapon system is brought forward and a new improved effectiveness evaluation model (ADC-II) is given. The missile operational effectiveness is quantized by using experts mark, arrangement analysis, fuzzy comprehensive evaluation and weighted summation method. By example analysis, it is proved that this proposed method is of correctness and availability, which brings about the scientific decision-marking basis for the design and application of missile weapon system.

1. Introduction

Under the special conditions of battle circumstance, campaign assignment, deploying regiment, campaign flowing and capability testing of weapon accouter, Efficiency of weapon system accords with accomplishing the appointed campaign assignment (time, space, amount, and so on) by combining qualitative and quantitative analysis in time, space, percent, probability and amount, etc. It's required to evaluate the efficiency of missile system on optimizing combination, deploying assignment, judging intimidation extent of target object, designing control software and demonstrating requirement of new weapon. Nowadays, Evaluate the efficiency of weapon system not only can use the expert assessment method, statistic experimentation method, campaign simulation method, but also can use the quantitative scale method^[1], ADC method^[2~4], analytic hierarchy process^[5] and cloud model^[6]. Considering at the point of battlefield confrontation, this paper improved the traditional ADC model by using coefficient of operators' level of missile weapon system (K) and battlefield confrontation coefficient (Q) and break missile weapon system reliability (D) into product of initiative stage, middle stage and reentry stage. During the evaluating and analyzing course, the paper put forwards the dependability by stage and gave a new improved ADC method which accords with the characteristic of missile campaign better, evaluates efficiency more impersonal, and have more practical value.

2. The Basic Principle and Improvement of ADC Model

In traditional ADC model^[7], the efficiency is an anticipation measurement to satisfy a batch of task for the system. The function involves three variables: availability (A), Dependability (D) and capacity (C). Thus, the model is built as follows:

$$E = A \cdot D \cdot C \quad (1)$$

Where A is the capacity when system is in natural state at the beginning of the assignment, D is the capacity that working system can accomplish prescriptive function on condition that availability is given, C is the capacity measurement to accomplish prescriptive assignment for the system on condition that availability and dependability are given. Aiming at the stage characteristics of the aero missile weapon system, the improved ADC model is:

$$E = K \cdot A \cdot (D_1 \cdot D_2 \cdot D_3) \cdot C \cdot (1 - Q) \quad (2)$$

3. Evaluating Analysis of Missile Weapon System

3.1 Principle of Missile Weapon System.

Missile weapon system is made up of firepower control subsystem and missile subsystem, where firepower control subsystem contains reconnaissance platform, control platform and send platform. After received the assignment, the missile system can obtain the target's position information by using the recon platform before launching, and then send to the control platform after editing by target disposal platform. At the last, the control platform flow the launch instruction to the send platform, and then complete the launch assignment. Operating principle is showed as Fig.1.

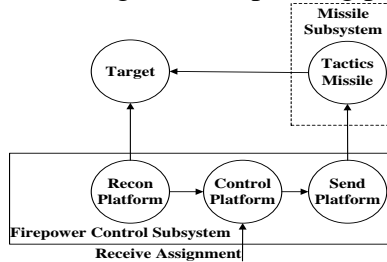


Fig.1 Principle of missile weapon system

3.2 Effectiveness Evaluation Index of Missile Weapon System.

By analyzing the constitution element and its function in assignment process of missile weapon system, the index system is structured and showed as Fig.2.

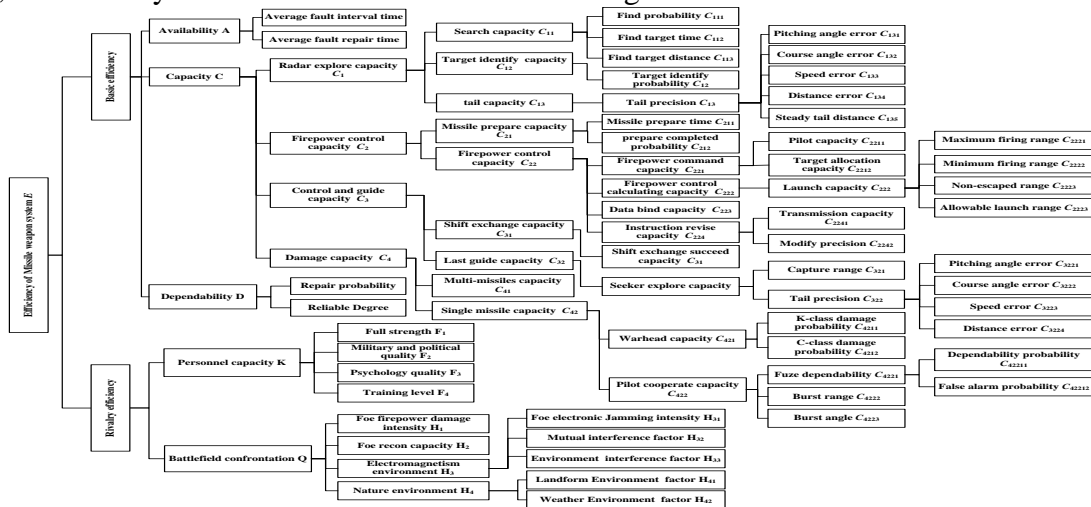


Fig.2 Effectiveness evaluation index of missile weapon system

Evaluating the effectiveness of missile weapon system in Fig.2 contains several steps as follows: availability evaluation before missile launching, namely the probability of each subsystem in regular state (A); dependability evaluation of the whole stage after missile launching and before hitting the target (D); connatural capacity evaluation of the missile system (C); confirm personnel capacity (K) and battlefield confrontation (Q). At the last, calculate the complex effectiveness value by using formula 2, namely evaluate the final damage capacity of the missile.

4. Efficiency Evaluating of Missile Weapon System

Known as Fig.1, the missile weapon system could be dimidiated into firepower control subsystem and missile subsystem, and each subsystem has two states (regular or fault), so missile system has 4 states shown as follow:

- State 1: missile subsystem is regular, and firepower control subsystem is regular too;
- State 2: missile subsystem is fault, but firepower control subsystem is regular;
- State 3: missile subsystem is regular, but firepower control subsystem is fault;
- State 4: missile subsystem is fault, and firepower control subsystem is fault too.

4.1 Confirm Availability of the System A.

The availability of weapon system is the possibility of equipment used in battlefield on the basis of tasks [8]. Evaluating index mainly describe the states at the start of tasks for the working system. The availability is made up of all states probabilities at the beginning of tasks for the system [9]. Suppose this system works in regular state, and the mean time between failures (MTBF) and mean time to repair (MTTR) are satisfied the request of index, otherwise lost the tasks. So the availability of missile weapon system (A) can be expressed as follow:

$$A = [a_1, a_2, a_3, a_4] \quad (3)$$

Where a_1, a_2, a_3, a_4 are the probabilities of system in states 1~4, i.e.

$$A = [a_M a_H, (1-a_M) a_H, a_M (1-a_H), (1-a_M)(1-a_H)] \quad (4)$$

Where a_H is the probability of regular firepower control subsystem; a_M is the probability of regular missile subsystem.

As showed by Fig.1, firepower control subsystem is made up of recon platform, control platform and sending platform in series. So the probability of regular firepower control subsystem can be written as follows:

$$A_H = a_R \cdot a_C \cdot a_S \quad (5)$$

Where a_R 、 a_C and a_S respectively represent the availabilities of recon platform, control platform and sending platform.

In missile weapon system, a certain link may probably be made up of several kinds of different platform in parallel. For example, several sending platforms are composed in parallel to perform a sending task, if only one platform is in regular state, the system can finish the sending task. Take m sending platforms as examples, the regular probability is:

$$a_S = 1 - (1-a_{S1})(1-a_{S2}) \cdots (1-a_{Sm}) \quad (6)$$

Where a_{Sm} is the regular probability of No. m sending platform.

For each basic weapon platform unit, the formula to calculate availability is showed as follow:

$$a = \frac{MTBF}{MTBF + MTTR} \quad (7)$$

Where MTBF is mean time between failures and MTTR is mean time to repair.

4.2 Confirm Dependability of the System D.

The Dependability evaluation means the stability of working system, mainly describes the states during performing tasks of the system. According to the character of launching missile, divided the flight course into 3 stages as follow:

Initiative stage: don't be intercepted, the affect factors are faults of engine and firepower control system.

Middle stage: be intercepted by foe middle-far distance weapon.

Reentry stage: be intercepted by foe short-ranged weapon (electronic jamming and firepower intercept).

4.2.1 Evaluate Dependability of Initiative Stage

Suppose the fault probability of missile engine is p_f and firepower control system is p_g , the dependability of missile system in initiative stage is:

$$D_1 = \begin{bmatrix} d'_{11} & d'_{12} & d'_{13} & d'_{14} \\ d'_{21} & d'_{22} & d'_{23} & d'_{24} \\ d'_{31} & d'_{32} & d'_{33} & d'_{34} \\ d'_{41} & d'_{42} & d'_{43} & d'_{44} \end{bmatrix} = \begin{bmatrix} (1-p_f)(1-p_g) & p_f(1-p_g) & (1-p_f)p_g & p_f p_g \\ 0 & 1-p_g & 0 & p_g \\ 0 & 0 & 1-p_f & p_f \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad (8)$$

Where d'_{ij} is the probability of missile which changed from state i to j , for example, d'_{12} is the probability of missile that changed from state 1 to 2. The same procedure may be easily adapted to obtain any other items in formulas(8,9 and 11).

4.2.2 Evaluate Dependability of Middle Stage

During this period, the effected factors of missile are mainly that the missile subsystem may be intercepted by foe middle-far distance weapon and firepower control subsystem may be attacked.

Suppose the missile subsystem intercepted probability is p_i , and the firepower control subsystem attacked probability is p_h , thus the dependability of middle stage is showed as follow:

$$D_2 = \begin{bmatrix} (1-p_i)(1-p_h) & p_i(1-p_h) & (1-p_i)p_h & p_i p_h \\ 0 & 1-p_h & 0 & p_i \\ 0 & 0 & 1-p_i & p_h \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad (9)$$

As the missile may be attacked by foe several kinds of interception weapon during the middle launching stage, the k times intercepted probability of missile could be described as follow:

$$p_i = 1 - (1-p_{i1})(1-p_{i2}) \cdots (1-p_{ik}) \quad (10)$$

Where p_{ii} ($i=1,2,\dots,k$) is the No i intercepted probability of the missile.

4.2.3 Evaluate Dependability of Reentry Stage

As the missile turns into the last self-guided link, neither the firepower control subsystem is regular nor fault, the probability changed to the next regular state is "1" while to the fault is "0". Suppose the missile intercepted probability by short-range weapon is p_j , thus the dependability of last stage is:

$$D_3 = \begin{bmatrix} 1-p_j & p_j & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 1-p_j & p_j & 0 & 0 \\ 0 & 1 & 0 & 0 \end{bmatrix} \quad (11)$$

The dependability of missile is determined by the 3 launching courses: $D = D_1 \cdot D_2 \cdot D_3$ (12)

4.3 Confirm Capacity of the System C.

As a result of the missile used in assignment only has two patterns (regular or fault), it can consider the capacity of failure missile as zero. Accordingly the inherent capacity matrix of system can be described as follow:

$$c = [c_1, c_1, 0, 0]^T \quad (13)$$

Where c_1 is the probability of fulfilling the assignment for missile weapon system in regular state, and the factor directly reflects the synthesis campaign capacity of missile.

Showed by Fig.3, the basic model of inherent capacity for the missile system is made up of radar explore capacity C_1 , firepower control capacity C_2 , control and guide capacity C_3 and damage capacity C_4 , this paper adopts Analytic Hierarchy Process method and Fuzzy Comprehensive Evaluation method to deal with the capacity matrix C :

Step1 according to Fig.2, confirm campaign capacity evaluation factor domain of discourse U

$$U = \{u_1, u_2, u_3, u_4\}, \text{ where } u_1 = \{u_{11}, u_{12}, u_{13}\}, u_2 = \{u_{21}, u_{22}\}, u_3 = \{u_{31}, u_{32}\}, u_4 = \{u_{41}, u_{42}\}.$$

Step2 confirm remark grade domain of discourse V

$$\begin{aligned} V &= \{v_1, v_2, v_3, v_4, v_5, v_6, v_7, v_8, v_9, v_{10}, v_{11}\} \\ &= \{\text{best, more better, better, good, less good, common, less bad, bad, worse, worst, none}\} \\ &= \{1.0, 0.9, 0.8, 0.7, 0.6, 0.5, 0.4, 0.3, 0.2, 0.1, 0\}. \end{aligned}$$

Step3 construct factor judging fuzzy relation matrix R

$$R = \begin{bmatrix} r_{11} & r_{12} & r_{13} \\ r_{21} & r_{22} & r_{23} \\ r_{31} & r_{32} & r_{33} \\ r_{41} & r_{42} & r_{43} \end{bmatrix}$$

Where r_{ij} is the subject relationship of factor U_i in each layer evaluating factor set U corresponding the grade v_j in remark grade domain of discourse V , namely it's the single factor remark of the No i for the remark object.

Step4 confirm remark factor weight vector

Use the AHP method to confirm each factor weight vector matrix $A = \{A_1, A_2, \dots, A_m\}$ in evaluating factor domain of discourse U . Where A is a fuzzy subset of the U , besides $\sum_{i=1}^m A_i = 1, A_i > 0$ is also

satisfied.

Step5 fuzzy synthesis judge operation

Choose a fuzzy synthesis arithmetic operator“ \circ ”(M(*,+) arithmetic operator), synthesize A and R to obtain a fuzzy synthesis judge model: $B = A \circ R$, if $\sum_{i=1}^m B_i \neq 1$, carry out the normalization process.

Step6 calculate capacity C

When obtain the judge grade and corresponding points, calculate the grade of capacity by using the formula $\sum_{j=1}^n B_j \cdot V_j$.

4.4 Confirm Coefficient of operators' level K.

This part indicate the impact to the system caused by operators and commander, which are mainly decided by the full strength of missile troop, the operators' military and political quality, psychology quality in wartime and training level in peacetime, showed as Fig. 2. The coefficient of operators' level K is given as follow:

$$K = \sum_{i=1}^4 \omega_i \cdot F_i \quad \left(F < 1, \sum_{i=1}^4 \omega_i = 1 \right) \quad (14)$$

Where ω_i are weight vector decided by Expert Decision, F_i is the extent of each index factors attained on campaign, commonly expressed as the form of probability.

4.5 Confirm Battlefield Confrontation Coefficient Q.

The impact to the efficiency caused by battlefield confrontation factor that are different from various environments, and various factor in the same environment are also different from each other. The expression of battlefield confrontation coefficient Q is:

$$Q = \sum_{i=1}^4 \beta_i \cdot \sum_{j=1}^n \beta_{ij} H_{ij} \quad \left(H < 1, \sum_{i=1}^4 \beta_i = 1, \sum_{j=1}^n \beta_{ij} = 1 \right) \quad (15)$$

Where H_{ij} are the values of factor in battlefield confrontation coefficient, β_i and β_{ij} are the corresponding weight vectors.

In conclusion, we can obtain the campaign efficiency of missile weapon system by taking the factors K, Q, A, D and C into the formula(2), showed as follow:

$$E = \sum_{i=1}^4 \omega_i F_i \cdot A \cdot (D_1 \cdot D_2 \cdot D_3) \cdot \sum_{j=1}^4 B_j V_j \cdot \left(1 - \sum_{i=1}^4 \beta_i \cdot \sum_{j=1}^n \beta_{ij} H_{ij} \right)$$

5. Experiment and Results

Suppose in local combat, our troops have a full strength, the soldier aren't only familiar with the environment, but also have highly military, political and psychology quality. They perennially train in the campaign area and construct lots of self-contained sending strategic point, fortification, mobile way, headquarters and observation platform, etc. The foe troops not only have higher synthesis campaign capacity according to their plenty of campaign experience, but also are good at electronic war, recon exploring and associated damage.

5.1 Compute Availability of the System A.

Suppose a certain type of missile weapon system (contain missile and firepower control subsystems) attacked a target, the mean time between failures (MTBF) and mean time to repair (MTTR) are showed as Tab.1.

Tab 1 Mean time between failures and mean time to repair of missile weapon system

Item	Recon Platform	Recon Platform	Control Platform	Control Platform	Sending Platform	Missile
	NO.1	NO.2	NO.1	NO.2		
MTBF	90	80	70	60	40	80
MTTR	4	3	1	1	2	2

According to the Tab.1 and formula (7), the availability of missile subsystem and sending platform are separately showed as follows: $a_M = 0.976$, $a_S = 0.952$.

As the recon platform and control platform worked in parallel, their availability can be obtained by using formula (6) and (7):

$$a_R = 1 - \left(1 - \frac{90}{90+4}\right) \left(1 - \frac{80}{80+3}\right) = 0.998 ;$$

$$a_C = 1 - \left(1 - \frac{70}{70+1}\right) \left(1 - \frac{60}{60+1}\right) = 0.999 .$$

According to formula (5), the probability of firepower control subsystem is: $a_H = a_R \cdot a_C \cdot a_S = 0.949$.

According to formula (4) any more, the availability matrix is described as follow:

$$A = [0.926 \ 0.023 \ 0.050 \ 0.001] .$$

5.2 Compute Dependability of the System D.

Suppose the engine fault probability of missile is $p_f = 0.04$, and the fault probability of firepower control system is $p_g = 0.07$ in the initiative stage; the intercepted probability is $p_i = 0.25$, and the attacked probability is $p_h = 0.18$ in the middle stage; the missile intercepted probability by short-range weapon is $p_j = 0.35$ in the reentry stage.

So according to formula (8~11), we can obtain the dependability matrix of these three stages showed as follow:

$$D_1 = \begin{bmatrix} 0.893 & 0.037 & 0.067 & 0.003 \\ 0 & 0.930 & 0 & 0.07 \\ 0 & 0 & 0.960 & 0.04 \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad D_2 = \begin{bmatrix} 0.615 & 0.205 & 0.135 & 0.045 \\ 0 & 0.82 & 0 & 0.25 \\ 0 & 0 & 0.75 & 0.18 \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad D_3 = \begin{bmatrix} 0.65 & 0.35 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0.65 & 0.35 & 0 & 0 \\ 0 & 1 & 0 & 0 \end{bmatrix}$$

Thus the dependability matrix of the system is:

$$D = D_1 \cdot D_2 \cdot D_3 = \begin{bmatrix} 0.468 & 0.530 & 0 & 0 \\ 0 & 1.07 & 0 & 0 \\ 0.468 & 0.465 & 0 & 0 \\ 0 & 1 & 0 & 0 \end{bmatrix}$$

5.3 Compute Capacity of the System C.

On the basis of the Expert Decision, construct the estimation matrix by using the Analytic Hierarchy Process and test the coherence, such as Fig.2 showed. All factors in the estimation matrix are educed from the statistical analysis of survey data given by the missile experts. Besides, they are satisfied the T.L.Saaty 1~9 scale method.

Tab 2 Index mark of system inherent ability

System inherent ability C	Radar Explore Capacity C1	Firepower Control Capacity C2	Control and Guide Capacity C3	Damage capacity C4
Radar Explore Capacity C1	1	1/3	1/2	1/4
Firepower Control Capacity C2	3	1	1/5	1/3
Control and Guide Capacity C3	2	5	1	1/3
Damage capacity C4	4	3	3	1

It's easy to obtain the results: $W = (0.0896 \ 0.1392 \ 0.2956 \ 0.4756)$, $\lambda_{\max} = 4.4956$, $C.I. = 0.0368$ and $C.R. = 0.0401 < 0.1$, thus the estimation matrix satisfies the coherence index.

The each layer index weight vectors of capacity for the missile system are showed as Tab.3.

Tab 3 Index weight vector of capacity matrix for the missile weapon system

The First Layer	Weight	Second	Weight	The Third Layer	Weight	The Fourth Layer	Weight	The Fifth Layer	Weight	Remark grade domain of discourse													
										Best	More Better	Better	Good	Less Good	Common	Less Bad	Bad	Worse	Worst	None			
Radar Explore Capacity	0.0896	C ₁₁	0.3256	C ₁₁	0.452					0.1	0.0	0.0	0.1	0.2	0.0	0.1	0.0	0.1	0.0	0.13			
					0.316					0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.1	0.2	0.0	0.0	0.02		
					0.231						0.1	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.1	0.0	0.07	
		C ₁₂	0.2375	C ₁₂	1						0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.21		
		C ₁₃	0.4369	C ₁₃	1		C ₁₃₁	0.1				0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.0	0.0	0.12	
						C ₁₃₂	0.2						0.3	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.23	
						C ₁₃₃	0.2						0.2	0.2	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.08	
						C ₁₃₄	0.1						0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.21
						C ₁₃₅	0.2						0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.1	0.0	0.1	0.07
	Firepower Control Capacity	0.1392	C ₂₁	0.0965	C ₂₁	0.554					0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.1	0.0	0.03		
						0.445								0.3	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.07
			C ₂₂	0.9035	C ₂₂₁	0.3211	C ₂₂₁	0.321	C ₂₂₁₁	0.4			0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.25
								0.5							0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.0
					C ₂₂₂	0.3562	C ₂₂₂	1		C ₂₂₂	1		C ₂₂₂₁	0.3	0.2	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0
									C ₂₂₂₂			0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
		C ₂₂₂₃							0.2			0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.2	0.0	0.0	0.29	
		C ₂₂₂₄	0.3	0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.3	0.05								
C ₂₂₃		0.2122	C ₂₂₃	2						0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.44			
C ₂₂₄		0.1105	C ₂₂₄	5		C ₂₂₄₁	0.7688			0.1	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.11			
						C ₂₂₄₂	0.2312					0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.1	0.0	0.10		
Control and Guide Capacity		0.2956	C ₃₁	0.2103	C ₃₁						0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.2	0.0	0.26		
														0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.34
			C ₃₂	0.7897	C ₃₂	1		C ₃₂₂	0.7644		C ₃₂₂₁	0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.23
							C ₃₂₂₂			0.2845	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.19	
							C ₃₂₂₃			0.2	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.1	0.1	0.0	0.19
							C ₃₂₂₄			0.6603	0.0	0.0	0.0	0.2	0.8	0.2	0.6	0.6	0.3	0.6	0.0	0.19	
							C ₃₂₂₅			0.4288	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.1	0.07	
Damage Capacity	0.4756	C ₄₁	0.1002	C ₄₁						0.1	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.1	0.0	0.11			
		C ₄₂	0.8998	C ₄₂₁	0.8103		C ₄₂₁₁	0.4			0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.1	0.1	0.0	0.02		
							C ₄₂₁₂	0.5489					0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.19
	C ₄₂₂	0.1897	C ₄₂₂₁	0.2574		C ₄₂₂₁	0.8814		C ₄₂₂₁₁	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.16		
								C ₄₂₂₁₂	0.1186	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.09	
								C ₄₂₂₂	0.3562	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.23
								C ₄₂₂₃	0.3864	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.38	

Compute the capacity value by using fuzzy relationship synthesized theory, and the value of No.3 layer for the search, capacity is:

$$B_{11} = [0.4526 \ 0.3163 \ 0.2311] \circ \begin{bmatrix} 0.11 & 0.05 & 0.09 & 0.12 & 0.21 & 0.02 & 0.12 & 0.07 & 0.11 & 0.06 & 0.13 \\ 0.02 & 0.04 & 0.12 & 0.11 & 0.15 & 0.05 & 0.07 & 0.13 & 0.21 & 0.08 & 0.02 \\ 0.13 & 0.01 & 0.03 & 0.09 & 0.04 & 0.25 & 0.14 & 0.06 & 0.07 & 0.11 & 0.07 \end{bmatrix}$$

$$=[0.0862 \ 0.0376 \ 0.0856 \ 0.1099 \ 0.1517 \ 0.0826 \ 0.1088 \ 0.0867 \ 0.1324 \ 0.0779 \ 0.0813]$$

The same procedure may be easily to obtain the value of No.3 layer for the tail capacity:

$$B_{13} = [0.1561 \ 0.2304 \ 0.2142 \ 0.1015 \ 0.2978] \circ \begin{bmatrix} 0.06 & 0.04 & 0.08 & 0.09 & 0.07 & 0.22 & 0.14 & 0.15 & 0.02 & 0.01 & 0.12 \\ 0.31 & 0.02 & 0.03 & 0.01 & 0.05 & 0.11 & 0.12 & 0.03 & 0.04 & 0.05 & 0.23 \\ 0.21 & 0.22 & 0.03 & 0.05 & 0.06 & 0.07 & 0.09 & 0.11 & 0.02 & 0.06 & 0.08 \\ 0.11 & 0.03 & 0.05 & 0.01 & 0.08 & 0.12 & 0.06 & 0.14 & 0.13 & 0.06 & 0.21 \\ 0.04 & 0.06 & 0.05 & 0.07 & 0.09 & 0.11 & 0.23 & 0.11 & 0.03 & 0.14 & 0.07 \end{bmatrix}$$

$$=[0.1488 \ 0.0789 \ 0.0458 \ 0.0489 \ 0.0702 \ 0.1196 \ 0.1434 \ 0.1009 \ 0.0388 \ 0.0737 \ 0.1310]$$

$$B_1 = [0.3256 \ 0.2375 \ 0.4369] \circ \begin{bmatrix} B_{11} \\ B_{12} \\ B_{13} \end{bmatrix}$$

$$=[0.1050 \ 0.0776 \ 0.0978 \ 0.0643 \ 0.0824 \ 0.0886 \ 0.1123 \ 0.0984 \ 0.0767 \ 0.0766 \ 0.1336]$$

The same procedure, we can obtain these factors as follow:

$$B_2 = [0.0954 \ 0.0625 \ 0.0588 \ 0.0656 \ 0.0518 \ 0.0794 \ 0.0845 \ 0.0793 \ 0.0853 \ 0.1148 \ 0.2170]$$

$$B_3 = [0.0517 \ 0.0555 \ 0.0455 \ 0.0813 \ 0.0770 \ 0.0998 \ 0.1447 \ 0.1058 \ 0.1238 \ 0.1109 \ 0.1830]$$

$$B_4 = [0.0456 \ 0.0600 \ 0.0762 \ 0.1309 \ 0.1225 \ 0.0511 \ 0.0544 \ 0.1009 \ 0.1178 \ 0.1105 \ 0.1392]$$

$$B = [0.0896 \ 0.1392 \ 0.2956 \ 0.4756] \circ \begin{bmatrix} B_1 \\ B_2 \\ B_3 \\ B_4 \end{bmatrix}$$

$$=[0.0596 \ 0.0606 \ 0.0667 \ 0.1012 \ 0.0956 \ 0.0728 \ 0.0904 \ 0.0991 \ 0.1114 \ 0.1082 \ 0.1625]$$

Therefore, the capacity value of the missile weapon system in regular state is:

$$C = B \cdot V^T$$

$$= 0.0596*1 + 0.0606*0.9 + 0.0667*0.8 + 0.1012*0.7 + 0.0956*0.6 + 0.0728*0.5 + 0.0904*0.4 + 0.0991*0.3 + 0.1114*0.2 + 0.1082*0.1 + 0.1625*0 = 0.4311$$

And according to the formula (13), the capacity matrix is showed as:

$$C = [c_1 \ c_1 \ 0 \ 0]^T = [0.4311 \ 0.4311 \ 0 \ 0]^T$$

5.4 Compute K and Q.

Considering at the practice and the design performance of the missile weapon system, we can obtain the weight vectors and correlative parameters of the coefficient of operators' level K and battlefield confrontation coefficient Q showed as Tab.4.

Tab 4 Weight vectors and correlative parameters of coefficient of operators' level and battlefield confrontation

Items	No.1 Index	Weight	No.2 Index	Weight	Parameters	
Battlefield Confrontation Q	Foe Firepower	0.46			0.35	
	Foe Recon	0.25			0.28	
	Electromagnetism	0.18	Foe Electronic	0.5	0.16	
			Mutual Interference	0.2	0.21	
			Environment	0.3	0.25	
		Nature	0.11	Landform	0.7	0.23
				Weather	0.3	0.16
Operators' Level K	Full Strength	0.1			0.75	
	Military and	0.3			0.80	
	Psychology Quality	0.2			0.85	
	Training Level	0.4			0.90	

According to formula(14 and 15), we can get the results:

$$K = [0.1 \ 0.3 \ 0.2 \ 0.4] \cdot \begin{bmatrix} 0.75 \\ 0.80 \\ 0.85 \\ 0.90 \end{bmatrix} = 0.8450; \quad Q = 0.2757$$

5.5 Compute Complex Efficiency of Missile Weapon System E.

According to formula(2), we can get the results:

$$E = K \cdot A \cdot (D_1 \cdot D_2 \cdot D_3) \cdot C \cdot (1 - Q)$$

$$= 0.8450 \cdot (1 - 0.8330) \cdot [0.926 \ 0.023 \ 0.050 \ 0.001] \cdot \begin{bmatrix} 0.468 & 0.530 & 0 & 0 \\ 0 & 1.07 & 0 & 0 \\ 0.468 & 0.465 & 0 & 0 \\ 0 & 1 & 0 & 0 \end{bmatrix} \cdot \begin{bmatrix} 0.4311 \\ 0.4311 \\ 0 \\ 0 \end{bmatrix} = 0.2629$$

In conclusion, comparing at the impact of nature environment, the synthesis efficiency of missile weapon system influenced by the foe intercepted firepower, electronic jamming, recon exploring and battlefield electromagnetism environment are more greatly. At the same time, the system efficiency is also influenced by the coefficient of operators' level and battlefield confrontation seriously. Therefore, the troop should not only keep a certain intensity of combat readiness, full strength and military training, but also pay attention to the operators' political quality education and psychology quality training.

6. Conclusions

Considering at the stage character of the missile flight course, this paper break the dependability in traditional ADC method into product of different stages. Besides, the results with accession to the coefficient of operators' level K and battlefield confrontation coefficient Q accord with the working rule of campaign missile better. At the same time, the missile inherent capacity matrix is quantized analyzed by Experts Decision, Analytic Hierarchy Process, Fuzzy Comprehensive Evaluation and weighted summation method, it is also of benefit to realize the impact intensity caused by different factors to the missile system. The proposed method not only offers a reference for the design and application of missile weapon system, but also would be suitable for the other systems that with staged working course.

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