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Research on the Effectiveness Evaluation Index System of Strategic Early Warning System for Early Warning Counterattack Operations

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Abstract: *Early warning counterattack operation is one of the important combat styles, and the strategic early warning system is an indispensable and critical part of early warning counterattack operations. Based on the analysis of the working process of the strategic early warning system, and based on the principle of index system construction, the effectiveness evaluation index system is proposed, which lays the foundation for the comprehensive evaluation of the effectiveness of the early warning system.*

Keywords: *Early warning counterattack operations, Strategic early warning system, Effectiveness evaluation. Index system*

1. Introduction

The rapid development of science and technology and the accelerated development of new military changes have brought about revolutionary changes in the shape of warfare, the future of combat in personnel, equipment, materials, information, time, space, environment and other uncertainties have increased unprecedentedly, the elements of high-frequency interaction, non-linear flow, have become an important feature of modern warfare. Multi-service close coordination throughout, joint cross-domain operations have become the basic way to enhance the system's operational capabilities and also become an important guarantee of victory in war. Early warning counterattack operations is one of the important combat styles, early warning counterattack operations system construction is an important way to enhance China's strategic deterrence capabilities.

Early warning counterattack means that when the enemy launches a missile to launch a strike against us, our strategic command structure issues counterattack orders to missile units and combat units on the basis of early warning information, completes our missile launch and strikes at important strategic targets of the enemy before the incoming missile explodes, thus achieving the purpose of deterring and effectively countering the enemy. As an important part of the early warning counterattack combat system, the strategic early warning system plays an extremely important role in the early warning counterattack combat. The strategic early warning system is at the forefront of the early warning counterattack combat system and plays a role in combat that cannot be replaced by other equipment. Early warning system capability will promote the early warning counterattack combat system capabilities, early warning system is an important element of the early warning counterattack combat system construction, to play an important role in the system combat effectiveness. Therefore, strategic early warning capability building is a key element of early warning counterattack combat system capability building. Strategic early warning system effectiveness assessment can obtain early warning system construction indicators and decision-making information from multiple dimensions, evaluate and determine the gap between strategic early warning capabilities and operational needs, and continuously improve early warning capabilities by bridging capability gaps and eliminating capability redundancies, serving the comprehensive construction and planning demonstration of the early warning counterattack combat system[1-3].

2. Analysis of the Strategic Early Warning Process

The strategic early warning system mainly consists of a big data early warning platform and a space, ground and air-based early warning platform. The early warning equipment mainly includes early warning satellites, early warning radars, early warning aircraft and floating vehicles. Early warning

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activities include monitoring and detecting the active segment of incoming missiles, tracking and identifying the mid-flight segment, estimating ballistic parameters and predicting the landing point, etc.

2.1. Analysis of Active Segment Warning Operation and Characteristics

The active segment of a ballistic missile flight typically refers to the phase of the missile from launch to engine shutdown. Although the active segment of the flight time is small in proportion, it determines the overall ballistic trajectory and range. The active segment warning is significant and can provide sufficient operational preparation time for early warning counterattack operations. The engine of a ballistic missile is operating in the active segment, and its visible combustion wake is relatively easy to monitor with infrared detectors. Active segment missile warhead and body have not yet separated, releasing decoys difficultly, Missile target identification only involves the missile type judgment. The active segment missile flight speed is relatively slow, easy to track and capture. In addition, due to the short duration of the active segment, the early warning information security requirement is high, and the early warning detection platform must be deployed near the target launch site and have a wider detection perspective and coverage.

Active segment missile early warning mainly includes full-time domain surveillance of global or key areas and continuous scanning at certain time intervals, detecting missile target trailing flame signals and sighting and tracking, obtaining missile type information, transmitting captured information back to the command and control center in real time and releasing it to the entire early warning system. The command and control center processes and identifies the data, discriminates the missile target, and then continuously and accurately tracks and locates it, estimates the missile's ballistic parameters through information fusion technology, transmits the estimated data to other early warning platforms and early warning counterattack combat units, and completes the missile active segment early warning information security.

2.2. Analysis of Passive Segment Warning Operation and Characteristics

The passive segment of the missile flight is the flight phase during which the warhead body is guided after separation using only inertia and its own gravity, and can be divided into the free segment and the reentry segment. The free segment refers to the period from when the rocket motor stops until the warhead re-enters the atmosphere, and the duration of this segment is relatively long, accounting for about 80 to 90 percent of the total flight time. Re-entry section is the missile re-entry phase of flight, the stage of the warhead due to frictional resistance of the air, the speed of fall rapidly decreases, while the warhead surface temperature rises sharply, accompanied by the warhead fall of other interference targets due to friction generated by high temperature and will be burned or filtered by the atmosphere. A few specially designed decoys accompanied by real warheads disrupt the missile defense tracking.

Passive segment warning is based on the forecast guidance information provided by the command and control center and the current operational readiness of each early warning platform to develop the operating mode of each radar station while dividing the search mission area. Each early warning platform searches for incoming missile targets in the divided mission area, confirms and tracks missile targets, measures missile ballistic parameters, sends detection data to the data processing center, and the data processing center fuses and processes the target data to determine missile target trajectories. For multiple trajectories of the same target, the data processing center fuses the ballistic data and generate an early warning report. The data processing center sends the report to the command and control center to provide information assurance and data support for command and control decisions[4-5].

Passive segment missiles can confuse and disrupt early warning information assurance systems by releasing decoys or lowering target signature signals during flight. Early warning systems must identify warheads and decoys using valid information collected by various sensors, and continuously track and monitor actual warheads to obtain sufficiently accurate real-time missile status information. Therefore, compared to the active segment, the early warning information security requirements of the passive segment of missile flight focus more on the precision and accuracy of data, including missile tracking, warhead identification, and ballistic prediction.

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3. Strategic Early Warning System Effectiveness Evaluation Index System Construction

3.1. Principle of the Construction of the Effectiveness Evaluation Index System

The construction of the early warning system effectiveness evaluation index system should follow the following principles.

(1) Independence Principle. In order to reduce the complexity of the early warning system evaluation model, obtain relatively accurate data and draw reliable conclusions, the selected evaluation indicators should be relatively independent of each other to reduce correlation and overlap.

(2) Feasibility Principle. The process of analyzing and establishing evaluation index system should ensure that each index has strong operability, the reference value of each index should be easy to obtain, and the meaning of each indicator should be easy to understand, have a statistical basis, and be convenient for evaluation.

(3) Completeness Principle. The construction of the index system should fully reflect its early warning ability, and should not omit some important indexes and may ignore less influential indexes in order to improve the evaluation efficiency.

(4) Scientific Principle. The analysis of evaluation indexes and the construction of the index system should be guided by scientific theories, objectively analyze the interrelationships and essential connections among indexes, make reasonable use of quantitative and qualitative analysis methods, and ensure that the constructed index system is scientific and practical[6-8].

3.2. Strategic Early Warning System Effectiveness Evaluation Index System

The influencing factors of strategic early warning capability are complex and diverse. According to the principles of index system construction and the needs of early warning capability, we gradually derive the components of early warning capability according to the analysis idea from top to bottom and from macro to micro, and decompose each element into mutually independent sub-indicators to establish the evaluation index system (Figure 1).

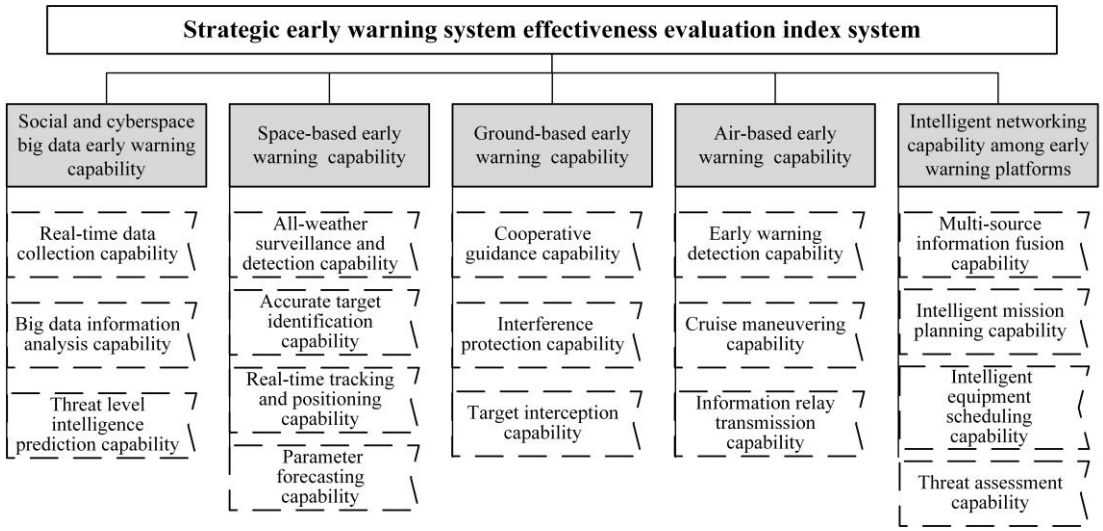

Figure 1: Strategic early warning system effectiveness evaluation index system

(1) Social and Cyberspace Big Data Early Warning Capability. Through continuous monitoring and collection of international environmental data information, as well as the international community and cyberspace combat-related political, economic, diplomatic, military and other information. Integrate all kinds of data information and conduct multi-dimensional big data analysis. Deeply mine data information related to counterattack operations, intelligently extract key indicators, form a big data early warning information guarantee for society and cyberspace, and provide advance prediction, decision-making and combat preparation for counterattack.

(2) Space-based Early Warning Capability. Space-based early warning is able to continuously detect and identify incoming enemy targets in real time, determine the number, type and location of targets, and detect and assess the effects of destruction through early warning satellites and associated intelligent

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information processing systems. Information fusion, big data processing and cloud computing technologies are used to accurately determine the real-time location of enemy targets based on the information returned by load detectors and eye-tracking devices.

(3) Ground-based Early Warning Capability. In order to increase the probability of surprise defense of incoming targets, the enemy will use a variety of jamming measures to reduce the detection and identification capability of the early warning platform. Therefore, ground-based early warning platforms must accurately identify and track targets through intelligent anti-jamming, big data processing and intelligent identification technologies.

(4) Air-Based Early Warning Capability. Air-based early warning platform through early warning aircraft, unmanned aerial vehicles and other equipment, can real-time perception of battlefield situational information, intelligent modification of early warning detection, tracking and networking. The detection range can cover a large battlefield area, and has the ability to fuse multi-source information and the ability to detect and evaluate the effect of destruction. In order to avoid being detected and attacked by enemy detection, it must also have the ability of rapid maneuver, stealth and air-holding.

(5) Intelligent Networking among Early Warning Platforms. Through intelligent networking among early warning platforms, each early warning platform is interconnected, resource sharing, mutual backup and dynamic self-organization. The data processing center is built to control the synergy of multiple platforms, and has the ability to intelligently plan the tasks of each platform and dispatch platform resources, dynamic networking, real-time information processing, and intelligent tracking based on incoming enemy target information. The networking of early warning platforms is a comprehensive manifestation of the scientific nature of mission planning, the timeliness of early warning equipment scheduling, the timeliness of multi-domain, multi-source information fusion, and the accuracy of target threat assessment[9-10].

4. Conclusions

The strategic early warning system is responsible for important early warning tasks such as early warning and general guidance in the early warning counterattack combat system. Therefore, the evaluation of the effectiveness of the strategic early warning system is of great significance for the evaluation of the effectiveness of the early warning counterattack combat system. In this paper, based on the principles of index system construction, combined with the strategic early warning system work process, the strategic early warning system effectiveness evaluation index system is constructed, which lays the foundation for the next early warning system effectiveness evaluation work. It has certain reference significance to the strategic early warning system capability improvement.

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