A Brief Analysis of Competency of Radar Operators

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Abstract: As an important position in the air defense early warning system, the radar operator mainly undertakes tasks such as air situation monitoring and intelligence processing. Therefore, a radar operator not only needs keen observation ability but also decisive judgment ability. This paper summarizes and analyzes the competency of radar operators to ensure the safety and stability of airspace, safeguard national security, and promote China's economic development.
***Keywords*:** radar; operator; competency

1. Introduction

Radar operators play an important role in airspace security work, mainly realizing real-time monitoring of aerial targets and intelligence processing. They not only need to maintain all-weather combat readiness, but their daily work also features high precision requirements and rapid response characteristics [1]. Therefore, radar operators are required to be on duty 24 hours a day without interruption and always maintain a high level of tension, ensuring they remain fully engaged in their work with full enthusiasm, maximizing the accuracy rate of air situation handling to reach 100% and the timeliness rate of intelligence transmission to reach 100%. For a radar operator, achieving the above goals requires extremely high standards in both professional skills and cognitive and thinking abilities. Therefore, this paper analyzes the competency of radar operators in order to achieve a comprehensive understanding of the overall ability requirements of this position.

2. Significance of Research on Radar Operator Competency

From international conflicts in recent years, it can be seen that ground-based early warning surveillance radar, as an important early warning force in modern warfare, is usually the first high-value target to be attacked. This fully shows that early warning surveillance forces occupy a pivotal position in modern warfare [2]. At present, radar troops are the main information source of China's aerospace early warning intelligence network, and radar operators are the main force of radar troops. Their capability quality is the decisive factor in whether radar equipment can accurately obtain air situation information. In particular, with the iterative upgrades of various weapon equipment in stealth, ultra-high speed, ultra-low altitude, and flexible maneuverability, the requirements for radar operators in handling complex air situations, mastering multiple batches of targets, counter-stealth means, counter electronic countermeasures, and advanced radar operation capabilities have become more prominent.

Competency originally means learning and knowledge, and its academic definition refers to the characteristics of individuals who perform excellently in a certain field or position. Competency-based training is to formulate a corresponding training system combined with actual job requirements, and then construct a standardized competency model, so as to improve learners' knowledge level and professional skills [3]. For example, in the International Civil Aviation Organization, aviation training is regarded as evidence-based training, and the cultivation effect of competency is verified by a data closed-loop method. Therefore, in pilot theoretical course teaching, not only scenario simulation and other teaching methods are integrated, but also forward learning modes are included, so that pilot training can better meet pilot competency requirements. There is a classic saying in radar troops, "A small operator is connected to the commander." It can be seen that as the "first contact point" of the air situation, the stronger the professional skills of the operator and the more accurate the air situation provided, the more efficient the air defense operational command decision-making will be, and the more initiative in mastering air superiority will be. Therefore, analyzing and studying the competency of radar operators to achieve "person-post matching and full utilization of talents" and further improve the combat effectiveness of radar troops is of great significance.

3. Survey Results of Radar Operator Competency

The author conducted interviews with more than 10 key operators who were awarded the title of the Air Force "Top 100 Excellent Operators", ranked high in competitions at various levels, and handled complex air situations multiple times.

Based on hierarchical task analysis and cognitive task analysis methods, it is considered that radar operator competency can be analyzed from seven dimensions, including professional skills, cognition, and thinking ability.

(1) Professional skills dimension. The weapon equipment used by radar operators is a radar with complex systems and comprehensive functions, and its professional skill requirements are far higher than operating light weapons. Therefore, this dimension mainly measures the operator's mastery of radar performance and the proficiency in exerting the full functional role of the equipment, namely the ability to understand the radar working principle, the relationships between modules, the internal operating mechanism of modules, and to search, discriminate, measure, monitor, and report targets through radar operation. For radar operators, their work is not only closely related to target monitoring, but also directly affects civil aviation flight safety. Through the radar display screen, radar operators must not only closely monitor the situation of our aircraft, but also analyze the flight status of civil aviation aircraft. Therefore, this job is highly challenging, has high professional requirements, and also requires certain work experience. For example, radar operators need to quickly distinguish target characteristics such as civil aviation flights, military aircraft, and unmanned aerial vehicles, and accurately determine friend-or-foe attributes and threat levels in the shortest possible time. In addition, they must fully grasp factors such as radar cross-section fluctuation levels and speed and altitude characteristics in order to minimize identification time and improve the accuracy of target information judgment.

(2) Cognitive and thinking ability dimension. During positioning duty, radar operators are usually required to maintain concentration, keen perception, rapid calculation, and bold prediction. Their ability to perceive things and logical thinking cannot be ignored. Therefore, this dimension mainly measures the operator's abilities in task focus and judgment, information capture and perception, parameter interpretation and calculation, target memory and prediction, and command understanding and execution. For example, the radar device remains in continuous operation, and each rotation leaves a 10-second track on the display screen. During this stage, radar operators need to maintain a high level of alertness and quickly identify each bright spot appearing on the screen. They must not only accurately distinguish birds and clouds, but also rapidly identify possible interference sources. Therefore, radar operators need not only very high concentration but also rapid response ability in order to quickly recognize and judge information.

(3) Psychological quality and emotion management dimension. In modern warfare, battlefield situations change rapidly and the complexity of air situations is self-evident. Whether operators can find key targets among a "screen full of plots", conduct continuous operations under high-pressure environments, quickly adjust after judgment errors, and rapidly self-adjust during combat intervals all directly affect the quality of air situation support [4]. Therefore, this dimension mainly measures the operator's abilities in calm response, endurance and patience, resistance to pressure and frustration, psychological adjustment, and emotion management. For example, the working environment of radar operators is relatively harsh, and they need to face screens for a long time during work, resulting in great mental pressure. Radar operators must not only complete routine monitoring during the day, but also calmly cope with challenges brought by night or severe weather, always remaining in a high-pressure working state. For radar operators, both physical and psychological pressures are considerable, thus they need strong physical and psychological stress resistance to better complete their work.

(4) Interpersonal and organizational cooperation dimension. In the process of air situation support, radar operators usually need to closely cooperate with on-duty operators, commanders, radar technicians, and other combat duty personnel to ensure the smooth completion of tasks. Therefore, this dimension mainly measures the operator's abilities in communication, understanding and expression, collaborative cooperation, handling disagreements, and organization and leadership.

(5) Professional motivation and values dimension. As a core specialty, radar operators have a relatively long training and growth cycle, with substantial "early investment", heavy daily duty pressure, and long working hours. To truly achieve dedication to the post, relatively higher professional identity and a strong sense of career responsibility are required. Therefore, this dimension mainly measures the operator's sense of mission toward military duties, sense of identity with their position, sense of achievement in completing tasks, sense of value in life development, and real feelings toward others' evaluations. In daily work, radar operators must always remain highly vigilant, ensure each scan is accurately completed, and promptly report any abnormal situation discovered to the command center. Achieving these goals requires radar operators to possess a high sense of responsibility and mission.

(6) Learning and growth potential dimension. Radar operators belong to a position characterized by "training for a thousand days and using for a thousand days." Especially as current radar equipment is constantly updated, continuous learning of new knowledge, summarizing new operational experience, and innovating new support methods are needed to truly "see far, judge accurately, and report precisely." Therefore, this dimension mainly measures the operator's modest eagerness to learn, ability to discover and improve personal shortcomings, willingness to accept new things, ability to learn from failure, courage to break through operational procedures, and enthusiasm for participating in centralized training and

competitions.

(7) Professional attitude and discipline dimension. No matter how strong or skilled a radar operator is, they are first and foremost a revolutionary soldier and should always maintain the proper qualities. Therefore, this dimension mainly measures the operator's awareness of obedience, discipline, confidentiality, teamwork, safety awareness, as well as internal relations and personal image.

Each service branch and each professional position has its own particularity and cannot be generalized. Only through multi-perspective and multi-dimensional analysis and research can its essence be explored, and better achieve "making full use of people's talents and abilities", promoting the leap in combat effectiveness construction.

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