

Improving the Quantitative Evaluation Methodology of Medical Units Capabilities in the Armed Forces of Ukraine

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Abstract

Aims: Aim of the study justification methods of quantitative evaluation medical unit's capability of Armed Forces of Ukraine. Increasing the level of interoperability of the Armed Forces of Ukraine and the armed forces of NATO member states.

Subject and Methods: The system of medical support of the Armed Forces of Ukraine. The evaluation of the capabilities of medical units of the Armed Forces of Ukraine on tactical level. The research is conducted by analyzing the normative documents of the Ministry of Defense of Ukraine, the General Staff of the Armed Forces of Ukraine, approved standards and procedures of NATO countries, own research. Methods of content analysis, bibliographic, statistical, as well as the method of system analysis are used.

Results: In the article the modular evaluation with use of multicriteria optimization is offered that provides reduction to one-criterion optimization with use of an integrated indicator. Each functional module evaluated separately and assigned a weighting factor (for different application scenarios). The indicators of a separate module of the medical unit are normalized to obtain an integrated indicator, which has a range of measurements from 0 to 1. The use of geometric mean will make it impossible to compensate for small indicators. Capability evaluation as a whole can be expressed as the average of the set of estimates of each capacity module through the weighted average geometric index.

Conclusion: The proposed method of modular assessment of the capabilities of medical units of the Armed Forces of Ukraine allows quantifying them and allows determining the degree of approximation of capabilities to the required level. Reduction to the integrated indicator allows you to compare the properties of capabilities that have different units.

Keywords: *Armed Forces; Medical Units; Capability Evaluation*

Abbreviations

CE: Capability Evaluation; CBDP: Capability-Based Defense Planning; AF: Armed Forces; FH: Field Hospital

Introduction

According to the Strategic Defense Bulletin of Ukraine, the purpose of defense reform in Ukraine is to acquire and maintain the required level of combat readiness and capability to perform state defense tasks, increase the level of interoperability of the Armed Forces of Ukraine and NATO forces. One way to achieve this goal is to implement an effective policy of planning and resource management in the defense sector using NATO capabilities-based defense planning approaches. An integral element of the capability-based defense planning process is the capability evaluation procedure. Evaluation medical units capabilities of Armed Forces of Ukraine is an integral part of capability-based defense planning process and a requirement for Ukraine’s accession to NATO.

Analysis of regulatory and legal document shows, that at present the methodology for evaluation the capabilities of medical units of the Armed Forces of Ukraine is imperfect and needs to be optimized in terms of clarifying indicators of quantitative evaluation of medical units capabilities in Armed Forces of Ukraine.

The authors propose to use the methods of multicriteria optimization to obtain a quantitative evaluation of medical unit’s capabilities to perform assigned tasks.

Results

Modern military operations characterized by rapid development, dynamic conditions and the input data received by the medical service are often incomplete, inaccurate, inconsistent, poorly structured and formalized.

An analysis of NATO’s guiding instruments and international agreements on standardization has shown that the CE procedure is one of the stages in the CBDP process and is a prerequisite for effective troop development planning, but existing approaches to CE are quite formalized. Evaluation the capabilities of medical units of military units in such conditions is an important issue in the development of defense planning of the defense forces of Ukraine and forecasting the likely development in combat actions.

According to the recommendations on the organization procedure of capability evaluation in the AF of Ukraine, assessment means comparison of required capabilities (operational, combat, special) approved by the “Unified capabilities lists of the Ministry of Defense of Ukraine, the Armed Forces of Ukraine and other components of the Defense Forces” (the Catalog), to perform tasks in each probable scenario of crisis situations and the available capabilities of forces and resources [1,5,6,10,14].

The carrier of capability can be both a discrete unit (module, unit, unit of equipment, system, etc.) and a set of forces and resources, with the expected effect during the task under specified conditions and for a specified time. Description capabilities implemented in accordance with Annex 1 to the Recommendation of CBDP in the Ministry of Defense Ukraine and the Armed Forces of Ukraine and contains requirements for capacity [10]. Capacity requirements are formulated in accordance with the functions entrusted to the capacity carrier. Whereas capabilities are multi-criteria, we propose to combine the requirements for them into functional modules. For each carrier own modules are defined on functional directions according to Catalog requirements (Figure 1).

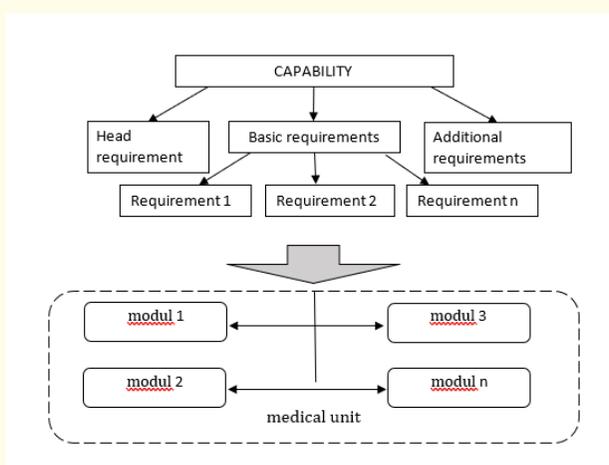


Figure 1: Modular structure of the carrier capability.

During the capability evaluation members of the working group, based on the necessary effects to be achieved by the unit form modules (blocks), which contain a set of requirements similar in functionality. Next, for each requirement, the criteria and indicators (their optimal range) are determined. We propose to divide the criteria according to the DOTMLPFI capability components according to NATO standards.

Each component of capability can have its own unique characteristics and criteria. The indicators must be both quantitative and qualitative. Quantitative indicators of the components are obtained by calculations (e.g. sanitary losses) or measurements (bed-places VMG). Qualitative indicators are calculated in accordance with the requirements of the approved methods of their determination (motivation of the personnel of the medical unit to perform the tasks assigned to them; leadership qualities of the unit commander) in absolute terms or by expert method using a score. However, it is still not possible to assess the capability of a medical unit by different types of indicators. This requires a way to objectively compare different criteria of capability requirements. Some of authors [7,8] consider the possibility of evaluation capabilities on the principles of qualimetry - quantification of processes using a scale of points. One of the main principles of this method is to summarize the various indicators that characterize the individual criteria of the object to a generalized indicator.

We propose the normalizing of different indicators to an integrated indicator, which allows you to compare the properties of capabilities that have different measurement units (to determine and develop the optimal option). It will also allow you to quantify the capability of the medical unit and determine the degree of approximation to required level of capability.

During the comparison the indicators of capabilities criteria of medical units of the Armed Forces of Ukraine, they must be reduced to a dimensionless type - to integrated indicator (S_{ni}) (1.1 - 1.3). If the required value of the indicator is known (requirements by the Catalog or terms of reference for evaluation), then:

$$S_{ni} = S_i / S_i \text{ required. (1.1)}$$

where S_{ni} - integral property indicator; S_i - absolute property index; $S_i \text{ required}$ - the required property index ($S_i \text{ required} \rightarrow \max$); $i = 1, 2, \dots, n$; measurement range 0 1.

If you specify a range in which the value changes from t_0 to t_n , then

$$S_{ni} = S_i / (t_n - t_0) \text{ (1.2)}$$

$$\text{or } S_{ni} = (S_i - t_0) / (t_n - t_0) \text{ (1.3)}$$

where S_{ni} - integral property indicator; S_i - absolute property index; t_0 - the minimum and maximum value of the property indicator; $i = 1, 2, \dots, n$;

In a comprehensive evaluation, it needs to be considered that for most criteria there are indicators whose low value cannot be compensated by a high value of other indicators. For example, low staffing cannot be offset by a high level of qualification. Therefore, to prevent such a situation, we propose to use the geometrical mean, which will prevent the "overlap" of some indicators to others (2). If any indicator has a value that does not meet the standard or is evaluated by a score of 0, the criterion is considered inappropriate, regardless of the high value of other indicators.

Therefore, the objective function for evaluating modules can be as follows:

$$M = \sqrt[n]{\prod_{i=1}^n S_{ni}} \text{ (2)}$$

where M - the capability rate of the medical unit module; S_{ni} - integral indicator of the i -th criterion; n is the number of indicators.

Also, it is necessary to understand that the modularity of the carrier capacity (medical unit) is universal and in different application scenarios is not variable. However, as the conditions of use change, the effect on the end result may change. That why is expedient to apply weights to the modules (the coefficient is determined by different application scenarios of units of the AF of Ukraine).

Therefore, the medical units capability rate is a set of estimates of modules capabilities expressed in terms of weighted geometric mean (3).

$$C_{mu} = (\prod_{i=1}^n M_i^{k_i})^{1/\sum_{i=1}^n k_i} \quad (3)$$

where C_{mu} – rate of the medical unit capability; M_i - assessment of the i -th module capability; k_i - weighting factor of the i -th modul; n is the number of modules.

The results of the quantitative calculation of capabilities using the verbal-numerical Harrington scale can be translated into the generally accepted scale of NATO capabilities assessments [11].

| Nº | NATO assessment (verbal assessment) | Quantitative value |
|----|-------------------------------------|--------------------|
| 1 | Excess capacity (very high) | > 1.0 |
| 2 | Fully functional (high) | 0.8 - 1.0 |
| 3 | Functional, minor risks (medium) | 0.64 - 0.8 |
| 4 | Operating with restrictions (low) | 0.37 - 0.64 |
| 5 | Unable (extremely low) | < 0.37 |

The numerical values given in the table are obtained on the basis of statistical analysis of a large amount of data, so that the Harrington scale has a universal application and can be used in appropriate modifications.

Conclusion

To conduct objectively evaluation of medical unit’s capability proposed to apply the principles of multi-objective optimization. Bringing disparate information to an integrated indicator makes it possible to compare and assess the levels of capabilities that have different measurement units. The proposed improvement of methods and modular evaluation of the capabilities of medical units of the Armed Forces of Ukraine allows to quantify them and allows to determine the degree of approximation of the capacity to the required level.

Further research will focus on testing and adapting methodology of evaluation capabilities of Armed Forces of Ukraine.

Conflict of Interest

The authors have no conflict of interests.

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