

# Problems Related To Determining The Combat Ability Of The Personnel Of Military Units In Peacetime And Their Solutions

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**Annotation:** This article presents the problems associated with determining the combat capability of the personnel of military units in peacetime and ways to solve them, as well as models for determining the combat capability of the personnel of military units. A technique for accurate assessment of the level of combat readiness of the personnel of military units in peacetime is given. Methods for determining the quality index of the combat capability of the personnel of military units are analyzed. Indicators that determine the combat capability of personnel have been formed. The assessment of the capabilities of military units explores the problems of data processing in information environments.

**Key words:** Combat capability, military unit, combat training, military unit, commander, military operations, personnel, combat status, serviceman, state of health, moral and spiritual state, spiritual and educational training, combat training, training season, science, education .

## I. Introduction

Technical progress develops the military sector and leads to radical changes in the forms and methods of combat operations. The state of military theory and practice in the era of rapid ICT development and the future perspective require the in-depth use of accurate methods of calculating the combat potential of military units. The sophistication of the means of armed conflict and the change (improvement) of the capabilities of military personnel are the reason for the increase in the combat power of the units. It is known that the reduction of the time given for decision-making leads to the assignment of tasks to subordinate units with errors and uncertainty, and to the increase of casualties. Therefore, the development of highly improved automated systems for determining the combat capabilities of military units in the planning of combat operations and task assignment consisted of two approaches.

The first approach depends on the development of mathematical calculation methods for determining the combat potential of military units, which is directed to the development of the basic mathematical support of the conducted fundamental research, while the second approach is focused on practice, on the basis of the developed theoretical and mathematical support, on the development of algorithmic and software solutions for military problems . Many foreign and leading scientists of our Republic have conducted scientific and practical research in the mentioned areas.

In particular, foreign researchers of the Academy of Military Sciences: NI Turko, IASheremet, VARYaboshapko, SAModestov; St. Petersburg: VIPotapov, VPDemidenko, VPIvanov, VPSisuyev, BAPlishevsky, VSSukhorutchenko; Smolensk: MIZernov, IICheklyayev; Novosibirsk: VAIsupov, AIGursky and others carried out scientific research on the development and practical application of the theory of determining the combat potential of military units. These researchers have improved the methods of determining the combat potential of military units by calculating the unit's ability to open fire (fire power), ability to strike (hit power) and ability to move ( maneuverability) . The methods of determining the quality indicator of the combat capability of the personnel of military units have been improved. The methods of determining the combat capability of the personnel of a military unit on the basis of numerical indicators and relating it to the potential of combat equipment and weapons available in the unit (hereinafter referred to as the potential of armament) have not been researched. When determining the potential of combat equipment and weapons, its tactical and technical characteristics are not determined separately according to their

importance in the battle. Algorithms and programs for determining the combat potential of a military unit by connecting the armament potential of military units with the combat capability of personnel have not been studied.

In Uzbekistan, mainly, the development of the theory of determining the combat potential of units in the system of the armed forces was carried out by XVDadabayev, DESultanov, SSAbduraimov, ARKodirov, T.G. Jafarov, BAAkhmadjonov and AA Ergashev. directly related to their names. Researchers of our republic have improved the methods of determining the combat potential of military units. The methods of determining the combat capability of the personnel of the military unit have been improved. Methods of general connection of indicators of combat readiness, morale-spiritual and physical condition, which constitute the combat capability of a military unit, have not been studied.

The combat capability of the personnel of a military unit is formed on the basis of the individual combat capability of each serviceman in the unit. When determining the combat ability of the personnel of the unit, the set of characters is divided into several groups. The study of signs is formed on the basis of the general requirements for each member of the personnel, the requirements for his profession, the skills of using technical equipment and communication tools, and the intellectual requirements for the logical conduct of martial arts in various military situations. First, a set of characters is formed for each of the servicemen of all military units, and then a mathematical model for determining the capabilities of military units is built, and the combat capabilities of units are evaluated for various combat situations.

## II. Nomenclature Of Combat Ability Marks

To solve all the above-mentioned issues, the following definitions are introduced:

$x_{pi}$  - military serviceman, military serviceman of  $X_p, p = \overline{1, r}$  the unit  $x_{pi} = (x_{pi}^1, x_{pi}^2, \dots, x_{pi}^N), i = \overline{1, m_p}$ . Therefore, military servicemen are divided according to their duties  $m_p$ , and usually units consist of 6-10 servicemen.

For example, a military unit in a conditional armored personnel carrier should have the following composition:

1. Division commander (AK - 74);
2. Mechanical drive (AKS - U)
3. Machine gun (PKM);
4. Grenade launcher (RPG - 7v);
5. Sniper (SVD),
6. Big gun (AK - 74),
7. Two shooters (AK - 74).

Each serviceman is taken as a research serviceman, and they  $x_{pi} = (x_{pi}^1, x_{pi}^2, \dots, x_{pi}^N), i = \overline{1, m_p}$  are represented by  $N$ -dimensional symbols. Here  $x_{pi}^1 - X_p, p = \overline{1, r}, i = \overline{1, m_p}$  is read as the first symbol of the unit's  $i$  serviceman. Below is **a set of common signs of military personnel**:

$x_{pi}^1$ - preliminary study of the candidate;  $x_{pi}^2$ - military examination;  $x_{pi}^3$ - psychological study (the level of intellectual development and psychoemotional stability are assessed);  $x_{pi}^4$ - level of physical fitness;  $x_{pi}^5$ - other types of tests (inspections) determined by the Ministry to study the candidate's qualities important for military service from a professional point of view.

The combat training of military personnel is assessed in the following disciplines, and marks are formed based on them, which **are understood as professional marks of military personnel**:

$x_{pi}^6$ - tactical preparation;  $x_{pi}^7$ - shooting training;  $x_{pi}^8$ - mountain preparation;  $x_{pi}^9$ - airborne training;  $x_{pi}^{10}$ - intelligence training;  $x_{pi}^{11}$ - tactical preparation;  $x_{pi}^{12}$ - control of combat vehicles;  $x_{pi}^{13}$ - engineering training;  $x_{pi}^{14}$ - protection from weapons of mass destruction;  $x_{pi}^{15}$ - physical training;  $x_{pi}^{16}$ - military topography;  $x_{pi}^{17}$ -

communication training;  $x_{pi}^{18}$ - military training;  $x_{pi}^{19}$ - line preparation;  $x_{pi}^{20}$ - general military regulations;  $x_{pi}^{21}$ - basics of informatics.

Training in these subjects is organized, and military servicemen are evaluated according to the training and standards, and the levels of mastery of the subjects are determined based on the results. Marks are formed in the cross-section of mastering levels of subjects.

In order to determine the combat ability of military personnel, intellectual and combat training subjects are divided into basic and non-basic subjects.

**A set of marks of skill of military personnel in combat technique and use of weapons:**

$x_{pi}^{22}$ - the ability to use any weapon;  $x_{pi}^{23}$ - combat experience.

**A set of intellectual characteristics of military personnel:**

$x_{pi}^{24}$ - drawing conclusions from optional situations;  $x_{pi}^{25}$ - decision making;  $x_{pi}^{26}$ - general military regulations;  $x_{pi}^{27}$ - assignment of tasks in critical situations.

So, the set of signs that determine the ability of military personnel was divided into four groups and analyzed, and all signs were named. Now the range of values of these symbols is defined below [11].

### III. Formation Of Signs Determining The Combat Capacity Of Personal Components

Representation of personal content using nominal symbols. That is, let's consider the issue of digitalization of signs of each military serviceman. Determining symbols and their naming and value fields is done as follows.

$x_{pi}^1$ - the values that the initial learning symbol of the candidate will take. Through this sign, the military serviceman's level of fitness for military service is determined as a result of his preliminary study. It is formed on the basis of nominal marks:  $x_i^1=1$ , then the level of suitability for military service is the highest and can provide it with an excellent performance of combat tasks, if  $x_i^1=2$ , then the level of suitability for military service is average and good, and if  $x_i^1=3$ , it is in this case, the level of fitness for military service is satisfactory. So,  $x_i^1$  the sign takes three different values, sometimes the values of these signs are determined by experts.

$x_{pi}^2$ - the values accepted by the military inspection mark are determined by military experts.  $x_i^2$ - and the symbol is the military information of a military serviceman, which is expressed in four forms: *satisfactory*, *good*, *excellent* and *unsatisfactory*. So, its signs are expressed in the form of the following scale,  $x_i^2 = 1$ (excellent);  $x_i^2 = 2$ (good);  $x_i^2 = 3$  (satisfactory);  $x_i^2 = 4$ can take (unsatisfied) values.

$x_{pi}^3$ - **psychological study (the level of intellectual development and psychoemotional stability are assessed)**. This character can have one of the following values  $x_i^3 = 1$ (excellent);  $x_i^3 = 2$ (good);  $x_i^3 = 3$  (satisfactory);  $x_i^3 = 4$ (unsatisfied) can accept. Of course, the grade is determined by expert experts, or it can be determined by computer tests developed by experts.

$x_{pi}^4$ - **level of physical fitness.**

The level of physical fitness of a military serviceman has three different characteristics. This trait is determined by the soldier's endurance, speed and strength levels. If  $x_{pi}^4=1$ , then the level of physical training of the serviceman is understood as excellent, if  $x_{pi}^4=2$ , then the level of physical training of the serviceman is understood as good, if  $x_{pi}^4=3$ , then the level of physical training of the serviceman is understood as satisfactory, if  $x_{pi}^4=4$ , then the level of physical training of a military serviceman is considered unsatisfactory. Therefore,  $x_{pi}^4$ - takes four different values.

All other parameters  $x_i^j, j = \overline{5,27}$ - one of the following values  $x_i^j = 1$ (excellent);  $x_i^j = 2$ (good);  $x_i^j = 3$  (satisfactory);  $x_i^j = 4$ (unsatisfied)  $j = \overline{5,27}$ was analyzed. Of course, the grade to be given is determined by expert experts, or by computer tests developed by experts.

So, **the first digitization problem mentioned above** finds its solution.

Each of the signs formed above are elements that characterize the abilities of a military serviceman, and a military serviceman learns, improves and develops them during his career. This process is initially the

training, experience and skills of a military serviceman , and then all these become a set of characteristics that make up combat capability. According to the definition, the combat ability of the personnel of a military unit depends on the completeness of the personnel, combat skills and moral-combat qualities, losses and the ability to compensate for them, provision of material resources and other factors [62-64]. If the supply of the unit is considered to be ideal, the combat ability of the unit depends on the completeness of personnel, combat skills and moral-combat qualities. The high quality of these indicators is important for the performance of the personnel's combat mission. The combat ability of each soldier in the unit is determined, and then the combat potential of the unit is evaluated.

#### IV. Assessment Of Military Unit Combat Capabilities Assessment Problems In Data Processing In Information Environments

Effective solution of many technical and practical issues of military forces is directly related to continuous control information systems. They are special universal digital hardware and software tools with their own math and software. The concept of continuous control is the randomness of events over a given period of time, which can occur in many units. This, in turn, is extremely important for system users.

an extended block diagram of the continuous control military processing processes is presented in Fig. 1.

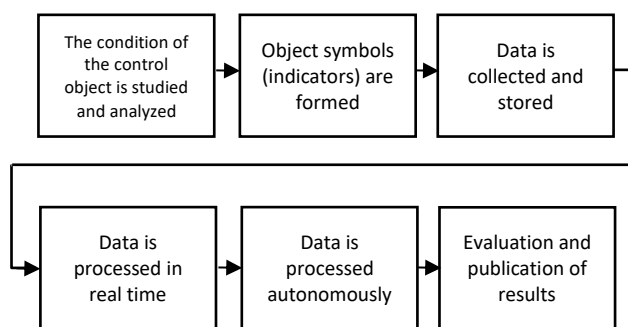


Figure 1. Extended block diagram of continuous control military processing processes.

The combat potential of military units depends on the combat potential of each serviceman in it. The average of the combat potential indicators gives the combat potential of the unit. So, based on the scheme, first of all, the characteristics of the fighter's combat potential are studied and analyzed.

Based on the scheme, control military signs are formed. Formation of symbols is carried out on the basis of military analysis, measuring devices or expert opinions. The resulting data is collected and stored in databases. Then, real-time or autonomous data processing is performed. The obtained results are formed in the desired form and are put into use based on the need or the combat situation of the military is evaluated.

From the point of view of assessing the military combat situation, we can implement the data processing process based on the following scheme (Fig. 2).

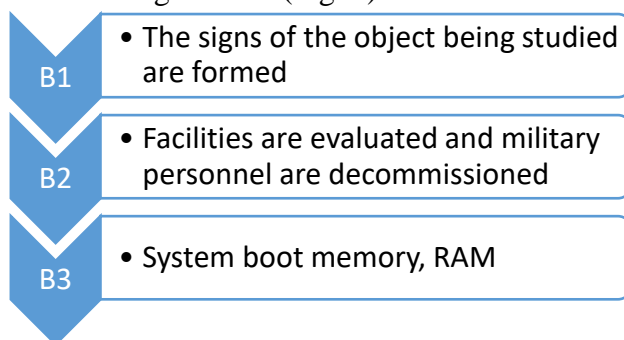


Figure 2. Block diagram of the process of assessment of combat situations.

The first  $B_1$  block determines the values of the studied military symbols. Usually, the military is represented as a multidimensional vector representation, and the symbols of the military show the all-round maturity coefficients of the military. These symbols can accept real number, nominal, boolean values.

The second  $B_1$  block determines whether the control military belongs to one or another military unit on the basis of a posteriori data. Of course, a decision is made using a pre-constructed criterion of informativeness and a decisive rule developed on its basis. When making a decision, the combat potential of the soldier is evaluated and his contribution to the formation of the combat potential of his unit is considered.

Also, the scheme built on the basis of the stated data for the purpose of assessing military situations is explained by the requirements for increasing the accuracy levels of high-accuracy algorithms for assessing the combat potential of symbols in situations of limited resources in continuous control military processing systems. This requirement shows that the issue of developing methods and algorithms for assessing the combat potential of military units is fundamentally different from the traditional issues of recognizing other symbols. For example, we can cite military, sociology, geology and other human activities. In addition, the studied military is different in that it incorporates the military of all the fields under consideration. Its set of characters consists of military symptoms, psychological parameters, technical skill factors, elements of intellectual analysis, etc.

These are reflected in the following problems:

1) often there is a lack of information about signs, the complexity of determining and evaluating the full potential of a motorist and the complexity of joint analysis of his abilities and capabilities, skills in using technical equipment;

2) the amount of information required for the system is small and the military has not been fully analyzed in terms of existing combat situations;

3) belonging to different types of information about the military, the diversity of the complex of symbols formed.

The scheme of processing the military units presented in Figure 1.3.2 from the point of view of assessing their potential is aimed at the implementation of all researches in the space of symbols that represent it and the development of mathematical models of the problems to be solved, as well as the development of its algorithmic and software in practice.

Let's assume that a military unit is represented as follows  $x_{p1}, x_{p2}, \dots, x_{pm_p} \in X_p, p = \overline{1, r}$ . Here  $x_{pi}$  is a vector of N-dimensional symbol space, each military  $x_{pi} = (x_{pi}^1, x_{pi}^2, \dots, x_{pi}^N), i = \overline{1, m_p}$  is  $\Omega^l = \{\omega: \sum_{i=1}^N \omega^i = l\}$  considered in the --dimensional symbol space,  $X_p$  and  $r$  - represents a military unit, that is, denotes a military unit and  $p = \overline{1, r}$  accepts the values,  $X_p$  in a military unit  $m_p$  consists of  $x_{p1}, \dots, x_{pm_p}$  soldiers.

Informative symbols correspond to a single-valued  $X_p$  partition of the partition space  $\lambda_p = (\lambda_p^1, \lambda_p^2, \dots, \lambda_p^N), \lambda_p \in \{0; 1\}, i = \overline{1, N}$  vector is introduced.

the quality criterion suitable for the given r-unit military, and the space  $I(\lambda_p)$  of  $(\ell_p \ll N)$ ,  $\lambda_p$  informative symbols to be selected is constructed as follows (formula 1.1):  $\ell_p$

$$A^{\ell_p} = \{\lambda_p: \sum_{k=1}^N \lambda_p^k = \ell_p, \lambda_p^k \in \{0; 1\}, p = \overline{1, r}\} \quad (1.1)$$

According to the Boolean vector  $I(\lambda_p)$  of the set element (1.3.1) of the informative sign or set of signs important for the soldiers of the military unit in question, that is, the level of informativeness of the signs and signs  $\lambda_p$  is determined based on the accepted value of the quality criterion.

Suppose that  $I(\lambda_p)$  the quality criterion is expressed in the form of Fisher's functional (formula 1.2):

$$I(\lambda_p) = \frac{(a, \lambda_p)}{(b_p, \lambda_p)} \quad (1.2)$$

Here (1.3.2) Fisher's functional,  $a = (a^1, a^2, \dots, a^N), a = (b_p^1, b_p^2, \dots, b_p^N)$  vectors are considered in the space of N-dimensional characters, and their components are calculated as follows (formula 1.3):

$$a^j = \sum_{p=1}^r (x_p^j - \bar{x}_p^j)^2, j = \overline{1, N},$$

$$b_p^j = \frac{1}{m_p} \sum_{i=1}^{m_p} (x_{pi}^j - \bar{x}_p^j)^2, j = \overline{1, N}.$$

(1.3)

$X_p$  The average military of a military unit  $\bar{x}_p$  is calculated as follows

$$\bar{x}_p = \frac{1}{m_p} \sum_{i=1}^{m_p} x_{pi}, p = \overline{1, r} (*, *) \text{ denotes the scalar product of vectors.}$$

### 1. Selection of informative characters in informative character space.

Choosing a set of informative symbols is an important issue in identifying symbols. Character set selection is spaced based on learning choices  $N - \text{ўлчовли фазодан } \ell_p - \text{ўлчовли}$ , here ( $\ell_p \ll N$ ), will be.

Usually, the problem of selecting an informative character set is presented as an optimization problem. The optimization problem of choosing a set of informative symbols is expressed on the basis of the above information. There are many methods and algorithms [1-4,8] for finding a solution to the optimization problem, the most widely used one is the complete selection method. This algorithm works using (1.1) on the elements of the informative character set. For each element of the set, the following optimization problem is solved, that is, the value of the functional is calculated (formula 1.4).

$$\left\{ \begin{array}{l} I(\lambda_p) = \frac{(a, \lambda_p)}{(b_p, \lambda_p)} \rightarrow \max_{\lambda_p \in \Lambda^{\ell_p}} \\ \Lambda^{\ell_p} = \{ \lambda_p : \sum_{k=1}^N \lambda_p^k = \ell_p, \lambda_p^k \in \{0,1\}, p = \overline{1, r} \} \end{array} \right. \quad (1.4)$$

Then, the largest among them is found. The one that gives the maximum value to the functional  $\lambda_p$  (1.3.4) is the solution of the optimization problem.

### 2. Proximity function in informative character space.

Let's assume  $X_p$  from the military unit consisted of  $\varepsilon = (\varepsilon^1, \varepsilon^2, \dots, \varepsilon^N)$  two Soldiers, Soldiers, and their components in sufficiently small numbers  $x_{p1}, x_{p2}$  be a given vector.

function  $\rho_i$  between soldiers  $\rho_i(x_{p1}, x_{p2})$  ta ( $\ell_p \ll N$ ),  $\lambda_p$  is entered in the space of informative characters as follows (formula 1.5):

$$\rho_i(x_{p1}, x_{p2}, \lambda_p) = \begin{cases} 1 \text{ агар } |\lambda_p^i (x_{p1}^i - x_{p2}^i)| < \lambda_p^i \varepsilon^i, i = \overline{1, N}. \\ 0 \text{ акс ҳолда } |\lambda_p^i (x_{p1}^i - x_{p2}^i)| \geq \lambda_p^i \varepsilon^i, i = \overline{1, N}. \end{cases}$$

(1.5)

The first condition indicates the degree of similarity between the two military forces, and the second condition indicates their difference from each other, that is, these components are not similar to each other.

Let us assume that the elements of the Fisher functional [8]  $a = (a^1, a^2, \dots, a^N)$ ,  $a = (b_p^1, b_p^2, \dots, b_p^N)$  the components of the vectors, are given as follows in the space of N-dimensional characters (formula 1.6):

$$a_p^j = (x_{pi}^j - \bar{x}_p^j)^2,$$

$$b_p^j = \frac{1}{m_p} \sum_{i=1}^{m_p} (x_{pi}^j - \bar{x}_p^j)^2, j = \overline{1, N} (1.6)$$

$X_p$  The average military unit of the military unit  $\bar{x}_p$  should be calculated as follows.  $x_p = \frac{1}{m_p} \sum_{i=1}^{m_p} x_{pi}, p = \overline{1, r}$ , The following symbol  $(*, *)$  denotes the scalar product of vectors (formula 1.7).

$$\rho_i(x_{pi}, \overline{x_p}, \lambda_p) = \begin{cases} 1 & \text{агар} \begin{cases} |\lambda_p^i(x_{pi}^i - \overline{x_p}^i)| < \lambda_p^i \varepsilon^i, i = \overline{1, N}. \\ \varepsilon^i = \frac{a_p^i}{b_p^i} \leq 1 \end{cases} \\ 0 & \text{акс ҳолда } |\lambda_p^i(x_{pi}^i - \overline{x_p}^i)| < \lambda_p^i \varepsilon^i, i = \overline{1, N}. \end{cases}$$

(1.7)

### V. Of The J-Military In The Space Of Informative Signs $X_p$ Evaluation Of The Contribution To The Formation Of The Military Unit

Below  $x_{pj} \in X_p$ , The evaluation of the contribution of j - military to the formation of r - military unit in the space of informative symbols is given in formula 1.8.

$$\Gamma_j(x_{pj}, x_{pk}, \lambda_p) = \sum_{k=1}^{m_p} \sum_{i=1}^N \rho_i(x_{pj}, x_{pk}, \lambda_p), j = \overline{1, m_p}; k = \overline{1, m_p}; j \neq k.$$

(1.8)

### Informational symbols in the space of all the military $X_p$ Assessment of the contribution to the formation of the military unit.

is an estimate of the total contribution of all military personnel to the formation of a military unit, taking into account the degree of proximity of all military personnel, in formula 1.9 $X_p$

$$\Gamma_{ym}(x_{pj}, x_{pk}, \lambda_p) = \sum_{j=1}^{m_p} \sum_{k=1}^{m_p} \sum_{i=1}^N \rho_i(x_{pj}, x_{pk}, \lambda_p), j = \overline{1, m_p}; k = \overline{1, m_p}; j \neq k.$$

(1.9)

Here,  $\Gamma_{ym}(x_{pj}, x_{pk}, \lambda_p)$  the value  $X_p$ -means the total contribution to the military unit with the participation of all military personnel in the space of informative characters, while  $\Gamma_{\check{y}pr}$  the value  $X_p$ -means the calculation of the average contribution to the military unit with the participation of all military personnel in the space of informative characters (formula 1.10).

$$\Gamma_{\check{y}pr}(x_{pj}, x_{pk}, \lambda_p) = \frac{1}{m_p} \sum_{j=1}^{m_p} \Gamma_j(x_{pj}, x_{pk}, \lambda_p), j = \overline{1, m_p}; k = \overline{1, m_p}; j \neq k.$$

(1.10)

value refers to the calculation of the average contribution to the military unit in the informative character space of all military participants.

### VI. A Decision Rule In The Space Of Informative Signs

Suppose a new unknown  $w=(w^1, w^2, \dots, w^N)$  soldier is given. The assessment of this soldier's  $X_p$  potential contribution to the military unit is calculated based on formula 1.11.

$$\Gamma_w(w, x_{pk}, \lambda_p) = \sum_{k=1}^{m_p} \sum_{i=1}^N \rho_i(w, x_{pk}, \lambda_p), k = \overline{1, m_p};$$

(1.11)

If  $\Gamma_w(w, x_{pk}, \lambda_p) \geq \Gamma_{\check{y}pr}(x_{pj}, x_{pk}, \lambda_p)$  the inequality holds, then  $w=(w^1, w^2, \dots, w^N)$  a soldier has a high degree of belonging to the r-military unit relative to others and  $X_p$  contributes to the formation of the military unit to a high degree. It is also possible to apply  $X_p$  this algorithm to the soldiers of all other up to military units and  $p = \overline{1, r}$ ; calculate their unit belongingness scores.

Based on the results of the above proved lemmas, according to the vote calculation formula (1.11), the maximum number of votes given to the military whose value is unknown  $m_p \ell_p$  limited in number.

## VII. Conclusion

In conclusion, it should be said that the achieved results can be presented in the section of all elements of the space of informative symbols and all military units of the training sample. Of course, in these cases, the value of the estimates will increase and the results given in [1.5,6.7] will be updated to some extent.

It creates the uncertainty of accurate information in the commander's assessment of the combat situation of units [5]. Based on such information, it can lead to errors in the planning of combat actions, especially in the direction of units and, as a result, to an increase in casualties. Because the unit's high combat training ensures that the personnel can effectively use the available equipment and weapons.

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