

THE QUANTITY ASSESMENT OF THE HUMAN FACTOR IN UNIT COMBAT CAPABILITY

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In the paper, the task of quantity assessment of the human factor has been considered in the determination of the unit combat capability. For determination of personal (staff) combat potential a physical drill, a combat training, a moral and psychological training, as well as, a battle experience have been taken into account as human factors. Besides this, an influence of a field and an environment conditions have been taken into account. Using these numerical data and weapon effectiveness coefficients, the method of unit combat capability (a dynamic power) calculations has been offered. In accordance to this method, first, the static power of unit has been determined, then the battle and environment conditions are been taken account.

Key words: *human factor, combat capability, performance characteristics, weapon effectiveness coefficient, combat consistency, unit combat capability*

1. INTRODUCTION

At present “a human factor” category has been used in complex systems with two meanings: 1) the characteristic of “human-technics” interaction; 2) a complex of the human qualitative characteristics [1, p.5]. In dependence on a system structure the effect level of human factor on their activities is various.

The human factor effect on activities of military units, in particular of battle one (executing battle tasks) is quite much. In a period of increasing of the weapon and military technics combat capability, the “human-technics”

and “human-weapons” interactions increase much, too.

The combat capabilities of military units are determined, on the one part by the weapons and military technics effectiveness, on the other part by quality characteristics of personal (staff) involved on the battle’s area. The actions of weapons and military technics occur on the basis of physical-chemical laws, they can be expressed by exactly mathematical expressions and the appropriate calculations can be fulfilled.

On the battle’s area for the purpose of weapons and military technics operated by man, the

effectiveness of personal's (staff) combat application and the probability of successfully execution of combat task are depended on human brain activity, physical drill and moral-psychological quality.

But, the character of human activity, physical and moral-psychological capacity cannot be expressed by exactly mathematical expressions. There are many scientific articles devoted to this problem [2-6], and some methodology principles had been offered for the purpose of assessment of human factor. In addition to that, all discussions are based on the qualitative assessments. Such problem is

arising during an assessment of battle and environment conditions and application in calculations. But these assessments are only qualitative.

2. THE DETERMINATION METHOD OF THE UNIT'S DYNAMIC POWER

The unit's dynamic power (PD) defines a capability of combat task execution (assault, defence, encounter battle) on the unit's battle area. The unit's dynamic power can be presented as the synergetic of various independent to each other factors and indicators (see fig. 1).

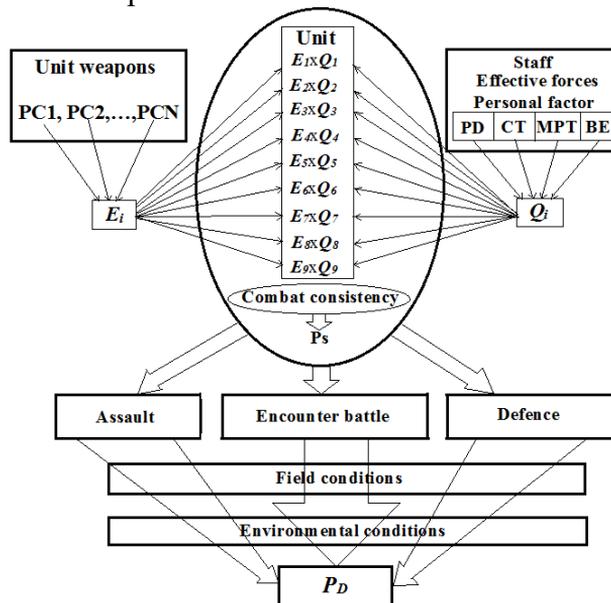


Fig. 1. A combat capability (a dynamic power) of military unit. $PC1, PC2, \dots, PCN$ are weapons performance characteristics of unit; E – weapons combat effectiveness; Q – combat potential of personal (staff); P_s – static power; P_D – physical drill; CT – combat training; MPT – moral and psychological training; BE – battle experience; P_D – dynamic power.

These factors and characteristics can be divided on two categories:

- 1) Unit's private factors and characteristics (internal factors);
- 2) Field and environmental conditions (external factors).

Field conditions include a restoration of combat capability (staff relaxation, replenishment), a combat readiness (battle organization, engineering infrastructure readiness of the region, the position and front line) and a presence of engineering obstacles. Environmental conditions include terrain conditions (soil and plant cover), weather conditions (humidity, precipitation, wind, mist) and time of day (morning twilight, day, gloaming, night).

3. UNIT'S INDIVIDUAL CHARACTERISTICS, STATIC COMBAT POWER.

Unit's individual factors and characteristics are defined by unit's staff structure, armament and personal's combat readiness. Let us analyze this in more detail. Let us introduce the next definitions:

- 1) effectiveness factors of the weapons and military technics in unit's armament (E);
- 2) combat potential of each unit's personal (staff, gun crew) (Q);
- 3) the level of unit's combat consistency (U).

These factors and characteristics determine a unit's static power (P_s), that is, a combat effectiveness only conditioned by unit's weapons and personals, and independent of environment and battle.

Weapon effectiveness factor defines a level of the given weapon application in battle and, as a result, a power effect on enemy. For the purpose of determination of the weapon effectiveness factors the method described in [7] can be used. This method can be applied for calculation of these effectiveness factors based on any weapons' performance characteristics.

Combat potential of unit's personal (staff, gun crew) is a characteristic of each personal (staff, gun crew) common idiosyncrasy and during battle define their decisive action ability, fighting spirit and combat skills. Combat potential of each personal (staff, gun crew) is defined by physical, mental and psycho-cultural qualities:

q_{pd} is a physical drill of personal (physical force, exercise tolerance, quick reaction capability);

q_{ct} is a level of combat training of personal (practical knowledge and skills);

q_{mp} is a mental and psycho-cultural condition of personal;

q_{be} is a battle experience of personal;

Below there are the sources of receiving these characteristics:

- a physical drill of personnel q_{pd} , is permanently evaluated during combat training process (by 100 scoring system) and registration of the unit's combat training is carried out in the special log book;

- a level of combat training of personnel q_{ct} , is permanently evaluated during combat training process (by 100 scoring system) and registration of the unit's combat training is carried out in the special log book;

- a mental and psycho-cultural condition of personnel q_{mp} , is formed during process of psycho-cultural training (social and political, ideological propaganda, psychological support), it is determined by commander privately for each person and registered in the special log book;

- a battle experience of personnel q_{be} , is based on the cases of personnel participation in real battle activities and determined taking into account a personnel's duration and intensity of the battle

Above personnel's qualitative indicators are defined in (0, 1) range and on the basis of it the personnel's combat potential is calculated by next formula:

$$Q = q_{pd} \times q_{ct} \times q_{mp} \times q_{be} \quad (1)$$

The level of unit's combat consistency is based on the units' training and exercises, defines an ability of coordinate and

synchronize activities as whole unit on the battle area. This characteristic is defined on the basis of marks obtained during units' training and exercises and is changed in (0, 1) range.

Thus, units' static combat power is calculated by the formula below:

$$P_s = \left(\sum_{j=1, J} \left(E_j \sum_{i=1, I_j} [Q_{ji}] \right) \times U \right) \quad (2)$$

Where: P_s is a unit's static combat power, J is a number of arms types of the unit (AKM, SVD, PK, RPQ-7 etc.), E_j is an effectiveness factor of j type arm, I_j is j arm's type number, Q_{ji} is a combat potential of i personnel (staff, gun crew) used j arm's type, U is a level of the unit's combat consistency.

When using collective arms the common combat potential of personal (staff, gun crew) is taken as an average quantity of their combat potentials.

4. BATTLE CONDITIONS AND ENVIRONMENT FACTORS

The unit's battle conditions and environment factors impact on the execution of battle task. This impact is different depending on the battle type: assault, defence or encounter battle.

Below there are battle conditions' factors:

- the restoration level of combat ability (L_{CA});
- the level of combat readiness (L_{CR});
- the presence of engineering obstacle infrastructure (EO).

The restoration level of combat ability is defined by the degree of ammunition replenishment and refueling during personnel rest

period after active battle (personal number and arms replenishment aren't considered here because it is taken into account during unit's static power calculation):

$$L_{CA} = L_r \times \frac{A (\%)}{100} \times \frac{F (\%)}{100} \quad (3)$$

Here: L_r is a factor of personal rest period (see table 1); A is a factor of ammunition supplies; F is a factor of fuel supplies.

Table 1. Battle conditions' factors.

	Assault	Defence	Encounter battle
Rest period			
< 8 hours	0,5	0,8	0,5
8 – 24 hours	1	1	1
> 24 hours	1,5	1,2	1,5
Battle organization period			
< 6 hours	1	1	1
6 – 24 hours	1,2	1,2	1,2
> 24 hours	1,4	1,4	1,2
Engineering structure readiness period			
< 6 hours	1	1	-
6 – 24 hours	1,2	1,2	-
> 24 hours	1,4	1,4	-
Long period	1,4	2	-
Density of engineering obstacles			
No obstacles	1,8	1	1,4
Low density of obstacles	1,6	1,2	1,3
Middle density of obstacles	1,4	1,4	1,2
High density of obstacles	1,2	1,6	1,1
Very high density of obstacles	1	1,8	1

The level of combat readiness (L_{CR}) is defined by a battle organization (L_{BO} , see table 1) and a period of the units' readiness for battle including region, position and

front engineering structure readiness L_{ER} [8]:

$$L_{CR} = L_{BO} \times L_{ER} \quad (5)$$

Here: E_R is an engineering structure (table 1).

The presence of engineering obstacle infrastructure (EOI) [8] is defined by the density of own and enemy constructed engineering obstacles at the battle area (L_{EOI} , see table 1) [8]:

Let us consider environment factors:

- relief, ground and plant cover are the terrain factors (TF);
- humidity, precipitation, wind and mist are the weather factors (WF);

– night, day and gloaming are the factors of day time (DT).

The terrain factor (TF) [9] is defined by the impact of terrain relief (L_{TR} , see table 2), ground soil (L_{GS} , see table 6) and plant cover (L_{PC} , see table 2) on the troop's combat activities (observation, fire execution, concealment and preservation, impassability and diggings):

$$L_{TF} = L_{TR} \times L_{GS} \times L_{PC} \quad (6)$$

Table 2. *Terrain relief*

	Assault	Defence	Encounter battle
Properties of terrain relief-landform or environment			
Flat ground	1,4	1	1,4
Hilly country	1,2	1	1,2
Low mountain terrain	1	1,2	1
Middle mountain terrain	0,8	1,4	0,8
High mountain terrain	0,6	1,6	0,6
Properties of ground soil			
Sandy ground	0,5	0,8	0,5
Soft clayey	1	1	1
Stone land	0,8	0,6	0,8
Properties of plant cover			
Open and shrub steppe	1	1	1
Middle woodland	0,8	1,2	0,8
Dense forest	0,5	0,8	0,5

The weather factors (WF) [9] are defined by the impact of atmospheric temperature (L_{AT} , see table 3), amount of precipitations (L_{AP} , see table 3), wind force (L_{WFr} , see table 3) and fog density (L_{FD} , see table 3) on the troop's combat activities (observation, fire execution, concealment, maneuvering ability, personal health):

$$L_{WFr} = L_{AT} \times L_{AP} \times L_{WFr} \times L_{FD} \quad (7)$$

Factors of day time (DT) are defined by the impact of visibility conditions on the troops combat activities (observation, fire execution, concealment, maneuvering and control abilities) (see table 3):

So, the combat capability (a dynamic power) of military unit can be calculated by next formula:

$$P_D = P_S \times L_{CA} \times L_{CR} \times L_{EOI} \times L_{TF} \times L_{WFr} \times L_{DT} \quad (8)$$

The combat capability can be calculated both for own and enemy military units. The some factors and characteristics of enemy units, in particular the individual peculiarities of military personnel, are unknown, then their values are taken equal to our units or based on the reconnaissance data the individual peculiarities for the enemy unit's personnel are taken equal to one value, for example: a moral and psychological state, a combat

experience, a level of combat training etc.

For assessment of the expected battle success A_{BS} we can calculate the ratio of own P_{D1} and enemy P_{D2} units combat capabilities:

$$A_{BS} = \frac{P_{D1}}{P_{D2}} \quad (9)$$

If $A_{BS} > 1$ then the probability of operational mission success is large.

Table 3. *Atmospheric temperature*

	Assault	Defence	Encounter battle
Atmospheric temperature			
Very hot (> 30° C)	0,5	0,8	0,5
Moderate (+5 ÷ +30° C)	1	1	1
Cold (+5 ÷ -15° C)	0,8	0,6	0,8
Very cold (< -15° C)	0,6	0,5	0,6
Amount of precipitations			
No precipitations, low precipitations	1	1	1
Moderate precipitations	0,7	0,9	0,7
Heavy precipitations	0,5	0,7	0,5
Wind force			
Windless, breeze	1	1	1
Moderate wind	0,7	0,9	0,7
Strong wind (storm)	0,5	0,7	0,5
Fog density			
Clear day	1	1	1
Mist	0,8	0,9	0,8
Heavy fog	0,5	0,6	0,5
Day time			
Night	0,5	0,8	0,5
Gloaming	0,8	1	0,8
Day	1	1,2	1

5. CONCLUSION

Thus, the unit's combat capability has been calculated based on combat effectiveness of the weapons and military techniques and taking into account the impact of other factors: human factor, battle and environment conditions. For this purpose, the combat potential of the military personnel has been transformed to quantity by calculation of individual peculiarities and taking into account the battle and environment conditions.

REFERENCES

- [1] Illuk O.O. Theoretical methodical basis of human factor in troops. Monography. War Academy of Ukraine. 2012. 251 p.
- [2] Drujinin G.V. Man in technological models. Part I: Man properties in technological systems. Moscow: MNIT, 1996. 124 p.
- [3] Akimova G., Solovyev A., Pashkina E. Methodological determination method of human factor impact on information systems operability // RAS ISA Reports, 2007. T. 29. pp. 104-112.
- [4] Korchemniy P.A. Military psychology methodology, theory, practices. Moscow: Voenizdat. 2010.

- [5] Yurev N. Human factor // Technics and weapons yesterday, today, tomorrow. 2003. No. 9, p.14.
- [6] Radchenko M.A. Human factor assessment at decision making for battle activities // National priorities of Russia. Series 1: Sciences and military security. 2015, 2(2) pp.159-163.
- [7] Aliev A., Sabziev E., Bayramov A. The method of weapon effectiveness factors determination // Transaction of Azerbaijan National Academy of Sciences, Series of Physical- Technical and Mathematical Sciences: Informatics and Control Problems, Vol.36, № 6, 2017. P.78-84.

[8] «K.K.K.: YY-8. Birlik ağırlıklı değeri kullanma broşürü.», Ankara, K.K.K. Basımevi və Basılı Evrak Depo Müdürlüğü – 1986. s. 19-29.

[9] “KKYY-190-7(A). Birlik etkinliklerinin eğlendirilmesinde hareket etkinliği metodu”, Ankara, K.K. Basımevi və Basılı Evrak Depo Müdürlüğü – 2001. Ek-Ç. 72 s.