LUDOVIKA – UNIVERSITY OF PUBLIC SERVICE

Doctoral School of Military Science

THESIS BOOKLET

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New method for the calculation of a quality indicator for the combat effectiveness of main battle tanks

titled Ph.D. dissertation

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Budapest, 2023

INTRODUCTION

Technological progress is leading to rapid changes in the equipment and operational procedures used by the armed forces. The efficiency of military equipment is already higher than in the past, so the combat performance and effectiveness of newer equipment has even more importance to military leaders. The question is: How big is this increase in effectiveness? This can only be answered if we are able to measure the effectiveness. This is the purpose of the various qualitative indicators that express the effectiveness and applicability of combat tools in a comparable, quantifiable way.

Qualitative indicators help the commanders to better predict the likely outcome of combat events.

SCIENTIFIC PROBLEM

In the conventional combat operations of ground forces, commanders planning and controlling operations need reliable data at their disposal about own units and the enemy's combat strength. Accordingly, calculations[1] must be made to determine the actual combat power based on the capabilities of their own and potential opponent's combat assets. For this purpose, the qualitative indicators of the various means of combat (combat) are used, which provide information on the relative combat strength of the opposing side's means of combat. The effectiveness of the previously used indicators is difficult to verify. In addition, previous databases are outdated[2] and the weapons they contain are no longer in service. With the emergence of newer tools, the difference in quality (performance) between individual combat tools can only be ascertained by carrying out the calculations necessary to determine the indicator, which requires knowledge of the method[3] of calculating the quality indicator. If this is not possible, a new procedure must be established to create a quality indicator that can be used in practice, in order to provide the basis for calculations to support command decisions at different levels of command.

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[1] Erő-eszköz számvetés, Hadtudományi Lexikon, A-L, (I. köt.), p. 304., illetve az erőviszony fogalma taglalja tartalmi részét. I.m. p. 305. (Force ratio assesment)

[2] Previously, the Hungarian Defence Forces used the quality indicators adopted from the Soviet Army, but no new database was created after our accession to NATO.

[3] In my research presented in the first chapter, I found few sources on the methods used in the past to establish the relative value or combat effectiveness of weapon systems. The scientific basis of the various indicators is therefore difficult to asses.

The scientific problem can be formulated as the following:

Combat quality indicators, previously developed as a result of military research and practical experience, are difficult to apply in the current modern circumstances and therefore cannot effectively support practical (operational) planning processes for combat activities. There is a need for a more simple and straightforward quality indicator that can be refined by the user and applied to a specific situation.

HYPOTESES

In my research I have established three hypotheses. The first two are based on the formulation of assumptions that are distinct in meaning but fundamentally related, while the third is based on the verification of the technical characteristics of the underlying calculations.

- (H1) The combat performance of tanks is primarily determined by the effectiveness of their armament and armour protection.[4]

- (H2): The outcome of combat can be realistically predicted on the basis of the relative performance of the opposing assets. The quotient of the two performances gives the most probable outcome of their combat against each other.

- (H3) In evaluating the combat performance of tanks against other tanks, the penetrating power of APFSDS[5] and the resistance of armour to APFSDS are the determining factors.

The two closely related concepts, combat performance[6] and combat performance indicators,[7] are the core elements of my academic work and the subject of my researches. I attempt to prove them together. My third hypothesis can be proved or rejected without the first two.

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[4] The three main characteristics are the determining factors for the combat capability of each combat vehicle, but my hypothesis, when considering the role of the three components in terms of fighting each other, assumes that in a collision between two vehicles the role of agility is much smaller than that of the other two. In order to verify this assumption, I analyse the components of each capabilities and their role in order to confirm or reject my hypothesis.

[5] Armour-piercing fin-stabilized discarding sabot, a special sub caliber ammunition

[6] The concept of combat power is not determined by the Military Science lexicon. In the Hungarian language, I consider performance to be a generally accepted term expressing the effectiveness of a combat tool, based on the definition of the degree of variable capability, and I will use it as such.

[7] By combat performance indicator I mean the ratio of the combat performance of two opposing assets on each other.

SCIENTIFIC OBJECTIVES

1. My objective is to summarise and present the theoretical and practical scientific results related to the definition of quality indicators and combat effectiveness by reviewing the national and international scientific literature.

2. To draw conclusions on the distribution of hits by scientifically evaluating and summarizing combat experience.

3. My aim is to analyse and select the (combat) performance components that fundamentally influence the outcome of the engagement of modern main battle tanks in order to determine the individual sub-factors (input data) of the new quality indicator to be created.

4. My aim is also to create a more simple method of calculating a quality indicator than previous similar combat effectiveness indicators.

RESEARCH METHODS

The use of applied research methods was aided by the relevant parts of the university textbook summarising the professional foundations of research methodology.[8] István Gőcze's publication[9] on research methodology guided me in the correct selection and effective application of research methods.

My primary research method was the review and evaluative analysis of the available literature on the subject, in order to summarise the results of domestic and foreign military research. In order to illustrate the development of qualitative indicators and to draw conclusions from the practical experience of using each method, I will use exploratory document analysis to examine and evaluate the various sources. Understanding the theoretical background to the development of quality indicators will help to understand the different aspects and identify the different methods. However, a difficulty is that the theoretical foundations of the subject under study are often based on studies of technical data that are classified as industrial or military secrets, or on non-public combat procedures.

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[8] Hornyacsek Júlia: A tudományos kutatás elmélete és módszertana. Nemzeti Közszolgálati Egyetem Hadtudományi és Honvédtisztképző Kar, Budapest, 2014, 256 p. ISBN 978-615-5491-36-8., https://hhk.uni-nke.hu/document/hhk-uni-nke-hu/Teljes%20sz%C3%B6veg!.pdf, (Letöltve: 2022. november 01.11.00.)

[9] [9] Gőcze István: A tudományos kutatás módszerei, Hadtudományi Szemle, Bp., 2011., IV. évfolyam, 3.szám, pp. 157-166., Forrás: https://www.epa.hu/02400/02463/00010/pdf/EPA02463_hadtudomanyi_szemle_2011_3_157-166.pdf,(Letöltve: 2022. december 06. 14.00)

In my research, I have measured and verified the effective target area of tanks, and measured and compared the dimensions of the fighting areas of two tanks.

I have dedicated a separate chapter to the evaluation of combat (war) experience, summarising the results of available scientific reports and studies. Using databases, quantitative content analysis and mathematical methods, I have drawn conclusions and proved my claims and hypotheses. I compared the results of the indicator I created with the results of previous similar indicators in tabular form, and drew conclusions on the usefulness of the new indicator.

THE RESULTS OF MILITARY RESEARCH

Following a review of the Hungarian literature, I found that the field of qualitative indicators of combat equipment was largely based on our Cold War heritage, on the adoption of the Soviet concepts and tools of the time, in accordance with the Warsaw Pact military operational planning procedures. Research into the theory of the subject was limited to presenting the Soviet achievements of the time, and in the decades that followed only tangential mention was made of the place, role and potential application of qualitative indicators.

As a related field of research, the study of the technical capabilities of combat vehicles and armoured vehicles has come to the fore in recent decades. One direction is research[10] into quality characteristics that are important from a technical-operational point of view, and the other is theoretical researches[11] into the selection of new equipment procurement.

On the basis of a review of the foreign literature and a summary of its results, I have established that quality indicators can be established on the basis of an evaluation of the combat properties of combat equipment or on the basis of the results of practical comparative tests. In the former method, the components of a part's capability can be derived from technical (technical) characteristics, which are measured and calculated to form the basis of a given quality

[10] Turcsányi Károly: A haderő harckocsi igénykielégítési folyamatának makroszemléletű vizsgálata, Doktori értekezés, Bp, 2008, forrás: http://real-d.mtak.hu/568/1/Turcs%C3%A1nyi%20K%C3%A1roly%20%C3%A9rtekez%C3%A9s.pdf, Letöltve: 2022. szeptember 17. 19.00. és Turcsányi Károly ezredes: Melyik volt a legjobb harckocsi? Haditechnika, 2018/5., 5. szám., pp. 69-75.

[11] Gyarmati József és Gávay György Viktor munkái. Lásd: Gyarmati József: Haditechnikai eszközök összehasonlítása közbeszerzés során, Hadmérnök, 2006/2., http://hadmernok.hu/archivum/2006/2/2006_2_gyarmati.html, vagy Gyarmati József: Többszempontos döntéselmélet alkalmazása a haditechnikai eszközök összehasonlításában, ZMNE, PhD értekezés, 2003., valamint Gávay György Viktor: Kerekes harcjárművek védettségének vizsgálata és összehasonlító elemzése az elmúlt évtizedek katonai tapasztalatainak és követelményeinek felhasználásával. PhD értekezés, Hadtudományi Műszaki Doktori Iskola, 2019., p. 222.

characteristic. In the latter case, the results of practical tests, test firings, or combat exercises carried out under identical conditions provide the input data for the calculation of the quality indicator.

The selection (separation) of the decisive and less decisive components of combat qualities can be carried out by detailed analysis, exploration of theoretical correlations and processing of practical experience.

Of the three combat attributes, the role of firepower and armour protection is decisive, while the role of mobility needs to be investigated, but is not considered essential by some publications[12] when comparing the capabilities of different tanks.

Soviet/post-Soviet military science looked at the combat effectiveness of tanks (combat vehicles) as an basic component of the combat arms warfare, which provided a simplified way of quantifying combat power. The universal qualitative indicators (combat effectiveness coefficient and combat potential) that had been developed for use with several types of weapon systems showed the effectiveness of the suitability for a single mission of different types of combat assets, but their usefulness was difficult to verify, so research took a different direction. The universal effectiveness indicators were later replaced by specific quality indicators, calculated from technical characteristics, which expressed the difference in quality within each category of weapon.

Another important finding is that the Soviet/Russian quality indicators represent the degree of quality by deviating from the mean. A complex indicator represents the value of a chosen, widely used weapon system taken as one (figure), in proportion to the difference in characteristics or properties of the relative tools.

The Soviet/Russian scientific approach has had a significant influence on research and views on quality indicators of US land combat assets over the past decades. As a result, military science research in both countries has used essentially the same methodological approach to produce the various quality indicators. As a result of this common perspective, the way of expressing quality is to compare it with the average combat effectiveness mentioned above.

[12] Степанов, Чл.-корр. В.В. - Зайцев , Е.Н ОАО: СОСТОЯНИЕ И ТЕНДЕНЦИИ РАЗВИТИЯ ТАНКОВЫХ ПАРКОВ РОССИИ И СТРАН НАТО ДО 2025 ГОДА, Известия Российской академии ракетных и артиллерийских наук. 2015. № 4., http://btvt.info/1inservice/rarn_2015_stepanov.htm, letöltve: 2022. február 6., 18:10. (Sztyepanov-Zajcev).

This method, however, entails the problem of double correlation for the quality indicators of both countries, which in essence increases the potential for miscalculation.

ASSESSMENT OF THE THREAT OF THE MAIN BATTLE TANKS

The experience gained from the use of tanks in combat confirms the previous assumptions and the theoretical calculations concerning the distribution of hits. The distribution of hits on the surface of the tank is influenced by the nature of the conflict and the technical and other combat capabilities of the opposing parties. The latter is mainly due to the emergence of man-portable and guided anti-tank missiles, which have evolved considerably in recent decades and which employ the cumulative (HEAT) warheads. The latest top attack anti-tank missiles open a new chapter in the fight against armoured vehicles, as do the various suicide drones and other weapon systems that attack armoured vehicles from above, but no clear, scientifically valid data[13] on their effectiveness is yet available.

However, the use of kinetic energy, sub-calibre armour-piercing munitions is the main method of engagement of armoured vehicles against each other. An evaluation of experience[14] has shown that the distribution of hits with these devices has not changed significantly over the past decades. The distribution of hits in the horizontal view, both from theoretical models and from practical experience, shows that the dominant direction of kinetic projectiles hits from armoured vehicles is from the front, +/- 30 degrees to the longitudinal axis. The vast majority of hits are located on the glacis and turret front armour of the tank and on the side armour of the vehicle. Examining the vertical plane of the hits, I found that about one third of the hits were located below the turret ring and about two thirds above it on the turret. Differentiating the armour to these threats results in tanks engaging the enemy with the best possible chance of success, given armour protection and mass. Mass-efficient, differentiated armour is an element of combat effectiveness, as it provides operators with the most optimal protection to defeat the enemy.

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[13] Processing the experience of the 2020-21 Azerbaijani-Armenian clashes, as well as the scientific assessment of the experience of the ongoing Syrian civil war and the Russian-Ukrainian war in this regard, will obviously help to determine the impact of the emergence and application of the top attack missiles and remotely piloted air vehicles on ground operations, including the future of armoured combat. An assessment of the impact of these new assets can only be made with very thorough and extensive research, taking all other factors into account, as today's information environment often gives a deceptive picture to the lay observer.

[14] Held, Manfred: Warhead Hit Distribution on Main Battle tanks in the Gulf War, Journal of Battlefield Technology, vol 3, No. 1, 2000. március. https://www.argospress.com/articles/2000/warhead-hit-distribution-on-main-battle-tanks-in-the-gulf-war, (Letöltve: 2022. november 3., 11.00.)

Technical progress has led to the emergence of dynamic or reactive armour protection. Both known technical solutions[15] significantly increase the resistance to cumulative (HEAT) devices and, to a lesser extent, the protection against kinetic projectiles. Newer, more sophisticated reactive solutions are more effective against kinetic projectiles than before. It is difficult to assess their role, and no scientific analysis of their effectiveness is yet available.

There is no practical experience of the capabilities of active protection systems, but they will clearly have an impact on the way tanks fight each other in the future. In the absence of experience, there is currently no way to reflect their role in the qualitative indicator to be established.

EVALUATION OF THE COMPONENTS OF THE COMBAT CAPABILITIES

The evaluation of the components of the combat characteristics that determine the combat performance of the tanks has confirmed my assumption that firepower (destructive power) and armour protection (as part of survivability) are the primary determinants of the combat performance of the tanks. Mobility can help exploit both, but has no direct influence on combat effectiveness. I have found that similar agility characteristics have a similar effect on the utilisation of the opposing tank's firepower and armour protection, and thus come to the same conclusion as recent Russian research.[16]

In examining the effectiveness of the armament and evaluating the armour protection, I have confirmed my hypothesis number three, that kinetic energy destructive sub-calibre armour-piercing shells are more effective than cumulative principle tank shells of the same space size, and that the previous role and performance of the tanks in a battle against each other is therefore the decisive factor.

On the basis of my results above, I have laid down the principles for establishing a qualitative indicator of combat performance. I have identified the technical parameters that can realistically

[15] Two different (main) solutions are known: one is the Explosive Reactive Armour (ERA), armour protection, and the other is the Non Explosive Reactive Armour (NERA). Both solutions are very complicated technical system with special materials and engineering acknowledgement. And there are many subvariant among the industrial led developments.

[16] Степанов, Чл.-корр. В.В., Е.Н. Зайцев ОАО: СОСТОЯНИЕ И ТЕНДЕНЦИИ РАЗВИТИЯ ТАНКОВЫХ ПАРКОВ РОССИИ И СТРАН НАТО ДО 2025 ГОДА, Известия Российской академии ракетных и артиллерийских наук. 2015. № 4., http://btvt.info/1inservice/rarn_2015_stepanov.htm, (Letöltve: 2022. február 6., 18:10.) (Sztyepanov-Zajcev).

predict the outcome of a theoretical battlefield engagement and excluded factors and characteristics whose role is marginal or undetectable.

The identification of the relevant parameters for the calculation has the advantage that the qualitative indicator itself can be established as a simple process (calculation) that allows conclusions to be drawn about the combat capabilities of the opposing parties in a (adaptable) way adapted to specific combat situations. These parameters are part of the critical information requirements of commanders in a specific operational planning process to ensure a realistic assessment of the opposing armour assets.

ESTABLISHMENT OF THE COMBAT PERFORMANCE INDICATOR

Countries in a similar situation and with similar capabilities to our own can much less afford to lose their few valuable combat assets (tanks) than a great power, so the question of the combat performance or combat power of individual assets must be much more emphasized in military thinking. A different perspective requires a different approach: minimising the combat losses of a force with fewer resources does not allow compensating for qualitative deficiencies with quantity. The limited economic potential of small countries puts their losses in a different perspective. The importance of each means of combat thus enhances the role of qualitative indicators. The new approach therefore encourages the establishment of more realistic calculation methods for comparing combat power (performance) that allow fewer errors.

How can individual performance be estimated with less error? The methodological approach must reduce the number of mathematical errors. Therefore, in order to avoid the problem of double correlation, which I have previously identified, it is necessary to directly compare the combat performance of the opposing parties' assets by means of a method based on single correlation.

According to international (Russian and American) terminology, the Hungarian name for the ratio of the probability of combat performance of weapons against each other is an indicator, and the correct name, given that it refers to combat performance, is the combat performance indicator.

The essential difference from all previous qualitative indicators is the aspect of correlation: it directly relates the characteristics of the most decisive components of combat performance to the capabilities of the opposing party, by comparing firepower and armour protection. The

method avoids the error of double correlation and gives a more accurate picture than before of the expected outcome of the clash of opposing armour assets.

Based on the summary of my research, the outcome of the engagement of tanks is determined by the effectiveness of the application of armour against the armour of the opponent. Of the opposing sides, the side with the higher combat performance has a greater mathematical chance of emerging victorious. To prove my hypotheses, this will be the quotient of the values calculated by comparing the armament and the armour protection of the opposing side. The combat power can therefore always be calculated for a given opposing side, so the resulting quotient can only be interpreted as the outcome of the clash between the two sides. This is a significant departure from the previous indicators, due to a radical change in the way the ratio is viewed.

In order to compare the armour and armour protection of opposing armour, it is necessary to use another important research result: the distribution of hits on the surface of the tanks. As a result of my investigations in chapter two, I have used the relevant scientific results.

The most vulnerable part of the tank is the front, so the armour is thickest here. Field experience shows that 50% of hits are located here. Between 20 % and 20 % of the hits (right and left) fall on the sides of the body and turret. The remaining 10 % hit the rear of the turret and chassis. For simplifications, using this data and the known armour penetration and armour protection values, cross-pairing the types gives values that show how many hits per 100 hits would cause armour penetration damage to a tank.

Knowing the armour-piercing power of the projectiles and the resistance of each surface of the target tank, it is possible to determine what percentage of hits (in %) could penetrate the armour and what percentage could be considered effective. By performing the same calculation for the other tank, we obtain its characteristic value, which I have called its combat performance. The index of these two values gives the **Combat Performance Index** (CPI) of the tanks against each other. It is important to note that for each tank and combat vehicle, this index can be established by testing against a specific opponent, since the combat capabilities of different combat vehicles can only be considered constant when tested against that opponent.

CONCLUSIONS

- The combat performance of each combat equipment and its qualitative indicators cannot be clearly determined from the combined combat performance of the unit. Thus, research aimed at determining the combat power at unit level, which is essentially a study of the combat potential of units, could not provide realistic results on the capabilities of individual combat assets.
- The qualitative indicators based on the characteristics of each equipment can be determined by the capabilities and characteristics that really and primarily influence combat performance in the vast majority of combat situations. Of the combat characteristics, firepower and armour protection play a prominent role, while mobility only indirectly contributes to the former two.
- The key components of manoeuvrability (acceleration, specific power, off-road capability) are similar in magnitude for comparable tanks. Hence, the inclusion of manoeuvrability in a qualitative indicator is not appropriate because it reduces the weight of firepower and armour protection in the assessment of combat performance.
- Combat performance is therefore determined by the effectiveness of firepower and armour protection.
- In the case of tanks, weapon system performance can be characterised by the armour-piercing capability of kinetic energy projectiles, while armour protection can be characterised by the resistance to such projectiles.
- Based on practical combat experience, the distribution of impact projectiles shows a trend. They indicate that 40-70 % of hits are likely to be in the front of the tank, 20-30 % per side on the side of the tank and 4-10 % per side on the rear. The distribution is depending on the combat circumstances and the environments.
- The effectiveness of the armour protection from the front 60 degrees direction is decisive, while from the other directions it is less influential for projectiles below the gauge. Combat experience suggests that only a small proportion of projectiles strike here, and that they almost always strike the side armour from the forward half-air at a flat angle (30 degrees or less). For this reason, the protection of the tanks against each other's projectiles from the body and the front 60 degrees direction of the turret is the decisive factor in the battle between the tanks, and each tank is differentially armoured according to the corresponding design philosophy.

- The new combat performance indicator relative to the opponent does not give significant differences compared to other quality indicators, but can be used to help identify and exclude extreme results.
- It provides a more accurate picture than previous indicators when comparing tanks of the same technological level.

NEW SCIENTIFIC RESULTS

T1: I have summarised and presented theoretical and practical scientific results on the definition of quality indicators based on scientific research and practical examples. I have explored the methods of establishing quality indicators, analysed the problems encountered in the past and the solutions to them. Based on the experience of using quality indicators and recent research results, I have presented research directions.

T2: By evaluating the results of combat experience and related theoretical research, I analysed and determined the vulnerability of tanks and the probable distribution of hits during their combat against each other. I demonstrated the validity of the results by presenting a practical armour protection solution.

T3: I have analysed and identified the technical characteristics that significantly influence the outcome of the engagement of tanks. By analysing the decisive technical characteristics of these capabilities, I have selected those necessary to calculate a new quality indicator. I have found that it is primarily the performance of the armament and the effectiveness of the armour protection that determines the success of the engagement between tanks, as well as the fact that the penetrating power of the armour-piercing shells and the resistance of the armour to shells below the space gauge are decisive. I have demonstrated the role and influence of combat characteristics on combat performance.

T4: I have laid the foundations of a calculation method that leads to a new approach, the so-called individual-correlation quality indicator, instead of the previous average-correlation indicators. I have named the new quality indicator the Combat Performance Indicator (CPI). Using the defining technical characteristics, I have created a methodology for calculating the new approach-based quality indicator that can be applied by commanders and staff officers who execute combat missions and plan them.

At the beginning of my thesis, I stated that my basic aim was to create an easy-to-use indicator of the tanks, which would predict the outcome of the combat. However, given the basic principles, it is conceivable that it could be used for other combat tools with similar tasks, subject to certain modifications. I am thinking of a modified indicator of the combat capabilities of infantry fighting vehicles and armoured combat vehicles against each other, but which could be created using the same approach. I believe that this is only possible after a proper evaluation of the impact of anti-tank missiles. The method developed for tanks is unlikely to be transferable in the same way to missile-launched vehicles. I believe that the role of dismounted infantry troops with anti-tank weapons in vehicle-launched combat, the influence of their combat activity and the interdependencies between them also need to be explored and the practical applicability of the results demonstrated.

A further direction for research could be the creation of a task-specific combat effectiveness indicator, based on the approach of the CPI, which would create an alternative to the combat potential, combat effectiveness indicator and other indicators with different names. Such a quality indicator could be developed by examining the combat task that can be performed by each of the assets (armoured fighting vehicle and infantry fighting vehicle, possibly armoured personnel carriers) in a similar task order. If successful, this type of more universal, task-based quality indicator would express the combat value of infantry fighting vehicles and armoured fighting vehicles in relation to each other, thus helping to plan operations and conduct evaluations.

Another possible avenue for further research is to reflect in the quality indicators the specificities of remotely armed combat vehicles or armoured fighting vehicles. It is by no means certain that the method developed as a result of my research can be applied in the same way to remote-controlled armoured combat vehicles. My doubts are fuelled by the role of the vertical distribution of the hits and the significant difference in the effective target area.

Today, there is no war without small drones, mini UAVs. In the case of sophisticated, high-end weapon systems, such relatively inexpensive devices essentially "lift the eyes" of the commander, or possibly the gunner, to a height or distance that allows the armoured assets to be more effectively concealed and protected, while greatly increasing their effectiveness. The very existence of the drone, the removal of sensors from the combat equipment, changes the applicability of armoured equipment and combat procedures to such an extent that it calls into question the usefulness of previously established quality indicators.

PRACTICAL USE OF RESEARCH RESULTS

Based on the previous examples, there may be a need for a database that provides commanders and staff with continuously updated information to assist them in the military decision-making process with data on the combat performance of each type of tank. My research has shown me that a more useful method than a database is to provide commanders with the necessary data for a specific combat mission, so that they can obtain a sufficiently accurate qualitative indicator of the performance of their mission, appropriate to the situation. Therefore, my method is a simplified calculation method applicable in a concrete situation, based on the use of the research results summarized in my doctoral thesis. The knowledge of this method can be useful for my fellow officers as well as for the instructors of military schools, since the emergence of new combat tools or the determination of quality indicators for combat tools with changed combat capabilities for some reason is only possible with the knowledge of the method. When planning military operations, it is necessary to accurately assess the own and the enemy's combat assets and combat strength, therefore I consider it useful to teach and familiarize those whose work is assisted by the method.

The development of technology points in the direction that the creation and development of databases for simulation systems used in military training cannot do without the collection, analysis and appropriate use of data on the combat performance of individual combat vehicles, including tanks, based on scientific principles.

The future development of the simulation training systems of the Hungarian Defence Forces and the theoretical (tactical) training of specialists at the appropriate level can only be achieved by involving theoretical scientific research programmes based on a well-prepared, long-term strategy.

It is my recommendation that research into the theory and practical application of quality indicators should be continued, so that the results of theoretical combat research can be used in the form of combat procedures, operational planning procedures and possibly technical recommendations that can be implemented in practice in the future.

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SCIENTIFIC AND PROFESSIONAL ACTIVITIES

Major Norbert Nagy started his military studies in the field of armour engineering and graduated as a mechanised infantry officer in 2000. In 2010, he received his MSc in Command from the Zrínyi Miklós National Defence University.

During his military career, he served as a sub-unit commander and then in various staff positions at different levels of command. He is currently the Acting Commander of the 11th Armour Battalion. His most important tasks are the conversion of the battalion to Leopard 2 tanks and the preparation of the battalion for the new type.

His scientific research focuses on the theoretical and practical aspects of military operations. He is primarily concerned with all questions of interest to military science in the planning, organisation and management of conventional military operations, focusing on the technical, organisational and doctrinal aspects of tactical operations.