



PERSPECTIVES ON THE DEVELOPMENT OF THE ARTILLERY BRANCH OF THE SERBIAN ARMY

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Abstract: Artillery, as a branch of the Serbian Army, has made significant advancements in technological terms. Modern combat conditions require the synchronization of technological achievements with organizational, personnel, logistical, and operational needs. The introduction of new technological solutions has led to changes in the logic and practice of organizational structures, tactics, development strategies, logistical support, the method of securing combat positioning elements, methods of providing fire support to units, data collection, etc. Thus, the entire system of functioning of the artillery branch must be subject to changes. This paper analyzes the current capabilities and achievements of the artillery branch and the discrepancies relative to technological advancements. Given the ongoing progress in science and technology, it is crucial to analyze the real needs of the branch and the feasibility of their implementation within the temporal and financial dimensions of the Serbian Army.

Keywords: artillery, development perspectives, capabilities.

1. INTRODUCTION

The development of modern military technologies presents new demands for all branches of the Serbian Armed Forces. The role of artillery in contemporary combat operations is becoming increasingly complex, necessitating the integration of advanced technologies with traditional methods of employment. In this context, analyzing the current capabilities of the artillery branch of the Serbian Armed Forces is essential to identify areas requiring reform and enhancement.

The current doctrines governing the use of artillery rely on a combination of firepower, mobility, and precision. However, global trends indicate the need for greater automation of artillery combat systems, improvement of communication networks, and enhancement of logistical support. Modern combat conditions demand rapid response and adaptability, which also calls for changes in the organizational and structural framework of artillery units.

In addition to technological aspects, the study also addresses changes in the tactics of artillery employment. Traditional methods of fire support must be adapted to new scenarios that include asymmetric threats and urban warfare. At the same time, logistical support must be optimized to ensure the continuous operational capability of artillery units.

New technologies play a crucial role in enhancing the capabilities of the artillery branch. The development of autonomous artillery combat systems, the use of unmanned aerial vehicles for reconnaissance, and advanced methods of data collection and processing are significantly changing the way artillery operates.

Personnel training must also keep pace with these changes, ensuring that professional military personnel are equipped to command, operate, and maintain the artillery branch's combat systems.

The objective of this paper is to provide an analysis of the current capabilities of the artillery branch of the Serbian Armed Forces, identify discrepancies in relation to modern demands, and propose directions for future development. Through an analysis of organizational and structural frameworks, tactics of employment, logistical support, new technologies, and training, the paper offers a foundation for further strategic planning and the implementation of necessary reforms.

2. MODERN REQUIREMENTS FOR THE ARTILLERY BRANCH IN FUNCTION OF INCREASING OPERATIONAL CAPABILITIES

The artillery branch of the Serbian Armed Forces faces increasingly demanding requirements in modern military operations due to the evolution of contemporary warfare and the changing nature of conflicts. The growing complexity of threats, asymmetric warfare, and the need for rapid response in diverse combat conditions have necessitated the establishment of new demands. These demands include the enhancement of technological capabilities, the increase of operational efficiency, and the adaptation to various operational scenarios.

Modern artillery combat systems must address several key needs [1]: increasing range, reducing the weight of artillery systems for improved mobility, enhancing precision and accuracy of targeting to reduce collateral damage, increasing rate of fire, shortening

preparation time for action, improving projectile effectiveness on target, simplifying and economizing maintenance, as well as ensuring the ability to conduct modernization throughout the system's entire life cycle.

Increasing range has always been a fundamental requirement for the artillery branch since its inception. This requirement is primarily driven by the need for artillery units to provide fire support to supported forces at greater distances, thereby expanding the operational zone and enabling more efficient execution of assigned tasks. The development of new propellant technologies is central to achieving these extended ranges, allowing artillery systems to reach targets further away while maintaining or even enhancing the effectiveness and precision of their strikes, as improved propellants and advanced rocket motors, significantly contributes to increasing the range of artillery munitions [1]. Additionally, improving the aerodynamic characteristics of projectiles, such as reducing air resistance, further enhances efficiency and range. Moreover, **reducing the weight** of artillery systems becomes imperative due to the need for faster and easier mobility. Lighter artillery systems can be transported more easily and quickly, including the capability for helicopter transport, allowing new firing positions to be occupied in a shorter time. Weight reduction is achieved through the use of new materials, such as aluminum alloys and composite materials, which provide high strength with low mass. However, these are two contradictory requirements, as achieving greater ranges with traditional artillery systems typically demands larger caliber and heavier guns. Experts face the challenge of balancing these opposing needs and must determine what is more important based on specific operational requirements and tactical objectives.

Improving the precision and accuracy of targeting is also a necessary step toward increasing the efficiency of modern artillery combat systems. The introduction of advanced fire guidance and control systems, such as Global Navigation Satellite Systems (GNSS) and Inertial Navigation Systems (INS), enables more precise targeting and reduces collateral damage [1]. In addition, the use of sophisticated ballistic calculations, which precisely account for various meteorological and ballistic parameters, significantly increases the accuracy of firing compared to earlier manual calculations. The integration of these technologies enhances the effectiveness of artillery fire, thereby reducing the risk of unintended damage.

Increasing the rate of fire and reducing preparation time for action are two interrelated requirements in the modernization of the artillery branch. These requirements stem from the need to achieve short but intense fire strikes and to quickly change firing positions to avoid counter-battery fire. Technological advancements in automatic loading systems and automated targeting lines, compared to manual loading and setting of firing elements, allow for faster projectile firing. This reduces the time between shots and maintains a high rate of fire. As a result, the overall efficiency of artillery units increases. The practical application of the MRSI (Multiple Rounds Simultaneous

Impact) firing mode enables the firing of multiple projectiles with different propellant charges and varying firing elements, so that all projectiles hit the target simultaneously. This firing mode is sometimes referred to as a „single-gun volley“.

Enhancing the effectiveness of projectiles on target involves achieving maximum impact while optimally utilizing resources. This requirement can be met by integrating advanced technologies into ammunition, such as precision guidance systems (e.g., GPS or laser guidance), optimized warheads (e.g., tandem-charge warheads), improved aerodynamic characteristics of projectiles (e.g., recessed base, elongated jacket to reduce air resistance), and the use of "smart" fuzes that can automatically adjust the mode of action depending on the type of target (e.g., fuzes with multiple modes for different types of targets). These advancements reduce the need for repeated strikes on the same target. Additionally, increased effectiveness on target adds value in modern combat conditions by reducing collateral damage. In this way, missions are carried out in compliance with the provisions of International Humanitarian Law.

Simplified and economical maintenance means that the effectiveness of artillery combat systems depends not only on their firepower but also on their ability to remain operational under prolonged and intense conditions. Simplified maintenance involves the development of artillery combat systems with easily replaceable components that require minimal specialized tools or training for upkeep. Economical maintenance is achieved by reducing maintenance costs and increasing the reliability of artillery combat systems, thereby enabling continuous operation with minimal interruptions.

The ability to implement modernization throughout the entire life cycle of a system refers to the long-term sustainability and relevance of artillery combat systems. In a world of rapid technological change, the capability of an artillery combat system to be modernized over its life cycle ensures that it remains effective and capable of meeting new challenges [1]. Modernization may involve upgrades or the introduction of new technologies and components that enhance system performance. Maintaining compatibility with future innovations ensures that the artillery combat systems of the Serbian Armed Forces remain competitive and ready to respond to the demands dictated by the modern combat environment.

Operational capabilities of the Serbian Armed Forces

In the context of the operational capabilities of the Serbian Armed Forces, modern requirements for the artillery branch directly contribute to their enhancement. The Serbian Armed Forces define operational capabilities as the ability to achieve desired operational effects within a specified time frame and under certain standards and conditions by combining forces, resources, and methods of task execution [5]. According to the Doctrine of the Serbian Armed Forces (2010), operational capabilities include the capability of command, the capability for timely availability of forces, the capability for deployment and mobility within the operational zone, the capability to exploit the information space, the capability for effective use of forces, the capability of force resilience and protection, and force sustainability. Further analysis

examines how modern requirements for the artillery branch impact the operational capabilities of the Serbian Armed Forces, emphasizing their significance and practical application in military operations. To better understand the connection between modern artillery requirements and the enhancement of operational capabilities, it is necessary to explore individual aspects in greater detail and their implications for military practice.

The capability of command represents the ability to efficiently plan, organize, direct, and control the operations of the Serbian Armed Forces or their components to achieve set operational objectives and accomplish assigned missions and tasks [5]. Modern artillery combat systems, equipped with advanced communication and information technologies, enable faster decision-making and command transmission, as well as more efficient planning and execution of operations. Additionally, these advanced artillery systems allow commanders to more effectively monitor the situation on the ground and adjust their decisions in real-time, thereby increasing operational efficiency.

The capability for timely availability of forces reflects the ability of the Serbian Armed Forces or their components to form and sustain sufficient military forces within a given timeframe to respond to and conduct operations. This capability is determined by the size, structure, readiness level, stress level, and efficiency of the force integration process [5]. In other words, timely availability of forces represents the ability to form and support adequate military forces within a specified time for response. In the context of modern requirements for the artillery branch, this capability is directly enhanced through technological innovations that enable faster mobilization, deployment, and reduced preparation time for artillery units. As a result, artillery units are timely available to execute primary and assigned tasks and respond more swiftly to changes in complex combat conditions. These advancements allow the Serbian Armed Forces to efficiently manage their forces and respond to challenges more rapidly and effectively.

The capability for deployment and mobility within the operational zone refers to the ability of the Serbian Armed Forces or their components to deploy forces into the operational zone and maneuver them in accordance with the operational objectives within a specified timeframe [5]. Modern artillery combat systems, with reduced weight and enhanced mobility, enable artillery units to quickly adapt to changing conditions on the ground, occupy new firing positions or targeting elements, and provide the necessary fire support. Faster deployment and improved mobility of forces directly contribute to timely responses and the achievement of operational efficiency in dynamic combat conditions.

The capability to exploit the information space involves the ability of the Serbian Armed Forces or their components to collect, process, use, and exchange data on space, time, and both friendly and enemy forces [5]. Modern artillery combat systems utilize advanced technologies for data collection and processing, enabling precise location of targets and own positions. These systems allow artillery units to obtain accurate

information about targets, atmospheric conditions, and the terrain, significantly enhancing the accuracy and effectiveness of their actions. Additionally, the integration of automated fire control systems facilitates real-time data exchange between different units and commands, leading to better coordination and decision-making in line with the current situation on the ground.

The capability for effective or efficient use of forces refers to the ability of the Serbian Armed Forces or their components to successfully conduct operations and achieve combat and non-combat effects that support the accomplishment of operational objectives [5]. Enhancements in precision and accuracy of targeting, increased rate of fire, and improved effectiveness of projectiles on target directly contribute to the effective and efficient use of artillery units in combat operations. These improved performances allow artillery units to strike targets more accurately while reducing the need to fire multiple rounds, which in turn decreases the likelihood of revealing their own firing positions.

The capability of force resilience and protection refers to the ability of the Serbian Armed Forces or their components to reduce the likelihood of their forces being detected and to mitigate and eliminate the effects of enemy weaponry [5]. This capability is realized through the implementation of organizational, physical, and technical measures aimed at preserving personnel and equipment. Modern artillery combat systems, with their increased range and precision, enable operations from greater distances, reducing the risk of detection and counter-battery fire. Additionally, rapid changes in firing positions further enhance the resilience of forces against enemy attacks. These measures may also include improved camouflage techniques, protection against electronic jamming, and enhanced ballistic protection for crews, equipment, and machinery.

The sustainability of forces refers to the ability of the Serbian Armed Forces or their components to care for, maintain, supply, and relocate personnel and military equipment within a specified time frame, under certain conditions and with available resources, in order to ensure favorable conditions for the effective use of available forces and assets [5]. The sustainability of forces is directly linked to the requirements for simplified and economical maintenance of artillery combat systems. The use of artillery systems that allow for easy maintenance, as well as the optimization of logistical supply chains for spare parts and ammunition, are crucial for the long-term operational viability of artillery units. Additionally, the ability to modernize systems throughout their entire life cycle ensures that artillery combat systems remain relevant and functional, even during prolonged operations, thereby providing continuous and effective support to other forces.

Modern requirements for the artillery branch in the context of the operational capabilities of the Serbian Armed Forces emphasize the importance of continuous technological advancement and adaptation to new combat conditions. Technological innovations in artillery play a crucial role in enhancing the efficiency of military operations, enabling faster, more precise, and more flexible responses on the battlefield. Through these

innovations, artillery significantly contributes to the overall operational readiness of the Serbian Armed Forces, ensuring better command, availability, and mobility of forces, as well as more efficient information management and resilience against enemy threats. In this way, artillery becomes an even more critical factor in achieving operational objectives and maintaining combat readiness in the dynamic and complex environment of modern warfare.

3. ANALYSIS OF THE EXISTING CAPABILITIES OF THE ARTILLERY BRANCH AND IDENTIFICATION OF ISSUES AFFECTING THE PACE OF CAPABILITY DEVELOPMENT

The artillery branch of the Serbian Armed Forces has achieved significant technological advancements. Modern combat conditions require aligning technological achievements with organizational, personnel, logistical, and operational needs. The introduction of new technological solutions has led to changes in the logic and practice of organizational structures, tactics, development strategies, logistical support, methods of ensuring combat elements, fire support techniques, data collection methods, and more. Thus, the entire functioning system of the artillery branch must be subject to change. The following text provides an overview of the current capabilities and achievements of the artillery branch, as well as the discrepancies relative to technological advancements. Given the continuous progress in science and technology, it is crucial to analyze the actual needs of the branch and the possibilities of their implementation within the time and financial constraints of the Serbian Armed Forces.

3.1. Current Capabilities

The Serbian Armed Forces are actively working on the modernization of the artillery branch through the introduction of new systems and the enhancement of existing ones [3]. One of the most significant projects is the operational deployment of the domestically produced 155 mm NORA B-52 self-propelled howitzer, which provides greater mobility, range, and firepower. Additionally, the modernization of the Oganj M77 self-propelled multiple rocket launcher into the digitized M17 system allows for more precise and efficient artillery use. The modernization of the 122 mm SH 2S1 Gvozdika self-propelled howitzer also contributes to the increased operational capabilities of the artillery branch.

Currently under testing are the modular self-propelled multiple rocket launcher LRSVM M18 "Oganj" and the modular self-propelled multiple rocket launcher LRSVM 262/122 mm „Tamnava," which will bring new capabilities to the Serbian Army's rocket artillery. Unlike the digitized M17 system, the modular M18 does not have a fixed launcher but uses a pre-loaded rocket launcher mounted on a truck, providing greater flexibility and faster readiness for action. This system can fire various types of rockets, both guided (such as the ALAS missile) and unguided (such as the 128 mm PLAMEN D rocket),

significantly enhancing its operational use and efficiency in modern military operations. The ALAS missile, also in the testing phase, represents the most ambitious development project of the Serbian defense industry. It is an anti-tank/multi-purpose self-guided missile system with a long range, capable of targeting a wide spectrum of threats such as tanks, infantry fighting vehicles, command posts, infrastructure, ships, industrial facilities, and low-flying helicopters. On the other hand, the LRSVM 262/122 mm „Tamnava" is also a fully automated system that uses launcher containers armed with 262 mm rockets and all variants of 122 mm rockets. This system enables the autonomous execution of combat missions, and its modularity ensures flexibility in the choice of rocket armament. The system is equipped with GPS and INS technologies for precise targeting, and the loading and unloading of the launcher system is performed using a crane mounted on the platform. "Tamnava" can launch rockets with a range of up to 70 km (262 mm) and 40 km (122 mm), significantly enhancing the firepower and range of the Serbian Army's rocket artillery.

New ammunition with a gas generator and recessed base improves the ballistic characteristics of projectiles, while the testing of long-range rockets allows for an expanded operational firing range [6]. The integration of drones for reconnaissance and fire guidance represents a significant step towards modernizing and increasing the efficiency of the artillery branch.

The artillery branch of the Serbian Armed Forces has made significant progress over the past decade. This development ensures that artillery units are better equipped and more prepared to respond to modern military challenges, risks, and threats with greater efficiency and reliability. Continuous modernization efforts ensure that artillery remains one of the key branches of the Serbian Armed Forces.

3.2. Identification of issues affecting the pace of capability development

Although the Serbian Armed Forces are actively investing in the modernization and equipping of the artillery branch, there are significant discrepancies when compared to the latest technological advancements and the demands of modern warfare. These discrepancies can be identified in the following areas: **Lack of precision munitions; limited use of drones; outdated sensor systems; limited logistical support; training of personnel; lack of spare parts and accessories.**

The analysis of the current capabilities of the artillery branch and the identified discrepancies in relation to modern technological requirements reveals the necessity for continuous improvement to maintain a high level of operational capability. These discrepancies clearly indicate the development directions and strategies that should be implemented to achieve greater efficiency in military operations. By integrating advanced technologies, strengthening logistical support, and reforming the educational system, the Serbian Armed Forces can significantly enhance their artillery capabilities and better prepare for future military challenges.

4. DEVELOPMENT DIRECTIONS FOR THE CAPABILITIES OF THE ARTILLERY UNITS OF THE SERBIAN ARMED FORCES

In light of technological innovations and changes in modern warfare, the enhancement of the artillery units of the Serbian Armed Forces requires a strategic approach across various aspects. It is essential to focus on the organizational and structural framework, tactics of employment, logistical support, the introduction of new technologies, and the improvement of training. The following text analyzes these elements, with a review of current capabilities and the experiences of foreign military forces, in order to identify best practices and overcome existing challenges.

4.1. Organizational and structural framework

The organizational and structural framework of the artillery units of the Serbian Armed Forces serves as the foundation for efficient planning, organization, and execution of combat operations [2]. In the context of modern warfare, where speed of response, flexibility, and adaptability are considered key success factors, continuous adaptation of the organizational and structural framework is essential to meet the increasingly complex demands of combat conditions.

One possible aspect of improving the organizational and structural framework is increasing the level of autonomy for artillery units. This can be achieved through the formation of modular units capable of independently executing tasks at the tactical level with minimal support from other branches. These units would be equipped with modern artillery combat systems, advanced communication, and information technologies, enabling them to respond more quickly and effectively to changes in combat conditions. Additionally, it is necessary to consider increasing the number of specialized electronic warfare units to strengthen the artillery's ability to respond to contemporary threats. Integrating these specialized units into the existing structural framework would contribute to a more comprehensive and flexible response to various types of threats. Furthermore, enhancing vertical and horizontal coordination within artillery units, as well as between artillery and other branches of the Serbian Armed Forces, is crucial. Effective coordination and communication between different command levels and units in the field are vital for the successful execution of complex combat operations. By introducing advanced fire control systems, artillery units can achieve a high level of synchronization, further enhancing their combat effectiveness.

Improving the organizational and structural framework of the artillery units of the Serbian Armed Forces is essential to increase operational flexibility, autonomy, and efficiency in modern military operations, enabling the artillery to better respond to the complex and dynamic challenges of contemporary warfare.

4.2. Tactics of employment

The tactics employed by the artillery units of the Serbian Armed Forces play a significant role in achieving success and completing missions. However, the existing combat doctrines, shaped by traditional methods of artillery use, have not fully accounted for the integration of modern technologies and the modernization of artillery combat systems. This situation calls for an urgent reassessment and adaptation of current doctrines to ensure their relevance in modern warfare.

Modern artillery combat systems offer significantly greater precision, mobility, and autonomy for units. However, the integration of these systems into existing formations often encounters obstacles due to inconsistencies with current rules and tactics of employment. For instance, the current doctrines do not fully exploit the capabilities offered by advanced guidance systems, such as GNSS and INS, or the use of drones for reconnaissance and artillery fire guidance.

Therefore, it is essential to adapt combat doctrines to reflect the new capabilities brought by the modernization of artillery. This involves integrating new technologies into the techniques used in operations, from planning and reconnaissance to the execution of fire missions and rapid, efficient changes in firing positions. Beyond technological aspects, new tactics must also consider changes in the nature of conflict, including asymmetric threats and urban warfare. Artillery units must adapt to scenarios where the enemy employs unconventional methods, requiring greater flexibility and the ability to respond quickly. Adapting to these demands is essential for maintaining effectiveness and minimizing collateral damage. The reform of doctrines must also encompass better-coordinated actions with other branches of the military, particularly in the context of joint operations. The integration of artillery with the forces of other branches and services enhances overall capabilities and allows for more efficient use of resources on the battlefield.

Ultimately, the tactics employed by the artillery units of the Serbian Armed Forces must be adapted to new technological advancements and contemporary combat conditions.

4.3. Logistical support

The modernization of artillery requires adequate logistical support capable of sustaining new systems and technologies. This includes the procurement of specialized tools and spare parts, as well as the optimization of supply chains to deliver parts and ammunition to artillery units in the field. Beyond its importance for maintenance and supply, logistical support also impacts timely responses in critical situations, ensuring continuous readiness [4]. The introduction of new technologies in logistics, such as automated inventory management systems and advanced transportation methods, enhances the efficiency of logistical support. At the same time, it is necessary to ensure flexibility in logistical processes to quickly adapt to changing conditions in the field and maintain

continuity in supply and maintenance, even in complex combat conditions.

4.4. New technologies

The integration of new technologies into the artillery units of the Serbian Armed Forces contributes to the enhancement of operational capabilities and the adaptation to modern combat conditions. Contemporary artillery combat systems increasingly rely on technological innovations that enable more precise, faster, and more flexible operations. One of the most important aspects of introducing new technologies is the development and implementation of advanced fire control systems, such as Global Navigation Satellite Systems (GNSS) and Inertial Navigation Systems (INS). These systems allow for precise targeting and increased accuracy in firing, reducing the need to launch a larger number of projectiles. Additionally, the introduction of unmanned aerial vehicles for reconnaissance and fire guidance represents a significant step forward in the modernization of artillery units, as it enables real-time intelligence gathering and faster decision-making in the field. Modern artillery also utilizes smart munitions capable of neutralizing targets with great precision. Firing fewer projectiles reduces the risk of revealing one's own positions. The introduction of automated loading and aiming systems significantly accelerates the firing process, enabling faster responses and adaptation to changes on the battlefield. By introducing new technologies, the Serbian Armed Forces ensure that their artillery units remain relevant and capable of responding to the increasingly complex challenges of modern warfare.

4.5. Training

Training is a crucial element in the future development of the artillery units of the Serbian Armed Forces, particularly in the context of implementing new technologies and adapting the tactics of artillery use. To ensure that artillery personnel are prepared for the effective use of the latest systems, the curriculum at the Military Academy and the training programs at training centers must be continuously updated and aligned with the demands of modern warfare. Currently, the discrepancy between theoretical education and the practical application of new systems highlights the need for a reform of the educational process. In the future, training should focus on the integration of modern artillery systems into educational programs, thereby reducing the gap between theory and practice. Beyond training in handling and operation, future development should also include the enhancement of IT skills, given that modern artillery combat systems require advanced informatics competencies. These skills are crucial for the effective operation and maintenance of new systems. Through comprehensive training programs, similar to those implemented by advanced military forces, such as the Israeli Defense Forces, the Serbian Armed Forces can significantly improve the operational readiness of their artillery units. Emphasizing continuous training and adaptation to modern technologies will ensure that the

Serbian Armed Forces are prepared to meet the increasingly complex challenges of modern combat conditions.

Enhancing the capabilities of the Serbian Armed Forces' artillery units requires a strategic approach that encompasses various aspects. Contemporary warfare challenges and technological advancements necessitate the continuous adaptation of artillery units. By integrating new technologies, optimizing logistical processes, and reforming the educational system, the Serbian Armed Forces can significantly improve the operational capabilities of their artillery units and ensure they are capable of effectively responding to the demands of modern warfare. Such an approach enables the artillery to remain relevant in achieving operational objectives and maintaining national security.

5. CONCLUSION

The Artillery of the Serbian Armed Forces, faced with dynamic changes in the modern combat environment, demonstrates significant progress through the continuous modernization of its capabilities. The operational capacities of this branch ensure rapid and precise fire strikes against various targets. This paper provides an overview of the current capabilities of the artillery branch, identifies the challenges that affect the speed of capability development in relation to contemporary technological demands, and discusses the necessary development directions to enhance operational capabilities. The integration of new technologies, adaptation of organizational and structural frameworks, improvement of logistical support, and enhancement of training are key elements that enable artillery units to remain relevant and effective in confronting the complex challenges of modern warfare. To achieve a higher level of capability, the Serbian Armed Forces must continue their efforts in modernizing the artillery branch and ensure that all changes align with contemporary requirements and resource constraints. Continuous adaptation and improvement allow the artillery to remain a crucial component of the Serbian Armed Forces' firepower, capable of effectively executing tasks in combat operations.

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