APPLICATIONS OF CRISPR-CAS9 TECHNOLOGY IN MILITARY AFFAIRS AND INTERNATIONAL SECURITY

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CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats) is an adaptive immunity mechanism that occurs naturally in bacteria, protecting them against viruses by incorporating viral sequences into their genome, which confers specific resistance to pathogens. Based on the understanding of the CRISPR mechanism in bacteria, the system was subsequently adapted as a reference technology in the field of genome editing; its principle relies on the precise recognition and cleavage of DNA sequences by the Cas9 protein complex. This genome-editing capability enables the correction of genetic mutations and the modification of heritable traits, opening new possibilities for enhancing population resilience as well as managing biological risks. From this point of view, its impact on demographic factors inevitably influences the international security environment, as well as the trends of military evolution. The main objective of the paper is to analyse the applications of CRISPR-Cas9 technology in the military field, and to asses its implications for the security environment, encompassing not only the applications, but also the risks, threats and vulnerabilities that may arise from the use and proliferation of gene-editing technologies.

Keywords: CRISPR-Cas9; Gene Editing; Biosecurity; Emerging Biotechnologies; Bioethics;

INTRODUCTION

The essential element of the military field is man. Regardless of technological developments, man remains a historical constant of the military element and of war. Whether we are talking about political control, military planning or command, or even the civilian population – we can see that man is the primary element, guiding the principles of military science. From this point of view, regarding the context and conditions of war – J.F.C. Fuller noted that there are two conditions of war: natural and artificial. The natural condition is represented by predetermined, unmodified elements such as the geographical area, meteorology, or the human quality of armies. The artificial condition is represented by modified elements such as equipment, gear, or technologies used in warfare. Even though these conditions were outlined two centuries ago, they remain relevant today (Fuller, 1993, p. 182).

Taking this into account, for the first time in human history we can speak of combining the two conditions – natural and artificial – to create the best possible form and to control something that was previously beyond technological possibilities. Through genetic modification, the human being can control the natural condition, thus bringing a revolutionary contribution to security, warfare, and demography. With this technology, security policies and strategies, as well as military doctrines, will need to be modified and readjusted to this new condition – the symbiosis between natural and artificial.

Due to the impact it could have on humans, genetic modification technology is no longer just a medical or biological issue but extends into security sciences, military sciences, and other humanities.

From this perspective, we considered it necessary to provide a very focused analysis of the applications of *CRISPR-Cas9 technology*. The possibilities of use, limitations, and risks have not been fully studied, representing a major gap. Due to the impact it could have on humans, genetic modification technology is no longer just a medical or biological issue but extends into security sciences, military sciences, and other humanities. Thus, it is necessary to analyse the main applications in the military field, as well as the risks, disadvantages, threats, limitations, and impact it could have in the international security environment. The purpose of this paper is not limited to a mere enumeration of practical applications but to provide a compact, yet multilateral analysis to reorient research in this field and connect a subject previously studied only in biotechnological and medical sciences with the field of security and military sciences.

The main hypothesis of the paper is that *CRISPR-Cas9 technology* represents a vital tool of future armies, radically changing the security environment and the way wars and international conflicts are fought. It could add value to the human resource and radically alter natural exponents previously considered immutable. Moreover, the paper does not aim only to justify the use of such technologies but to present, as a whole, both the advantages and practical applications, as well as the risks, threats, and vulnerabilities that exist, highlighting a complex and almost unknown process.

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The first chapter will address the new type of warfare and the way future armies will look, the paradigm shift, and the revolutionisation of technological and natural elements. The first chapter will also cover the basic process of *CRISPR-Cas9 technology* to be explored in more depth in the second chapter. The second chapter will present the practical applications of *CRISPR-Cas9*, as well as the problems and vulnerabilities that can be solved through this technology. The third chapter will analyze the impact on the security environment, potential risk factors, threats that may arise, as well as political, legislative, and technological vulnerabilities and limitations.

PERSPECTIVES OF TECHNOLOGICAL INNOVATION. BETWEEN INTELLIGENTIZED WARFARE AND TECHNO-SENTIENT WARFARE

The beginning of the third decade of the 21st century was marked by a revolution in military affairs. Even though there were earlier precedents, attention turned to the use of emerging technologies in the military field to complement traditional military forces. This form of *"intelligent warfare"* appeared as an official doctrine (since there had previously been conceptual strategies and abstract forms) in China's strategic document *China's National Defense in the New Era*. China's new strategy was adjusted in response to U.S. political changes.

In 2019, the United States made a significant strategic shift – from the War on Terror back to conventional rivalry with Russia and China. This document highlights China's readjustment to a strong adversary, both economically and militarily. Intelligent warfare was a form of adaptation to both the quantitative and qualitative gaps between the United States and China (Cordesman, 2019, pp. 1-2).

According to China's National Defense in the New Era: "*Driven by the new round of technological and industrial revolution, the application of cutting-edge technologies such as artificial intelligence (AI), quantum information, big data, cloud computing and the Internet of Things is gathering pace in the military field. International military competition is undergoing historic changes. New and high-tech military technologies based on IT are developing rapidly. There is a prevailing trend to develop long-range precision, intelligent, stealthy or unmanned weaponry and equipment. War is evolving in form towards informationized warfare, and intelligent warfare is on the horizon.*" (State Council Information Office, 2019, p. 6).

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Informationalized or intelligentized warfare represents, for the Chinese state, a way to gain real operational advantages over a new battlefield environment, thereby eliminating conventional gaps or vulnerabilities (Defense Intelligence Agency, 2019, p. 24). China's form of intelligentized warfare was conceptualized much more broadly during 2020–2021. Expanding the concept of complementarity between traditional military forces and emerging technologies, Chinese researchers defined a new type of warfare – meta-war. By using virtual reality, meta-simulations, or integrated brain-computer interfaces, a *"super-space"* of combat can be created, merging the real and the virtual, connecting the real battlefield with the *"mental"* one. It can be said that the first step toward merging the natural with the artificial was achieved through the notion of meta-war (Baughman, 2024, p. 31).

In contrast with China's strategy, the North Atlantic Treaty Organization does not have a well-defined doctrine or strategy as a paradigm, like China's concept of *"Intelligentised Warfare"*. Western thinking considers cyberspace and the digital domain as complementary tools within a much broader concept of defense. From this perspective, huge differences can be observed between China's comprehensive

"Intelligentised Warfare" paradigm and NATO's elements of cyber defense. This is evident in NATO's 2022 Strategic Concept, which does not clearly delineate informational warfare but frames it as a tool of *"hybrid warfare"*. NATO's central missions focus mainly on resilience, cyber defense, development, and digital domain control (NATO 2022 Strategic Concept, 2022, p. 7).

Indeed, the concepts of informational warfare and net-centric warfare first appeared in American research. In 2004, Eliot A. Cohen noted the emergence of a revolution in military affairs regarding technology. He argued that the transformation of armies is a result of geopolitics – specifically American supremacy – calling the modernisation and transformation process an *"American process"*. He emphasised that the technological gap is far more important than training, morale, or professional preparation. Thus, a technologised army is harder to defeat, as it can complement traditional methods with technological ones. He also noted that most revolutionary processes start bottom-up, with military leadership and political decision-makers needing to adapt and readjust strategic thinking in line with technological innovations. Interestingly, he remarked that the revolution in combat technologies would reach its peak with the implementation of *"biological technologies"* (Cohen, 2004).

The main difference between how Western and Chinese thinking approach the implementation of emerging technologies is, at most, doctrinal. In the West, as evidenced by strategic documents, emerging technologies are viewed as complementary tools to traditional military techniques – a separate part of a complete system. Chinese thinking emphasises merging traditional and technological concepts to create a single environment – essentially, a single domain combining technology, information, and traditional techniques under a new defense paradigm. This difference is worth noting because genetic modification through CRISPR-Cas9 is a component of what China calls *"Intelligentised Warfare"* (Billore, 2024). This is important because *"Intelligentised Warfare"* has evolved significantly, reaching the concept of *"Meta-War"*. Biotechnological developments are unfolding in a similar way. The lack of adaptation to the current context and the absence of a new paradigm will create problems of coordination, planning, and adjustment to future technological developments.

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A component of *“Intelligentized Warfare”*, according to the Chinese state, is “cognitive dominance” and the *“informationalization of man”*. Thus, for the first time in human history, man becomes the subject of technological innovation. Using new brain technologies (brain implants, genetic modification), the People’s Liberation Army seeks to enhance the cognitive abilities (intelligence, decision-making, courage) of its officers through these technologies – the human brain becoming a new operational battlefield. Through this fusion of man and technology, the PLA aims to create a new form of command and control (C2), where humans can be directly connected to technology (Kania, 2024, p. 86).

Techno-sentient warfare is a relatively new concept, developed by the U.S. Army War College publication *Techno-Sentient Warfare* in 2035, published in 2024. It envisions a new paradigm for the West to counterbalance China’s *“Intelligentised Warfare”* concept and to create a new form of waging war. The authors argued that techno-sentient warfare is not simply a Western alternative but a continuation, an evolution of the *“Informationalized Warfare”* paradigm. Within techno-sentient warfare, the contribution of the human resource will be considerably reduced through the gradual automation of emerging technologies. Thus, political decision-makers and military leaders will be able to operate outside traditional environments – air, land, maritime – in areas that until now were beyond the scope of the military. The main lines of action of techno-sentient warfare will not focus on the traditional fields of the military but on technological aspects that will grow in importance in the next decade. Among these are: quantum neural networks – neurotechnology that will connect the human being to quantum computers; informational and cognitive warfare that will evolve into neuro-warfare (control of the adversary’s cognitive power); enhancement of human performance and hyper-enhancement through genetic modification technologies, pharmaceuticals, technological augmentation, and decision-support systems (Carlson et al., 2023, passim 6-9).

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PRACTICAL MILITARY APPLICATIONS OF CRISPR-CAS9 TECHNOLOGY

CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats) is a natural system of adaptive immunity found in bacteria and archaea. This mechanism works by recognizing and neutralizing genetic material from viruses or other invasive genetic elements. The system is based on short DNA sequences derived from past pathogens, stored in the bacterial genome like a *"molecular registry"* of previous infections. A central element of the CRISPR complex is the Cas9 protein (CRISPR-associated protein 9), an endonuclease capable of cutting DNA at the region indicated by a fragment of guide RNA. This guide RNA, complementary to the target sequence in the viral genome or any other DNA of interest, gives the system the specificity it needs for recognition. The interaction between Cas9 and the guide RNA enables precise identification and cleavage of invading DNA molecules.

Recent research has adapted this natural mechanism into an extremely powerful tool for genome editing. By redesigning the guide RNA sequence, Cas9 can be directed to almost any region of the genome, allowing genes to be inserted, removed, or modified with unprecedented precision in biomedical practice. A notable example is Casgevy, the first CRISPR/Cas9 therapy approved by the U.S. Food and Drug Administration (FDA) for the treatment of sickle cell disease and transfusion-dependent beta-thalassemia (Singh et al., 2024). This therapy involves ex vivo editing of hematopoietic stem cells, which increases the expression of fetal hemoglobin (HbF) and leads to a significant reduction in vaso-occlusive crises as well as a decreased need for blood transfusions. In most patients included in clinical trials, the transition to transfusion independence was maintained for at least 12 months, confirming the robustness and efficacy of the intervention. Beyond these remarkable advances in treating hereditary hematologic diseases, there are promising preclinical results in areas such as Duchenne muscular dystrophy, where animal models subjected to genome editing have regained expression of a protein essential for normal muscle function – indicating major potential for corrective genetic therapies in severe neuromuscular pathologies. Emerging uses of CRISPR are also extending to metabolic

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and cardiovascular conditions; one example is the treatment of familial hypercholesterolemia, where base editing combined with lipid vectors has produced marked reductions in LDL cholesterol levels (Hoekstra et al., 2024; Hughes-Castleberry et al., 2023). In addition, applying genome-editing techniques to chronic granulomatous disease has provided early clinical data suggesting restoration of immune function, with a favorable safety profile and minimal adverse reactions reported so far. CRISPR-Cas9 technology is becoming increasingly relevant in combating antimicrobial resistance, which the World Health Organization considers one of the main threats to global public health (CAS Insights, 2024). Through the FAB-CRISPR platform, which uses antibiotic-resistance markers to rapidly select modified cells, the efficiency and traceability of genetic editing are improved (Adarska et al., 2025), opening avenues for innovative therapies against multidrug-resistant infections.

CRISPR technology has proven its relevance in agriculture, where it contributes to strengthening food security by developing crops with optimized genetic traits, such as increased drought tolerance, pathogen resistance, and higher yields. These innovations have the potential to redefine the resilience of global agri-food systems and provide sustainable solutions in the face of contemporary climate pressures.

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Gene therapy can increase the efficiency of the military human resource. First, by editing certain genes, soldiers could have enhanced cognitive abilities such as: highly developed memory, concentration, and problem-solving skills—giving them an advantage during high-pressure situations. In terms of physical abilities, strength, endurance, and muscle mass can be modified and enhanced (Billore, 2024).

Another aspect that can be altered is resistance to external stress factors. Until now, military science has assigned responsibility to eliminating these factors, seeking solutions and technologies that could mitigate their effects. Gene therapy can improve resistance to such factors by increasing lung capacity and tolerance to uncomfortable temperatures, enabling soldiers to cope with hostile environments. These traits can be modified genetically, and such mutations also exist in the natural state of human physiological evolution. For example, soldiers guarding Siachen Muztagh have acquired hereditary resistance

CRISPR-Cas9 technology opens new perspectives on optimizing human performance. Human enhancement, often referred to as "Human Performance Enhancement", marks a transition from the use of pharmaceuticals, supplements, and nutritional strategies aimed at maximizing individual performance toward the integration of CRISPR-type biotechnologies, with the potential to increase biological resilience, amplify physiological functions, and correct genetic predispositions.

to temperatures of −50°C, and other demographic groups have developed resistance to very high altitudes that would cause physical and psychological disorders in an average person (Ibid.).

Possibly the greatest discovery in this field is a radiation-resistant gene. Based on microscopic organisms – tardigrades (water bears) – Chinese specialists have identified cells resistant to high levels of radiation. Tardigrades are of interest for genetic biotechnology – they can withstand temperatures of −200°C, survive for more than an hour in boiling water, and endure outer space. The mechanism of their cells is unique, working by creating *"shields"* around all their cells. A team of military researchers stated that they inserted such genes into a human embryo, generating increased resistance to radiation. The resistance is not total, but it is estimated that it could prevent cellular irradiation in the event of a nuclear war (Chen, 2023.)

FUNDAMENTAL SECURITY ISSUES OF GENETIC MODIFICATION TECHNOLOGIES

In addition to clinical studies in the medical field, *CRISPR-Cas9 technology* opens new perspectives on optimizing human performance (BioSpark Studio, 2025). Human enhancement, often referred to as *"Human Performance Enhancement"*, marks a transition from the use of pharmaceuticals, supplements, and nutritional strategies aimed at maximizing individual performance toward the integration of CRISPR-type biotechnologies, with the potential to increase biological resilience, amplify physiological functions, and correct genetic predispositions. Within this framework, recent reports indicate that research directions in China are increasingly oriented toward applying these genetic optimization technologies for military purposes, with an implementation horizon estimated around 2030 (Carlson et al., 2023). This evolution illustrates how biotechnologies, and especially genome editing through CRISPR-Cas9, are being integrated into national security strategies, transforming from biomedical tools into strategic resources with major geopolitical implications.

The concept of demographic security, defined as the ability of a state or community to maintain the numerical, qualitative, and structural balance of its population, offers a framework for understanding how CRISPR-Cas9 could be instrumentalized politically.

Genetic editing promises to correct hereditary mutations, extend life expectancy, and strengthen population resilience to environmental factors, thus functioning as a potential instrument of demographic policy. However, the anticipated benefits face significant risks, especially the emergence of *"biological stratifications"* generated by unequal access to technology. In such a scenario, certain social groups would accumulate systematic genetic advantages, while others would be marginalized, leading to new forms of inequality and exclusion. These tensions are amplified in authoritarian regimes, where biotechnologies can be turned into instruments of social control. State-imposed genetic standardization raises major ethical dilemmas concerning individual autonomy and respect for biological diversity, issues that become even more problematic in the absence of transparent regulatory mechanisms.

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In this context, China has adopted an explicit strategy of *"Military-Civil Fusion"*, through which discoveries and innovations from the civilian biotechnology sector are directed toward military programs. Strategic documents indicate Beijing's goal of becoming a global leader in human enhancement technologies through CRISPR and other genetic editing methods by 2030 (Stone & Wood, 2020, pp. 25-26). Ongoing programs target the development of traits such as increased resistance to fatigue, accelerated recovery after trauma, superior reflexes, and enhanced sensory adaptations, going beyond the therapeutic sphere and opening debates on redefining the human condition in relation to military and political needs (Carlson et al., 2023, p. 66).

The functioning of laboratories dedicated to genomic editing for human enhancement depends on three essential dimensions: biosecurity infrastructure proportional to risk, institutional governance mechanisms, and the integration of computer-based (in silico) modelling into the experimental process. The World Health Organization's Laboratory Biosafety Manual (4th edition) proposes a risk- and evidence-based framework that emphasizes local adaptation of facilities, equipment, and microbiological practices, but especially the existence of an organizational culture of safety and the systematic training of personnel (World Health Organization /WHO, 2020). It is also worth noting the central role of the digital component, whereby computer models (in silico), including those based on artificial intelligence (AI), are becoming indispensable tools for planning genetic editing interventions. These allow the design of optimized CRISPR guides, the prediction of efficiency, and the identification of unwanted effects through statistical and machine learning algorithms. By integrating these methods, the development cycle is shortened, and risks are reduced through the pre-experimental selection of variants with the most favorable molecular profile (Zhang et al., 2020; Listgarten et al., 2018; Sherkatghanad et al., 2023).

This technological orientation, however, requires a broader reflection beyond strategic analysis. The integration of genetic enhancement into military and demographic planning demands an evaluation of the moral limits of human genome modification and of the social and political consequences it generates. In particular, the focus falls on equity in the distribution of benefits, the risk of new forms of genetic inequality, and the potential erosion of biological diversity. Likewise, individual autonomy becomes vulnerable in a context where state imperatives tend to prevail over personal rights. Strategic analysis of CRISPR technologies must be complemented by a strong bioethical and legal anchoring, since in the absence of clear normative frameworks, genetic editing risks being absorbed into the security and competitive logic of contemporary geopolitics. Such an evolution would transform a biomedical tool with undeniable therapeutic value into an instrument of social control and genetic standardization, with structural effects on the organization of society and on how the concept of humanity is redefined.

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In this sense, the bioethics literature highlights the fundamental distinction between somatic interventions – which affect only the patient's body and are not passed on to descendants – and germline interventions, which become part of the collective genetic heritage and carry intergenerational implications. Savulescu and Singer (2019) formulate a normative framework that conditions the responsible use of genetic editing on the fulfilment of strict criteria, including empirical demonstration of safety, the absence of reasonable alternatives, and the guarantee of informed consent. In the absence of these safeguards, the application of the technology risks undermining essential principles of bioethics – personal autonomy, distributive justice, and responsibility toward future generations. These principles have been enshrined in international legal documents, such as the Oviedo Convention (1997), which allows interventions on the human genome only for preventive, diagnostic, or therapeutic purposes but explicitly prohibits modifications with hereditary effects passed on to descendants, and the Universal Declaration on the Human Genome and Human Rights (UNESCO, 1997), which establishes the human genome as the common heritage of humanity. Although these legal instruments set fundamental normative benchmarks, they prove insufficient in the face of the accelerated pace of technological progress and the diversity of geopolitical contexts in which *CRISPR-Cas9 technologies* may be used.

From the perspective of demographic security, CRISPR-Cas9 can be presented as a technological solution for major issues: reducing the incidence of hereditary diseases, strengthening population resilience in the face of climate change, and countering demographic decline. However, the central risk lies in the instrumentalization of genetics for political purposes, through the imposition of biological standards of health or performance that can lead to systemic inequalities and genetic discrimination. In the absence of effective bioethical and legislative regulations, such instrumentalization could inaugurate new forms of coercive biopolitics, in which the individual becomes an object of social engineering and demographic planning with authoritarian overtones. Consequently, the need for a standardized technical-scientific framework that complements the ethical-legal dimension is becoming increasingly evident. Such a framework should include procedures for traceability of genetic interventions, through which each editing project is documented and reported in an international registry accessible to competent authorities. Traceability would serve not only transparency but also accountability, ensuring the ability to reconstruct the decision-making and technological chain in the event of incidents or non-compliant uses.

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In addition to traceability, it becomes essential to establish mandatory protocols for risk assessment and biosafety management, designed not to limit the development of biotechnologies in the military sphere but to guarantee that such use takes place under conditions of security and predictability. These protocols should operate within the logic of global biosecurity, setting uniform standards for laboratories, genomic data flows, and the circulation of scientific results, so that military applications of CRISPR-Cas9 remain compatible with the principles of scientific responsibility and international stability. Integrating such standards into an international framework requires the involvement of global organizations with normative authority and coordination capacity, such as the United Nations (UN) and the World Health Organization (WHO).

A major vulnerability is represented by the opening of a new market – the biotechnology market, especially the genetic economy. According to a report of the International Security Advisory Board, operating within the U.S. Department of State, even though the United States dominated the biotechnology sector for two decades, China has managed to narrow the research, development, and implementation gap in biotechnology solutions. This began in 2016 with the adoption of the 13th Five-Year Plan. China's progress in the biotechnology sector has been achieved through practices lacking transparency. Biotechnology research and development are funded and often subsidised by the state. The main purpose is to generate profit and align the biotechnology sector with the country's strategic interests. This contravenes the principle of open market and international scientific cooperation (U.S. Secretary of State, 2024, passim 16-20).

Given that it is a new economic sector, there is a major gap in both domestic legislation and international regulations. As a result, some states or communities may be exposed to exploitation through predatory practices. Likewise, the absence of state policies for coordination, control, and limitation could create major incidents and undermine individual security – or genetic security. For example, there have been cases, even starting at the end of the 20th century, of *"gene hunters"* in China. They collected DNA through blood samples from local populations to find certain genes relevant to the research and development process, generating commercial profit. At the height of the *"Gene War"* in China (between the Chinese scientific community, the Chinese government, and the *"gene hunters"*), the main actors had primarily financial interests in Chinese genetic resources. The local population, especially those with specific conditions who would have benefited the most from gene therapy, were ignored by both the actors involved and the media (Guo, 2013, pp. 497-499).

Usually, when referring to CRISPR-Cas9 technology, authors prefer to emphasize therapeutic benefits and applications for human augmentation. But this does not exclude the fact that CRISPR-Cas9 technology can acquire offensive capacities in the form of biological weapons. In Chinese military science, the idea of *"biological deterrence"* is currently being discussed, intended to amplify the destructive and lethal potential of war, even through *"ethnic-specific gene weapons"* (Kania, 2024, p. 92).

These fundamental problems – from the tension between U.S. and Chinese economic and research-development practices, to the militarization of *CRISPR-Cas9 technology* and its use to create weapons of mass destruction, to the lack of control and legal norms (a legislative void) – could lead to the amplification of an arms race, carried out chaotically and without constraints regarding bioethics or morality. From this point of view, if the arms race in genetic modification begins, it will turn into a zero-sum game, with no possibility of returning to today's status quo.

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CONCLUSIONS

The way wars are fought will constantly evolve, adapting to contextual requirements, political initiatives, and technological progress. Regardless of how it evolves, man remains a central element of war and of national defence. Whereas in the past, the human condition was considered a predetermined constant, the development of genetic modification technologies, such as CRISPR-Cas9, has created a connection between the natural and the artificial, allowing not only doctrinal or paradigmatic adaptation of the armed forces but also the adaptation of man himself to the evolutions of warfare.

Genetic modification, especially through the CRISPR-Cas9 process, is an emerging form of biotechnology that has not yet been fully explored – many specifications, particularly long-term ones, remain unknown. This does not prevent its research, development, or theoretical implementation. On the contrary, it is absolutely necessary to research this field and its ramifications beyond the biological or medical sphere before it is implemented on a large scale.

Political decision-makers and military leaders must keep pace with technological advances, particularly those in genetic modification. At present, a paradigm shift can be observed in the academic world. In the future, the concept of war and the role of the human being within it will be completely redefined. Man and technology will merge, and the operational environment will become increasingly diffuse.

Genetic modification through *CRISPR-Cas9* is no longer a simple complementary technology; it directly alters the human being. From this perspective, even though there is not yet a mass practical implementation, CRISPR-Cas9 technology requires much greater attention and effort, given the impact it carries on both humans and nature.

From a military perspective, it is important to monitor how warfare evolves, requiring the creation of solutions and responses to new problems such as the genetic arms race or the proliferation of genetic weapons.

Furthermore, genetic modification technology does not stop at humans; all living beings can be altered according to the desires, needs, and strategic imperatives of states or private actors who facilitate such solutions.From this point of view, it is necessary to approach genetic modification (especially of human beings) from the perspective of legal norms (both national and international). At present, the legislative void, lack of cooperation and transparency, and the scientific community's enthusiasm toward a new and revolutionary process may generate serious problems that will affect international security.

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The precedent for human genetic modification, particularly for adapting to the new type of techno-sentient warfare, has already been set. The issue is no longer stopping the implementation of genetic modification programs but controlling and limiting them. From this point of view, the implementation of human genetic modification will generate new international security problems, new challenges for territorial defence, as well as other problems of economic, legal, and political nature. In the future, research in the field of genetic modification requires a multidimensional approach, involving contributions from biology, medicine, economics, law, bioethics, and military sciences, considering that it is no longer merely a medical research topic.

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