Food for thought 10-2021

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The Evolution of the Augmented Soldier

AN EXPERTISE FORUM CONTRIBUTING TO EUROPEAN ARMIES INTEROPERABILITY SINCE 1953

FINABEL
European Army Interoperability Centre

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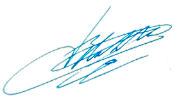
This Food for Thought paper is a document that gives an initial reflection on the theme. The content is not reflecting the positions of the member states but consists of elements that can initiate and feed the discussions and analyses in the domain of the theme. All our studies are available on www.finabel.org

DIRECTOR'S EDITORIAL

The EU's presence in the Balkan area has gone on for several decades, pre-dating European integration at a political level. As diverse member states jointly intervened under NATO guidance, military ties strengthened their grip setting the ground for a possible future military security for Europe. Kosovo specifically played a crucial role in the international acknowledgement of the need for a multinational approach among member states. Even though the CSDP promised an alternative to the transatlantic alliance, its deficits exacerbated the EU's increasing pluralism.

In light of this, militarily powerful European countries took action to enhance the possibility for Europe to take the lead in its military affairs. In particular, France and the UK were at the forefront of operations as KFOR, and the Eurocorps were partly successful in the region. Kosovo provided the perfect means to tackle the limits of the EU military, where results were primarily based on peacebuilding and stabilisation. The future of Kosovo remains an open question that could substantially affect the EU's military identity.
This paper aims to identify to what extent operations in Kosovo have shaped and integrated European military identity. By chronologically analysing the subsequence of steps taken in Kosovo towards this objective, it is possible to grasp overall progress in the field that is still missing the necessary interoperability to achieve long-lasting results. My intention through this work is to shed light on EU military achievements that are often disregarded and question whether such an identity is entirely desirable as the EU expands and pluralism increases.



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INTRODUCTION

The challenges armed forces face have not stopped evolving, and thus so do the technological advancements made by militaries to tackle those. Armies have tried to augment their capabilities with artificial accessories for centuries, and they have just recently started to see an exponential rise in progress. This paper will assess the baseline evolutionary development of augmented land-force soldiers. An augmented soldier can operate beyond normal human limits or abilities, either through chemical or mechanical enhancement. Mechanical enhancements regard artificial alterations and additions to the human body that aid in performing abilities more efficiently. Chemical enhancements or alterations are based on biological manipulations that expand standard human capabilities. We will start this paper with a historical overview of human augmentation for the battlefield. Chemical enhancements were already known to the Spartans, with their food culture, and the Vikings, with their hallucinogens. The German Imperial Knight von Berlichingen was well renowned for his prosthetic hand, which helped him become an admired German war hero. We will then look at the first effective use of mechanical enhancements and how the knowledge and technologies regarding exoskeletons and ocular enhancements evolved from viable options for everyday civilian use to the battlefield. Examples such as the HoloLens from Microsoft, known to United States soldiers as the Integrated Augmented Visual System, illustrate this civilian-military highway.

The same strategy will assess the state of chemical enhancements and mainly the use of pharmaceutical drugs and dietary supplements, as well as take a closer look at the ethical concerns surrounding these types of enhancements. Nowadays, pharmaceutics can help a soldier increase his cognitive functions, reflexes, and brain stimulation. This can, for example, allow a soldier to better and faster discriminate between friend and foe. More long-term solutions are also being developed, such as gene-doping, which for one will increase muscle growth. Mechanical as well as chemical enhancements can not only elevate a soldier's capabilities but can also prevent future physical and psychological health issues. Still, lately, concerns have arisen regarding the modification of soldiers' cognitive and emotional responses and the effects on their ability to still follow international law and their commanders. The same concerns also exist regarding the irreversible changes and possible damages when the human body is permanently modified. Before finishing with our conclusions, we will look at the latest developments and the future for the augmented soldier. An 'Iron-Man' like suit known as the TALOS, which combines an exoskeleton and ocular enhancements, illustrates the path soldier augmentation has taken, fusing and connecting what are today still separate technologies. The technological challenges these augmentations face are still many and will also be addressed in this part. Throughout the paper, examples of such augmentations will be used to illustrate mechanical and chemical enhancements, which, for the most part, stem from programmes from the main military powers in the world such as the United States, Russia, France, and China.

BACKGROUND

The history of the augmented soldier dates back to antiquity and the founding of the conventional military structure of people groups. These examples persist throughout historical development and contribute towards the comprehension and intersplicing of military doctrine with the training of the rank-and-file soldier. These examples, when analysed, aid in developing a comprehensive overview of the evolutionary integration and development of the contemporary conventional land forces soldier. From ancient Sparta to Rome, augmentation of combat-ready troops has been progressively developed, along with equipment and biological aids used to further this military mandate aim.

Initially, this augmentation came in the form of equipment superiority and intensive nutrition guidelines for physically developing formidable fighters. Within ancient Sparta, the hoplite forces possessed superiority over their foes through these rudimentary augmentations developed by a rigorous tradition of militarism. This proto-bioengineering of macro diet implementation of hoplite soldiers during the classical Greek period reached its zenith during the 5th century BC during the Peloponnesian Wars with the Athenian led Delian League. The diet encompassed a rigorous array of nutrient-rich food groups, which contributed to the physical development of the soldier's anatomy and strength. Spartan food culture was rooted in this principle of contributing to the military prowess of the soldier, and mostly removed from the perception of food as pleasure.[1]

This diet typology contributed towards the different functions and needs of a formidable fighting soldier. The combination included a heavy dietary emphasis on olives, harvested from Laconia, which supplied a rich source of monounsaturated fats, along with anti-antidote, heart health, and healing properties. Heavily diluted water with wine was included in the unit diet to provide further antioxidant components and ample hydration. Figs provided even more antioxidants, phytosterols, iron and calcium for strength, energy, and bone density. Spartan powder consisted of ground cereals, notably from barley rolls, providing cholesterol and blood sugar stabilisation, mitigating blood loss on the battlefield by providing a means to clot wounds faster. The black broth of the Spartans was a central mainstay of biological augmentary aids to the soldiers' diet. It was composed of pork dough, barley flour, salt, vinegar, and pigs' blood, immensely rich in vitamins, nutrients, and minerals and was incorporated as a starting meal of the soldier's day.[2]

1. Sarantos Kargakos, The History of Ancient Sparta (Athens: Gutenberg, 2006), 27.
2. J.G. Lazenby, The Spartan Army (Mechanicsburg: Stackpole Books, 2012), 43.

Further biological augmentation additions towards battlefield capabilities of soldier abilities can be witnessed in early Middle Ages Viking berserkers. These warriors consumed chemical aids, which are theorised to have elucidated intensive aggression in battle, fearlessness, and numbness to pain. The range of scholarly assumptions is embroiled in the debate about which of its components directly contributed towards this phenomenon. This dubbed 'berserker rage' is theorised to have been induced by consuming hallucinogenic mushrooms, the plant species *hyoscyamus niger* (also known as Nightshade), or copious amounts of alcohol.[3] The evidence for such consumption derives from literary and archaeological site findings.[4] Ethnobotanical chemical analysis of the military consumption of *hyoscyamus niger* suggests that the elucidation of aggression in battle, compounded with fearlessness, reflected a potent bio augment aid for the Viking berserker warriors. These elements significantly increased the endurance, strength, and formidability of land force soldiers of the Viking Age. The consumption of the plant also acted as a means to catalyse victories in psychological conceptions of Viking warriors by their adversaries.[5]

Mechanical augmentations within the parameters of the defined limits of mechanical augment typology have evolved substantially from basic medieval foundations of mechanical prosthetics utilised as military aids for soldiers in battle. The prime case example of this historical basis can be analysed within the prosthetic hand of the German Imperial Knight Gottfried von Berlichingen. This late medieval soldier engaged in an active military career of 47 years and became an iconic German war hero with an extensive cultural resonance for later German combatants. Notable of the image of this soldier was the prosthetic mechanical arm fitted to allow the medieval knight to continue his effectiveness in battle as a viable unit on campaign. This example of the von Berlichingen 'War Glove' became a basis of iconic military application of mechanical augment aims and possessed resonance within the German historical military psyche.

The mechanical prosthetic went through two iterations of design and replaced his right arm, lost due to cannon fire at the siege of Landshut. The mechanical design was intricately and explicitly created to allow the soldier to regain the ability to handle his weapon in battle and reintegrate into the fighting unit structure through renewed mechanical capabilities, thwarting the detrimental effects of losing a limb. The first device encompassed a more rudimentary initial design; however, the second version vastly updated its dexterity. This enabled von Berlichingen to regain full range of motion, utilising objects ranging from shields to horse reins and pen quills. It also reintegrated him into the field, allowing the knight to continue his military career as an active combat unit for several more years.[6]

The robust design of von Berlichingen's mechanical military augmentation became one of the first examples of a soldier regaining intricate levels of individual finger dexterity. However, the rudimentary basis of understanding the complex mechanical design implementa-

3. Robert Wernick, The Vikings (Alexandria: Time-Life Books, 1979), 285.
4. Neil S., Price. "The Viking way: religion and war in late Iron Age Scandinavia." Uppsala Universitet. Uppsala: Dept. of Archaeology and Ancient History (2002): 27.
5. Karsten Fatur. "Sagas of the Solanaceae: Speculative ethnobotanical perspectives on the Norse berserkers." Journal of Ethnopharmacology (2019): 244.
6. E. Paul Zehr, Inventing Iron Man: The Possibility of a Human Machine, (Maryland, JHU Press, 2011), 27.

Source: https://commons.wikimedia.org/wiki/File:Hybrid_Assistive_Limb,_CYBERDYNE.jpg

Hybrid Assistive Limb, CYBERDYNE, 2010
Yuichiro C. Katsumoto

tion can be witnessed in earlier examples of antiquity. These examples derive from a range of evidence-based materials, from archaeology to literary sources. The most notable of these findings include the Classical Roman '*Capua Leg*', held at the Royal College of Surgeons, London. This rudimentary prosthetic from 300 BC was created from bronze and was purported to be utilised by Roman surgeons to aid patients to regain their full range of motion.[7] This evidence is further compounded with a basis of understanding through the 400 BC literary text On the Articulations by Hippocrates, a basis through which the understanding functional utilisation of ligamenture allowed for effective mechanical usage of prosthetics. The late medieval 'War Glove' derived its evolutionary basis of intricate dexterity from this proto-augmentary research of the Classical age.[8]

This preliminary historical basis of understanding the augmentations of land force units in combat is imperative towards eliciting clarity of progressive evolution of both biomechanical and mechanical systems. These systems have all served particularly military functions and applications to aid the needs of land force soldiers on the battlefield. The early modern period consists of a framework approach that forms a plateaued basis of development towards the contemporary era. The core mechanical basis of augmented soldier systems exists within anatomic aids, such as exoskeletons. These systems have altered the strategic conceptualisation of the functions and abilities of the land force unit. The historical development of this augmentation derives from preliminary studies of the late 19th century, specifically 1890, through research undertaken in assisted mechanical mobility by Nicholas Yagin, an imperial Russian engineer. These passive systems possessed an early hydraulic functioning of passive movement aids utilising compressed gasbags.[9]

The exoskeleton serves as the epitome of mechanical land force unit augmentation and drastically changes the abilities and capabilities of combat-ready units. The next iteration of its evolutionary development incorporated a synthesis of both human and external power.

7. Hartmut F. Hildebrand, "Biomaterials – a history of 7000 years", BioNanoMat (2013); 14(3-4): 119–13, 122.
8. Hippocrates, On the Articulations, 52.
9. Yagin, Nicholas, 1890. Apparatus for Facilitating Walking, United States of America. 440,684, filed February 11, 1890 and issued November 18, 1890.

It was created in 1917 by American inventor Leslie C Kelley.[10] It was dubbed the 'pedometer', the device that utilised steam power in tandem with human movements functioning through parallel artificial ligaments. This advancement further accelerated in 1960 with the production of the 'Hardiman' suit, an advanced research project undertaken by General Electric and the US Armed Forces. The augmented system vastly increased the strength capabilities of the wearer and increased lifting power by a factor of 25, equating lifting 110 kilograms to lifting 4.5 kilograms. Powered by electricity and hydraulics, the exoskeleton allowed for manipulating force and objects through a system called force feedback. However, the practical limitations of its application in the field hindered its final success as a project. Its slow speed of 2 mph and heavy weight of 680 kilograms made its combat readiness entirely impractical. The primitive software utilised a slave-master system with a double-layered suit design. It was susceptible to detrimental bugs, such as violent and uncontrollable movements when two legs were moved at once.[11]

In tandem with military development and the evolution of the exoskeletal system, medical research into the orthopaedic applications of assisted mobility suits informed the baseline evolutionary development of their practical usability and success in achieving fieldwork aims of Yugoslavian research conducted during the 1960s. This incorporated the medical application, strengthening evolutionary usability of the exoskeleton system for use, notably during projects led by Prof. Miomir Vukobratović of the Mihajlo Pupin Institute in Belgrade.[12] In the late 20th century, these designs would further inspire conceptual proposals at military research institutes such as the Los Alamos National Laboratory in 1985.[13] This concept, developed by research engineer Jeffrey Moore, formed the first integrated approach towards an external mechanised armoured suit for infantry soldiers that incorporated augmented cybernetics, which would aid in audio-visual capabilities for the unit in combat.[14] In 1986, the contemporary realisation of a practical, supportive augmented exoskeletal design was initiated by former U.S Army Ranger, Monty Reed, who was inspired after an accident that had led to him breaking his back. The latest fully assisted iteration can practically operate at an average speed of 2.5 miles per hour and can carry 92 kilograms for the user.[15]

During the early modern period, land force soldiers' biochemical enhancements were often utilised to fit a very specific combat purpose. These functions ranged from endurance-boosting over increased aggression to increased fearlessness in battle. The inclusion of chemical supplements to evoke these aims have been incorporated into the armed forces of a wide array of nation-states and have held varying degrees of success in the field. During the mid-20th century, the inclusion of chemical stimulants became standardised in use for frontline combat infantry forces, notably

10. Kelley, C. Leslie. 1919. Pedomotor. United States of America.. 1,308,675 filed April 24, 1917 and issued July 1, 1919.
11. Makinson, B. J., "Final Report On Hardiman I Prototype For Machine Augmentation Of Human Strength And Endurance". Defense Technical Information Center. (August 1971): 32.
12. Renann Baldovino; Rodrigo, Jr. Jamisola, "A survey in the different designs and control systems of powered-exoskeleton for lower extremities",. Journal of Mechanical Engineering and Biomechanics, Rational Publication. 1 (4) (2017): 103–115. doi:10.24243/JMEB/1.4.192.
13. Hecht, Jeff. "Armour-suited warriors of the future", New Scientist: Issue 1527, November 25th, 1986.
14. Moore, Jeffrey A. " PITMAN, a Powered Exoskeletal Suit for the Infantryman". Los Alamos National Laboratory Arms and Armor, (1986): 1-15.
15. K Reed, Monty. "LIFESUIT Exoskeleton Gives the Gift of Walking so They Shall Walk". IEEE Global Humanitarian Technology Conference (2014): 382–385.

during WW2, where both the Axis and Allied forces utilised stimulants to achieve these pre-established combat aims. Benzedrine was incorporated into Allied usage for its performance-enhancing and stimulant effects for infantry units on the battlefield.[16] The *Wehrmacht* forces, utilised *Panzerschokolade* (tank chocolate) for its infantry forces, which incorporated methamphetamine into chocolate bar rations for land forces.[17]

Further advancements in biochemical augmentary aids for land force soldiers arose in the later WW2 period, in the form of D-IX pills, which included stimulant ingredients such as cocaine, oxycodone, and methamphetamine, which were used by German forces.[18] This inclusion of drugs for armed force usage was justified by the successes of the earlier used methamphetamine-based Pervitin.[19] The lead German researcher, Wolf Kemper, had aimed to create an augmentary biochemical to "redefine the limits of human endurance".[20] The project provided soldiers with increased strength, endurance, and aggression in battle, with test subjects at Sachsenhausen concentration camp able to march for up to 90 kilometres per day without rest while carrying a 20-kilogram backpack.[21]

This historical background context is imperative for further understanding the evolutionary process of development of contemporary augmentary aids of land force combat units. The historical lineage overview serves to clarify context towards understanding the fundamentals of cont**emporary mechanical and biomechanical augmentary aids, as their implementation within the field**s archives practical usability.

MECHANICAL ENHANCEMENTS

In this part, we will take a closer look at what mechanical enhancements can be used by soldiers. We will mostly focus on two types of enhancements: exoskeletons and ocular enhancements, best illustrated by the United States Army's Integrated Visual Augmented Goggles (IVAS).

Exoskeleton's Development: From Civilian to Military Use

A first and simple definition of an exoskeleton would be 'robotic devices that can be worn by the user and that work in synchrony with the body part or parts the skeleton is supposed to support'. Exoskeletons can support the user with the capabilities and reliability whilst reducing the strain put on the body. Today, exoskeletons can be divided by the body part they are supposed to support and second whether they are passive or active exoskeletons. An

16. Rasmussen, Nicolas. "Making the first anti-depressant: amphetamine in American medicine, 1929–1950". J. Hist. Med. Allied Sci. 61 (3) (2006): 288–323.
17. Lukasz Kamie'nski, Shooting Up: A History of Drugs in Warfare, (Oxford, Oxford University Press, 2017), 145.
18. Lawrence Paterson, Weapons of Desperation: German Frogmen and Midget Submarines of World War II. (London, Chatham Publishing, 2006), 16.
19. Lukasz Kamienski, Shooting Up: A Short History of Drugs and War, (Oxford, Oxford University Press, 2016), 111–13.
20. Dessa K. Bergen-Cico, War and Drugs: The Role of Military Conflict in the Development of Substance Abuse, (New York, Routledge, 2017) 111.
21. Armin Krishnan, Military Neuroscience and the Coming Age of Neurowarfare, (New York, Routledge, 2016), 34.

active exoskeleton is assisted by, for example, electronics or hydraulics, and a passive exoskeleton only supports the human body and usually helps divert the strain on the body to the ground.[22]

The interest in exoskeletons started to feed into development efforts in the mid-1960s. However due to a lack of knowledge and suitable technologies, viable prototypes only appeared in the early 21st century. The first functional exoskeleton saw the light as a piece of medical equipment that helped stroke or spinal cord injury patients during their rehabilitation. The 'Lokomat' produced by HOCOMA AG is one of the first examples of a product that gives the patients an improved chance of walking again and facilitates the physical therapists' task of assisting their patient in doing so. The use of exoskeletons in the medical field has persisted throughout the years. Today, they are used for rehabilitation purposes and by patients who have no chance of ever walking again on their own. Since 2010, many such products have entered the market, making it possible for differently-abled persons to walk again and not be dependent on their wheelchairs anymore. With the rise in popularity of exoskeletons, not only for medical personnel, but also for civilian use, a greater number of certifications reinforce trust in these products and result in increased sales for the companies producing them. The greater number in sales has consequently allowed companies to increase their Research and Development budgets.[23]

More recently, manufacturing plants have expressed an interest in exoskeletons. Indeed, companies have been looking at different types of exoskeletons to make their employees work easier and especially make their bodies less demanding. This is where the types of exoskeletons split into different categories, usually by the body part they support. This can refer to the lower or upper body, or even just a particular joint that gets overly taxed during the manufacturing process. Using an exoskeleton will reduce the wear and tear in that body part and thus prevent further health issues at a later stage in life.[24] In 2017, the Ford Motor Company started trialling upper-body exoskeletons in their line assembly plants. Workers who work on suspended car frames get to wear the Ekso vest by Ekso Bionics, which assists them in lifting their arms above their heads while holding tools, diverting the weight to their legs, and reducing the strain on their upper limbs. Ekso Bionics demonstrates the industry trends, as the company is known for their medical exoskeletons that help paraplegic patients. Yet, they saw the potential exoskeletons can have for able-bodied assembly workers.[25]

More recently, militaries around the world have started to seriously consider exoskeletons for their soldiers. Most notably, the US Army has already started testing different manufactures and types of exoskeletons and suits. The well-known weapons manufacturer Lockheed Martin is at the forefront of the US exoskeleton program. They entered the stage first with their Human Universal Carrier (HULC), a lower limb active exoskeleton weighing 32kg

22. Jia-Yong, Zhou, "A preliminary study of the military applications and future of individual exoskeletons", Journal of Physics: Conference Series, 1507, (2020): 1-3.
23. EDUEXO: The Robotic Exoskeleton Kit, "A Brief History of Robotic Exoskeletons", Available at https://www.eduexo.com/resources/articles/exoskeleton-history/
24. Ibid.
25. Medgadget, "Ford Trialling Exoskeleton to Help Factory Workers Avoid Injuries", Available at https://www-proquest-com.ezproxy.ulb.ac.be/docview/1962320894?pq-origsite=primo

with a capacity to increase the effective payload of a soldier by 91kg,[26] with a battery that lasts for 20 kilometres. The system uses an electric battery as its power supply for a hydraulic system that makes the exoskeleton move in concert with the users' body.[27] More recently, American soldiers have started testing a lighter version of such an exoskeleton from Lockheed Martin, the ONYX. Like the HULC, the ONYX is an active exoskeleton that helps increase soldiers' payload, mobility, and endurance, therefore considerably reducing fatigue. The exoskeleton also helps soldiers keep a straight posture whilst walking with heavy loads and diverting strain to the legs and ground, further reducing the risk of later health issues related to the overuse of their body. An important benefit of the ONYX is its weight, as it is almost 26kg lighter than its predecessor, weighing only 6.4kg.[28] [29] The skeleton is also fitted with a myriad of sensors that identify the terrain the soldier is on and the movements he is making, with computers then activating the necessary parts of the exoskeleton to best aid the wearer. Future generations of exoskeletons follow the approach taken by the ONYX, becoming even lighter and adding more sensors that will allow for continuous monitoring of the soldiers' vital parameters. The Russian K2 exoskeleton has already been utilised in the field during mine detection missions in Syria.[30] The US has plans to start fielding exoskeletons to a select few of their units by the end of 2021.[31]

It seems that exoskeletons will allow soldiers to be more effective on the battlefield, specifically by carrying more payloads and marching longer distances over more complex terrains. Coupled with other technologies, such as visual aids and wearable sensors, the future soldier will be able to do more and endure less unnecessary risk and, in the event of injury, be assisted better.

Visual Augmentation: Microsoft and the Military

Although scopes have been an accessory known to soldiers for over a century now, and they underwent some important advancements such as integrated range finders and night vision, a soldier's eyes still have their limitations, even when assisted by scopes. Those limitations, like obstructions such as vehicles, obstacles, or smoke, and being unable to share the images you see with the rest of your crew, are some of the challenges visual augmentation devices such as the American Integrated Visual Augmentation System (IVAS)program try to surmount.

The IVAS is expected to be used on the battlefield by approximately 40,000 US soldiers by the end of 2021. Based on the Microsoft HoloLens, the IVAS takes Microsoft's technologies and enhances and ruggedises them for the battlefield. The HoloLens has already been in use in the manufacturing, healthcare, and education sectors. Lockheed Martin themselves use Microsoft's technologies in their manufacturing plants, as does Mercedes. Doctors

26. EDUEXO: The Robotic Exoskeleton Kit, "A Brief History of Robotic Exoskeletons", Available at https://www.eduexo.com/resources/articles/exoskeleton-history/
27. Lockheed Martin, "Lockheed Martin's HULC (™) Robotic Exoskeleton Enters Biomechanical Testing At U.S. Army Natick Soldier Systems Center", available at https://news.lockheedmartin.com/2011-06-30-Lockheed-Martins-HULC-TM-Robotic-Exoskeleton-Enters-Biomechanical-Testing-at-U-S-Army-Natick-Soldier-Systems-Center
28. Lockheed Martin, "Exoskeleton Technologies", available at https://www.lockheedmartin.com/en-us/products/exoskeleton-technologies/military.html
29. Sydney J. Freedberg Jr. "Lockheed, Army To Test Exoskeleton In December", Breaking Defense, 24th May 2018, Available at https://breakingdefense.com/2018/05/lockheed-army-to-test-exoskeleton-in-december/
30. EDUEXO: The Robotic Exoskeleton Kit, "A Brief History of Robotic Exoskeletons", Available at https://www.eduexo.com/resources/articles/exoskeleton-history/
31. Lockheed Martin, "Lockheed Martin's HULC (™) Robotic Exoskeleton Enters Biomechanical Testing At U.S. Army Natick Soldier Systems Center", available at https://news.lockheedmartin.com/2011-06-30-Lockheed-Martins-HULC-TM-Robotic-Exoskeleton-Enters-Biomechanical-Testing-at-U-S-Army-Natick-Soldier-Systems-Center

in the United Kingdom also make use of holographic technology to better take care of their patients. The most notable feature of the HoloLens and IVAS is the ability to see and provide information whilst having your hands free to accomplish parallel tasks. The system is now supposed to be used by mounted as well as dismounted soldiers. Primarily, the soldier will see a feed coming from the cameras on the front of the goggles themselves. However, if part of a motorised squad, the soldier will also be connected to cameras outside said vehicle. This has two main benefits. First, the command can have a steady feed of what their forces are seeing and adapt their tactical approach from afar. Second, for mounted squads, they will see the drivers view or even a 360° view of the vehicle's surroundings. Thus, they will have an enhanced situational awareness when exiting an armoured vehicle at an unknown location. With the IVAS, they can see a real-time feed of the surroundings and potential threats before being exposed to them.

Furthermore, the goggles are fitted with an integrated Heads-Up Display (HUD) that provides the user with information whilst allowing them to keep eyes on the objective, thermal and night vision, and the ability to discriminate between friendlies and enemies more quickly.[32] The IVAS will also be of great help for military medics, as they can see images of their patient's anatomy whilst they are treating them.[33]

Visual augmentation will enhance a soldier's ocular capacities and provide them with information without them having to take their eyes off their objective or their hands from their weapons.

Smart Textiles, a Project Spearheaded by the EU

Up to this point, we have not mentioned the EU a lot. However, there are projects regarding the augmentation of soldiers in which the EU is a leading pacesetter. Recently, a prototype named Smart TextILEs (STILE) started testing in the field. The goal of such textiles is to make the soldier's uniform into more than just a simple piece of clothing. Indeed, uniforms made from smart textiles like STILE will be able to physiologically monitor the soldiers and send the information to their operations commander, which is particularly important in case of injury. Smart textiles will also better protect their wearer, more specifically against toxic gases, weather, fire, and insect bites. The clothes will also regulate temperature by adapting the soldier's body temperature to the environment. Furthermore, they will be able to adapt their camouflage to the environment and the soldier's movement.[34]

These three mechanical enhancements already provide some soldiers with more capabilities and keep them safer on the front lines, all whilst executing more functions with less effort than before.

32. Jared Keller, "The Army's next-generation Headset is almost ready for prime time", Task and Purpose, 3rd November 2020, Available at https://taskandpurpose.com/news/army-integrated-visual-augmentation-system-soldier-touchpoint/
33. Leuze, Christoph et al., "Augmented reality visualization tool for the future of tactical combat casualty care", Journal of Trauma and Acute Care Surgery, August 2021 - vol. 91, n°2, (2021): 40-45.
34. European Defence Agency (EDA), "EDA project aims for multifunctional smart textile for defence", available at https://eda.europa.eu/news-and-events/news/2020/05/27/eda-project-aims-for-multifunctional-smart-textiles-for-defence

Chemical and biological engineering and augmentation, in contrast to its mechanical form, are modifications carried out on the actual body rather than technological accessories added on to it. This can take various forms, from the application of medicines or substances to improve performance in certain areas to supplement the body's production of certain desirable hormones, and even the alteration or manipulation of genes. With rapidly advancing medical and chemical technology and scientific knowledge, the possibilities for applying such methods to augment the human body are vast. Forms of this type of augmentation have been applied since ancient times. Today, its most common form is the use of pharmaceutical drugs and dietary supplements - for example, caffeine to maximise short-term energy, painkillers to help with injuries or anti-depressants. While what has been carried out in the military field in this sense is currently quite limited and somewhat confined to the hypothetical, the idea of chemically and biologically augmented soldiers seems to be gaining increasing currency; as such, it is receiving growing interest and investment from governments.

Countries such as the US, China, and more recently France are researching methods for the augmentation of soldiers. China is actively "using gene-editing tech to enhance human performance" - a practice that is speculated will ultimately be used for military purposes as well.[35] The technology used for this involves a tool called Clusters of Regularly Interspaced Short Palindromic Repeats (CRISPR) which can alter or 'edit' genes and has mainly been used either to genetically modify crops or to cure genetic and hereditary conditions among patients. However, as Kania and VornDick report, military researchers in China have also shown an interest in the process.[36] Likewise, a drug called Modafinil - a eugeroic traditionally used to treat narcolepsy and daytime sleepiness - has also been explored as a means of improving cognitive function, reflexes, and brain stimulation.[37] This, if used to significantly augment the performance of soldiers, can be a major military asset.

France, partly as a response to the use of these developments in China and their future military potential, has also been researching soldiers' biological and chemical engineering. In December 2020, Defence Minister Florence Parly said that "not everyone shares our scruples and we must be prepared for whatever the future holds" when referring to the possible future development of augmented soldiers by non-allied states.[38] Likewise, the military ethics committee that approved further research into biological and chemical engineering has reported that the utilisation of such practices for military purposes is quite plausible in the medium to long run. This report makes men-

35. Ken Dilanian (2020). 'China has done human testing to create biologically enhanced super soldiers, says top U.S. official', NBC News, 3 December 2020 [online]. Available at https://www.nbcnews.com/politics/national-security/china-has-done-human-testing-create-biologically-enhanced-super-soldiers-n1249914

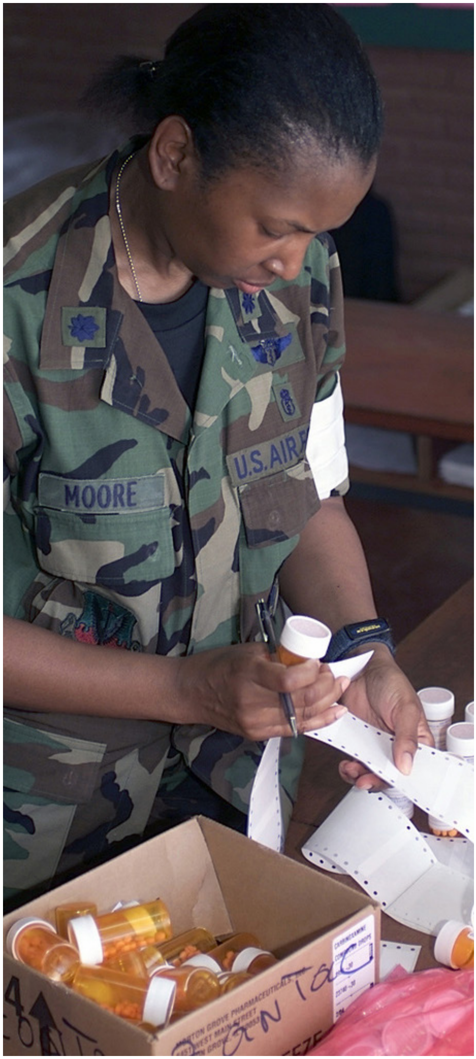
36. Elsa Kania and Wilson VornDick, 'China's Military Biotech Frontier: CRISPR, Military-Civil Fusion, and the New Revolution in Military Affairs', Jamestown Foundation: China Brief, 18 Vol 29 (October 2019)

37. Elsa Kania and Wilson VornDick (2019). 'Weaponizing Biotech: How China's Military Is Preparing for a "New Domain of Warfare"', Defense One, 14 August 2019 [online]. Available at https://www.defenseone.com/ideas/2019/08/chinas-military-pursuing-biotech/159167/)

38. BBC News (2020), 'France to start research into "enhanced soldiers"', 9 December 2020 [online]. Available at https://www.bbc.co.uk/news/world-europe-55243014

tion of "medical treatments" and "implants" to enhance "physical, cognitive, perceptive, and psychological capacities",[39] as well as methods to improve "cerebral capacity" and soldiers' ability to accurately distinguish between allies and enemies with minimal analysis. The occurrence of phenomena, such as civilian collateral damage or the "green on blue" attacks that targeted NATO forces in Afghanistan, would be reduced in the future.[40] Other enhancements, such as neural implants, would allow for patients' vital signs to be monitored and any sudden changes to be counteracted through the release of the appropriate chemicals; this too could be transferred to a military environment quite easily. In addition, substances that can dampen sensations of pain, stress, and exhaustion and "improve mental resilience if a soldier were taken prisoner"[41] can prove crucial in creating an enhanced 'super soldier'. The fact that the physical and mental toll of combat can be a considerable obstacle in military operations, alongside the dangers posed by soldiers being captured by enemy forces, would give an army boasting these enhancements a massive advantage.

The injection of genes, so-called "gene-doping",[42] hormones, or chemical substances into the body can also be important factors in the future of biological and chemical augmentation. Qualities such as physical strength, endurance and stamina, muscle mass, and pain tolerance can be potentially improved drastically through applying genetically modified genes into muscle. The hormone Erythropoietin has been shown to increase the mass of



Source: https://picryl.com/amp/media/lieutenant-colonel-ltc-verba-moore-usaf-commander-99th-aerospace-medical-squadron-517432

Lieutenant Colonel (LTC) Verba Moore, USAF, Commander, 99TH Aerospace Medical Squadron, Nellis, AFB Nevada labels prescription drugs during the medical exercise at Cerro Membre, Paraguay during Exercise NEW HORIZONS, 2001

The US National Archives

39. Jack Guy (2020), 'French army gets ethical go-ahead for bionic soldiers', CNN, 9 December 2020 [online]. Available at https://edition.cnn.com/2020/12/09/europe/french-army-soldiers-technology-ethics-scli-intl-scn/index.html
40. BBC News, 'France' [online]
41. Jack Guy, 'French army' [online]
42. G. R. Gaffney and R. Parisotto (2007). 'Gene Doping: A Review of Performance Enhancing Genetics', Pediatric Clinics of North America, 54, 807-822.

red blood cells and thus their ability to deliver oxygen; this would greatly improve endurance-based feats, such as cardio performance and stamina, while significantly reducing fatigue and delaying exhaustion in military operations.[43] Muscle mass and strength can be increased via Insulin-like Growth Factor 1 (IGF-1), a treatment known to have worked on ageing laboratory mice with muscle wasting. In addition, since rapid muscle growth is inhibited beyond a certain level by Myostatin, counteracting this hormone through an antibody can help attain quick and substantial gains in muscle mass. The injection of genes that create Analgesic Endorphins could increase pain tolerance and act as anti-inflammatories, potentially promoting easier healing in the process.[44]

LATEST DEVELOPMENTS OF AUGMENTED REALITY IN MILITARY APPLICATIONS

Modern warfare has seen a significant shift with the onset of the 21st century, as military operations have become more diverse and intense. Much progress has been made in the Information Technology (IT) field, resulting in innovations like Augmented Reality (AR). In military application, this can improve a soldier's battle-space knowledge, as real-world objects and environments can then be augmented to create better training sessions for the soldiers and help them adapt to complex conditions.[45] Therefore, the defence sector has entered the Biotech age,[46] marked by the decisive role of human augmentation, focusing on making the human platform match that of the machine. Indeed, the quest for advantage over adversaries has been the driver for developing military platforms and technologies.

A 2015 paper by Perkins and Steevens made a number of predictions for the use of chemical and biological engineering by 2025. They speculate that by then, it will be possible to "prescreen" soldiers for "potential vulnerabilities and diseases" through DNA testing, making it possible to engage in prevention and create tailor-made treatments.[47] Soldiers can also be screened for their "susceptibility or tolerance" to PTSD;[48] as a result, those found to be more vulnerable or likely to display more severe symptoms could be monitored and provided with the necessary clinical support. Another area in which medical knowledge is advancing rapidly, and will likely continue to do so, is the human microbiome. The paper predicts that by 2025 it will be possible to manipulate the microbiome and gut bacteria to positively affect a number of qualities in soldiers, such as "learning capacity", "alertness",

43. Jared M. Stafford, James J. Valdes and Aleksandr E. Miklos (2016), 'The Real Captain America: Bioengineering the Super Soldiers of Tomorrow', Small Wars Journal, 16 August 2016. Available at https://smallwarsjournal.com/jrnl/art/the-real-captain-america-bioengineering-the-super-soldiers-of-tomorrow
44. G. R. Gaffney and R. Parisotto, 'Gene Doping', 807-22.
45. S. Gurusubramani et al., "Augmented Reality in Military Applications", International Journal of Engineering and Advanced Technology, October 2019 - vol.9, n°1, (2019): 51-54
46. UK Ministry of Defence, (2021). 'Human Augmentation - The Dawn of a New Paradigm'. [online] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/986301/Human_Augmentation_SIP_access2.pdf
47. Edward J. Perkins and Jeffrey A. Steevens, 'Future Applications of Biotechnology', Small Wars Journal, 22 October 2015. Available at https://smallwarsjournal.com/jrnl/art/future-applications-of-biotechnology
48. Ibid.

and "ability to perform in a stressful environment". [49] Limited gene therapy - short of the form of editing carried out in China - might also be implemented to "reduce personal sensitivity"[50]and negative reactions to any number of substances or environments. This can remove many obstacles that can otherwise inhibit the peak physical and mental performance of soldiers in the field. Taken further, this might allow soldiers in the more distant future to attain immunity to substances or physical environments that would normally be considered toxic or near-lethal. Finally, bio-manufactured 'tattoos' might also be a feature by 2025. These would be able to sense soldiers' vital signs for stress, hydration levels, fatigue, and fear, as well as responding by "producing" or "releasing" [51] the hormones or molecules necessary to balance physical needs and eliminate sensations that can cloud their performance or judgement.

Nonetheless, ethical concerns mean that there will be clear limits to how far biological and chemical engineering will be explored in most countries. The French authorities have forbidden any enhancement that might "affect a soldier's ability to manage the use of force", as well as anything "affect[ing] their sense of humanity".[52] Similarly, the ethics committee that approved research on enhanced soldiers in late 2020 simultaneously ruled out "eugenic or genetic practices", which could render a soldier's DNA permanently altered and "jeopardise… [their] return to civilian life".[53] The US Defence Department has also ruled out permanent genetic enhancement, saying that it is focusing on "Iron Man, not Captain America" - in other words, the enhancements are to be added but not permanently.[54] Enhancements affecting the personalities and morals of soldiers can also be a concern.

Given that modern soldiers are required by international law to act within a certain framework and moral code, and are trained accordingly, a chemical or biological augmentation that reduces the soldiers' commitment to these principles can be dangerous. For example, while remorse might be an obstacle to soldiers' performance, the use of enhancements that eliminate it can lead to a lack of regard for both comrades, civilians, or the human rights of enemy forces. Moreover, the use of mind-altering drugs can take away soldiers' free will, which would in itself be a violation of their human rights and the principle of "informed consent" enshrined in the state-soldier social contract according to the principles of liberal democracy.[55] Thus, any form of mind-altering engineering might run the risk of significant controversy and undesirable results.

The potential side effects of such treatments (mainly chemical ones) are also likely to be a significant obstacle, creating ethical concerns, and reducing the desirability of some augmentations. In China, the pioneering research of a scientist who 'edited' the genes of two babies to provide them immunity to HIV, was faced with harsh backlash from scientists and authorities due to the negative

49. Ibid.
50. Ibid.
51. Ibid.
52. Jack Guy, 'French army' [online]
53. BBC News, 'France' [online]
54. Jon Harper, 'How Technology Could Create 'Super Soldiers''. National Defense 101, no. 753 (August 2016), pp. 32-5.
55. Jo Bird and Greta Bird, 'Human Rights and the Military: The "Chemical Soldier"', Alternative Law Journal 30 vol. 2 (April 2005)

side effects on the babies' cognitive development.[56] He was eventually sentenced to prison as his research was found to have violated several government bans.[57] Since the science of biological and chemical engineering is currently largely in its experimental stage, likely, any long-term effects of an enhancement that might seem beneficial in the short run would be unknown. If there is any significant risk of long-term harm from an augmentation, it is highly unlikely that it would see the light of day.

However, not all governments have the same red lines. While gene-editing technologies like CRISPR are unlikely to receive all-encompassing ethical approval in the US and Europe, China seems to have progressed further in this field due to looser controls. In late 2020, John Ratcliffe, the US Director of National Intelligence, claimed that "there are no ethical boundaries to Beijing's pursuit of power" in reference to the country's use of genetic enhancement.[58] Given the unease with which many policy-makers elsewhere view these developments in China and the shift in the balance of power it might present, a scenario might arise in the future where the states currently reluctant to follow suit eventually loosen their ethical guidelines and commit to more comprehensive augmentation, including gene editing.

The use of biological and chemical engineering to create augmented soldiers is something that, similar to the mechanical aspect, seems to have a great deal of mostly untapped potential for the future. It seems to be a field of research that governments and militaries will be increasingly interested in looking into. Nonetheless, its advancement is likely to face more obstacles than its counterpart mechanical engineering due to the ethical dilemmas and risks it can present. Authorities will probably seek a middle ground that reconciles the advantages of biologically and chemically enhanced soldiers with established human rights laws and military ethics.

On the other hand, Washington is no stranger to human-machine integration. As early as 2003, the then director of the Pentagon's research arm, the Defense Advanced Research Projects Agency (DARPA), Anthony J. Tether, stated the importance of human enhancement for the American armed forces.[59] In 2006, DARPA launched the Revolutionizing Prosthetics (RP) program to expand prosthetic arm options for wounded soldiers.[60] The programme funded two teams to create advanced anthropomorphic mechanical arms and control systems. The DEKA Research and Development Corporation had the aim of getting an arms control system to the market quickly, and Applied Physics Laboratory (APL) of Johns Hopkins University as the system integrator and lead to produce a fully neurally integrated upper-extremity prosthesis with appropriate documentation for clinical trials, Food and Drug Administration (FDA) approvals, and manufacturing transition.

Later, in 2013, the US Special Operations Command pushed forward the integration of a robotic exoskeleton, the Tactical Assault Light Operator Suit (TALOS), an advanced

56. Elsa Kania and Wilson VornDick, 'Weaponizing'
57. Thom Poole (2021), 'The myth and reality of the super soldier', BBC News, 8 February 2021 [online]. Available at https://www.bbc.co.uk/news/world-55905354
58. John Ratcliffe, 'China Is National Security Threat No. 1', Wall Street Journal, 3 December 2020 [online]. Available at https://www.wsj.com/articles/china-is-national-security-threat-no-1-11607019599
59. Pierre Bourgois, "Yes to Iron Man, No to Spiderman!", Institut de Recherche Stratégique de l'école militaire. Strategic Brief - 18 (February 2021): 1
60. John Hopkins Applied Physics Laboratory, 'Revolutionizing Prosthetics Program Overview'. [online] Available at: https://www.jhuapl.edu/prosthetics/program

infantry uniform that promised to provide superhuman strength with greater ballistic protection. Using wide-area networking and on-board computers, operators would have more situational awareness of the action around them and their bodies.[61] The initial design incorporated an exoskeleton equipped with a helmet which included a head-up display (HUD) visor associated with a refrigeration/heating system, and a suit of sensors capable of communicating the operator's biomedical parameters to an advanced medical centre in real-time.

However, the TALOS project ultimately failed to produce a suit, citing the standard set of technical challenges associated with exoskeleton development efforts, and ultimately announcing that the TALOS 'super-suit' concept as originally envisaged as not feasible in February 2019. The first technical challenge is related to sensing, meaning how the suit knows when and how to move. Indeed, without rapid sensing, there is a lag between the operator desiring to move and the actual movement. A second challenge is associated with actuation. Although actuating a knee is straightforward, more complex joints, such as hips and ankles, require very advanced, multi-dimensional actuators. The final technical challenge lies with power. An exoskeleton requires power on par with a small motorcycle. Though several power alternatives are available, engines would be too noisy, fuel cells would be too hot, and batteries would be too heavy. Additionally, most power sources are very flammable or explosive, presenting safety issues.[62]

In 2016, CNN reported that the US military was spending millions on an advanced implant that would allow the human brain to communicate directly with computers. DARPA expected the implant would allow humans to interface directly with computers, which could benefit people with aural and visual disabilities, such as veterans injured in combat and would give a tactical advantage to soldiers on the battlefield as they could receive information in real-time. In March 2018, the Next-Generation Nonsurgical Neurotechnology (N3) program was launched, allowing for developing high-resolution, bidirectional brain-machine interfaces for use by able-bodied service members. According to DARPA, these wearable interfaces could ultimately enable diverse national security applications, such as control of active cyber-defence systems and swarms of unmanned aerial vehicles. The agency also hopes such an interface could make it easier for service members to carry out complex tasks as well as help them multitask.[63]

To date, several military powers have embarked on the development of the enhanced soldier. Russia has recently developed its biomechanical program, known as Ratnik, which means 'warrior', an infantry combat system developed as a 'future soldier' concept. It comprises dozens of pieces of equipment, including firearms, body armour, optical, communication and navigation devices, life support and power supply systems, and an exoskeleton. It also includes a self-contained heater, a back-

61. Roger Teel, (2014), 'Army explores futuristic uniform for SOCOM', U.S. Army Research, [online] Available at: https://www.army.mil/article/104229/army_explores_futuristic_uniform_for_socom

62. Vikram Mittal, (2020), 'Why Military Exoskeleton Will Remain Science Fiction', Forbes, [online] Available at: https://www.forbes.com/sites/vikrammittal/2020/08/17/military-exoskeletons-science-fiction-or-science-reality/?sh=1bb767aca69e

63. Engineering & Technology, (2019), 'Darpa funds brain-machine interface project for controlling weapons via thoughts'. [online] Available at: https://eandt.theiet.org/content/articles/2019/05/darpa-funds-brain-machine-interface-project-for-controlling-weapons-via-thoughts/

Source: https://nara.getarchive.net/media/korean-soldiers-augmented-to-the-united-states-army-katusa-from-the-61st-chemical-0e663c

Korean Soldiers Augmented to the United States Army (KATUSA) from the 61st Chemical Company, 3rd Platoon, line up at night during FOAL EAGLE 2000 for a final decontamination inspection, 2000

The US National Archives

pack, an individual water filter, a gas mask, and a medical kit. The Ratnik vest's effective protection area is one of the world's largest. Its plates can stand ten sniper rifle shots fired at a distance of 10 metres. The reinforced configuration of the Ratnik vest provides extra lateral protection and anti-shrapnel protection for the shoulders, hands, and groin. Its overalls protect the whole body from the impact of bomb fragments. The second-generation Ratnik combat gear has been supplied to ground and airborne troops and the Marines since 2016. They consist of armoured clothing and combat equipment, small arms, and targeting and reconnaissance gadgets.

In 2018, Russia revealed the Ratnik-3, a powered exoskeleton that uses small actuators and motors to reduce the burden of increased body armour. Its 4-hour battery life is a notable constraint, but its makers claim it has already been tested in combat.[64] An advanced Ratnik-3 combat gear with an integrated exoskeleton and a helmet visor-mounted target designation system is currently being developed for the Russian Armed Forces.[65] It will incorporate stealth fabric, anti-mine boots, an anti-thermal suit hiding the soldier from infrared sensors, and an anti-radar camouflage suit. Other plans include introducing a tactical system using micro–Unmanned Aeri-

64. UK Ministry of Defence, (2021). 'Human Augmentation - The Dawn of a New Paradigm'. [online] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/986301/Human_Augmentation_SIP_access2.pdf
65. Defense World.Net, (2020), "Russian Army Receives 18000 'Ratnik' Combat Outfits". [online] Available at: https://www.defenseworld.net/news/28356/Russian_Army_Receives_18000__Ratnik__Combat_Outfits#.YUxtP-xxc2x

al Vehicles (UAVs), which streams from the UAV cameras will be projected to the helmet's visor or separate goggles. The electric goggles can also be used to display tactical orders and maps of the area.

CONCLUSION

This work has explored and laid out the development of the concept of 'human enhancement' throughout history. Human augmentation refers to the modern technologies that actively seek to combine biology, nanotechnology, and neurologic elements with other information to enhance human beings' predetermined characteristics. Of course, a concept that could enhance the human body in terms of strength, fortitude, and performance, making them capable of defeating their enemies, and surviving the perils of conflict is of great interest to militaries across the globe. Therefore, it makes sense that several military powers have initiated their pathway towards the augmented soldier, a soldier whose physical, perceptive, and cognitive abilities are stimulated through technology to strengthen his operational efficiency. These augmentations are becoming more and more sophisticated and are no longer limited to equipment. In particular, for the US, Russia, France, and, supposedly, China, the enhancement phenomenon seems to have become a reality to varying degrees. This is the case both through historical and current uses or projects (pharmacological substances, exoskeletons, etc.), and in future possibilities offered by techno-scientific progress (genetic engineering, etc.). Still, this theme is not exempt from some challenges. For example, at the operational level, it might pose a risk for the cohesion of the armed forces by producing a major distinction between enhanced combatants and 'natural' combatants, generating inequalities, tensions, and potential dysfunctions. Military enhancement could also raise legal issues, particularly with respect to international humanitarian law, especially if it were to be considered a means of war, forcing the state in question to examine its legality. However, the enhanced soldier raises primarily considerable ethical issues. Among other things, it could be disputed whether from the standpoint of the conduct of an enhanced individual during conflict (*jus in bello*) who may be unable to distinguish between civilians and combatants, or in post-conflict perspectives (*jus post bellum*) with a peace process that would be difficult to achieve in the case of enhancements. Therefore, this phenomenon has generated growing concerns within democracies, with several debates on the topic emerging in recent years. Controversial human augmentation technologies can take many years to become accepted by societies. For example, a matter of debate applies to genetic engineering, which refers to modifying reproductive cells or cells in the grown organism. Creating genetically modified humans has been widely considered unacceptable for many years. However, there are signs that the advent of new technologies is challenging this stance. It is more likely that national governments will eventually decide how far human augmentation can go, based on the country's security interests rather than based on ethical considerations.

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Created in 1953, the Finabel committee is the oldest military organisation for cooperation between European Armies: it was conceived as a forum for reflections, exchange studies, and proposals on common interest topics for the future of its members. Finabel, the only organisation at this level, strives at:

- Promoting interoperability and cooperation of armies, while seeking to bring together concepts, doctrines and procedures;
- Contributing to a common European understanding of land defence issues. Finabel focuses on doctrines, trainings, and the joint environment.

Finabel aims to be a multinational-, independent-, and apolitical actor for the European Armies of the EU Member States. The Finabel informal forum is based on consensus and equality of member states. Finabel favours fruitful contact among member states' officers and Chiefs of Staff in a spirit of open and mutual understanding via annual meetings.

Finabel contributes to reinforce interoperability among its member states in the framework of the North Atlantic Treaty Organisation (NATO), the EU, and *ad hoc* coalition; Finabel neither competes nor duplicates NATO or EU military structures but contributes to these organisations in its unique way. Initially focused on cooperation in armament's programmes, Finabel quickly shifted to the harmonisation of land doctrines. Consequently, before hoping to reach a shared capability approach and common equipment, a shared vision of force-engagement on the terrain should be obtained.

In the current setting, Finabel allows its member states to form Expert Task Groups for situations that require short-term solutions. In addition, Finabel is also a think tank that elaborates on current events concerning the operations of the land forces and provides comments by creating "Food for Thought papers" to address the topics. Finabel studies and Food for Thoughts are recommendations freely applied by its member, whose aim is to facilitate interoperability and improve the daily tasks of preparation, training, exercises, and engagement.

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