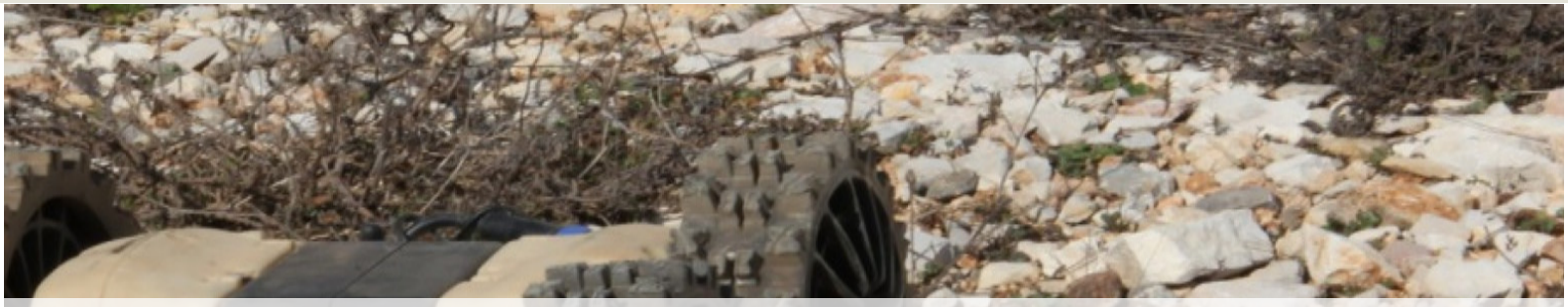

Military robotics, challenges and prospects for the Earth's military. What are the changes in the art of conducting a he

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The previous issue of the Papers described the vision of the US Army in the field of robotics. It was therefore more than normal to describe the future of robots in the Army, including in the conduct of operations.

"I'm telling you right now, 10 years from now, if the first person through the breach isn't a robot, shame on us!"This is how Assistant Secretary of Defense Robert Work evoked in November 2015 the American strategy for robotics and autonomous systems1 at a conference in California. Battlefield robotization, which is still in its infancy, seems to be at the heart of today's concerns and is part of a global context of modernization of armies and the search for technological superiority. More than 40 countries are working on it, even though the use of robots cannot be reduced to aerial drones2 and the fight against terrorism: between 2003 and 2007, 10 000 improvised explosive devices (IEDs) were destroyed by 5 000 US army robots. While the impact of future innovations or technological breakthroughs remains difficult to measure, military robotics is already a reality and its continued development is a certainty. However, the definition of a robot used for military purposes is not self-evident, as shown by the many semantic, conceptual, legal and ethical debates. Moreover, the preparation of the future in this field meets a proven operational need for the army as much as a necessity, while the robotic threat will be led to develop and diversify.

In the context of the Scorpion battle, the design of the use of robots on the battlefield is part of the search for operational advantages over the adversary and innovative success factors in order to contribute effectively to joint and joint maneuvering. The question therefore arises as to what changes could be induced by military robotics in the art of warfare, and whether the technological break would be such as to result in a conceptual break by 20303. 3 In other words, will military robotics transform warfare as tanks and airplanes did in 1917? By 2030, will it constitute an upheaval in the conduct of operations?

Battlefield robotization, whatever the future technological innovations and despite the

many changes it will imply, will not constitute a revolution in theThis is because its purpose should not and cannot call into question the primary principle of the confrontation of wills and the essential principle of man at the heart of decision making.

If military robotics constitutes a reality as much as an inevitable evolution, it corresponds above all to a need of the ground forces in the context of the Scorpio battle. Above all, the success of the integration of these new systems and the optimisation of their operational efficiency will depend on the ability of the Army to meet the cultural and organisational challenges of military robotics now.

An inevitable change, a need for the Army

QWhat's a military robot?

As early as 2012, the French Army Staff (EMAT) endeavoured to define the notion of a robot by publishing an exploratory concept of military robotics. This was an undeniable first step forward and, above all, necessary for any development in this field. EMAT's planning office is currently working on updating this document with a view to the Scorpion programme. Its vocation is to nourish doctrinal reflection and to prepare work on future equipment.

The document refers to military UAVs on land, known as "robots", and in the air, known as "UAVs", the latter being limited to UAVs used in contact with the adversary. It also proposes the following definition: "A military UAV is a land, air or naval system designed to carry out tasks with the aim of achieving effects of military interests. Its use is a human decision and a military responsibility. It comprises a vector, sensors, computers or effectors, which may include weapons, a control and support segment, and a telecommunications segment'.

It thus appears that a military UAV or robot is one means among others at the disposal of the Joint Chiefs of Staff, and not an end in itself, with the aim of producing effects. Its use will always be conditioned by a human decision, just as it will always be a military responsibility. Finally, the possibility of arming a UAV should be envisaged as of now, insofar as its use, in accordance with the law of armed conflict, is not prohibited.Finally, the possibility of arming a UAV should be considered now, insofar as its use, in compliance with the law of armed conflict, will provide a proven operational advantage in a context of proliferation and in the face of the threat of armed adversary systems.

Qhat is the general purpose for military robotics?

The question of utility will condition the technological or budgetary efforts to be made for land forces. The project to update the exploratory concept of the EMAT identifies three complementary issues: the survivability of the combatant, the optimisation of the use of man on the battlefield and the optimisation of effects, in order to constitute a factor of operational superiority.

The primary objective is to preserve the soldier and his potential, and to improve the protection of the combatant. The second objective is to spare him tasks that robots can perform more easily and better: repetitive, tedious or difficult tasks.

Finally, the interest of military robotics would also be to increase individual and collective

operational efficiency and to optimise the effects, which are considered to be factors of success: mass effect, diversion capacity, improved anticipation, limitation or control of the opponent's tactical surprise and knowledge of the battle space.

Consequently, the Army has identified different categories of robots to address these three issues: servant, sensor, fighter, and mixed systems4. UAVs and robots, integrating day and night into the air-land manoeuvre, will then have the mission to participate in the combat action by supporting or sustaining it5.

Why is battlefield robotics going to be a necessity for us? Robotics is already a reality for the Army: Systems are currently in service with the land forces (breaching, engineer reconnaissance, EOD intervention), others are being tested (contact intelligence), and acquisition programmes are planned in the short term. Robotics is also already present in our weapons systems, in the form of automation or remote operation (missiles, drones, turrets).

Moreover, while a growing number of armies are devoting a significant part of their budgets to the development of robotics, technological innovation in the civilian world will also provide opportunities for land forces. Pressure from the defence industries is therefore foreseeable in this area, hence the need to define requirements and priorities in the short, medium and long term.

Finally, if robotisation is on the march and progressing at high speed, the army must prepare itself to face the proliferation of the robotic threat today to protect itself against it as much as to preserve its technological rank. It is highly likely that our future adversary, state or non-state, will use innovative military robotic capabilities to surprise us tactically.

Moreover, we cannot rule out the risk in the long term of a gap between friendly and enemy robotic systems, employed without the ethical and legal constraints that we have.

Thus, pursuing the development of land or airborne UAVs within the army meets a real need and militates for a preparation of the future that is above all pragmatic. While military robotics is not an end in itself and must be considered as one weapons system among others, it remains to be seen how it will be able to strengthen the factors of operational superiority and find its place in future land engagement.

The integration of military robotics in scorpion combat:

Future land engagement

The form and requirements of future combat and the current evolution of the threat allow us to foresee the following context of engagement: the Army will continue to operate in a complex air-land environment, facing a protean adversary capable of adapting rapidly and of acting in a broad spectrum. Moreover, our technological advantage may be challenged, including by asymmetric actors that can take advantage of the democratisation of innovative capabilities such as aerial UAVs. Finally, in the medium term, the development and proliferation of denial-of-access weapons systems make it likely that the ability to achieve air superiority, which is today considered a necessary condition for any ground engagement, will disappear.

Thus, the Scorpion model was built as a response to the challenges of tomorrow and the uncertainty of their evolution. Relying in particular on the development of new

communication technologies, it ultimately aims to dominate the adversary by mastering chaos. It seeks to disorganize and weaken the opposing system through brutality and surprise. The objective is to promote fluidity, flexibility and responsiveness of the maneuver and to increase the lightning of the battle. While improving the performance of the force, the Scorpion fight will allow to bring uncertainty to the opponent6.

6 In this context, the development of military robotics will fully contribute to the operational effectiveness of thisthe operational effectiveness of this new model, provided it benefits from a favourable electromagnetic environment. Once this superiority has been achieved, deployed units, like robotic systems, will continue to respond together to a threefold challenge: physical due to evolution in a complex environment, intellectual due to human randomness and cognitive due to the mass of data generated.

Qhat will robotics bring to tomorrow's battle?

To express its full potential, robotics will have to take advantage of technical progress in miniaturisation, endurance, the development of artificial intelligence and the control of information flows.

In the short term, the increased performance of sensors (detection, identification, designation) and effectors (responsiveness, endurance, precision) will lead to a reduction in uncertainty, the first beneficiaries of which will be contact units7. The provision of robotic systems down to the lowest levels will promote the development of the initiative through autonomy of intelligence acquisition. Digitization associated with battle-space robotization will benefit from the fluidity of horizontal and vertical information sharing and will provide more accurate and comprehensive tactical situational awareness.

Moreover, by replacing the soldier, robotization will considerably reduce wear and tear on the soldier and allow him to concentrate on actions that only he can perform.

In the area of support, the pace and continuity of the manoeuvre will be improved by robotic convoys through anticipated, advanced and adapted logistics, facilitating timely exchanges between the contact zone and the rear area8.

Finally, the detectability and vulnerability of CIS platforms can be reduced by the use of robotic systems, for example by setting up a relay network. Counterbalancing an impossible discretion due to electromagnetic emissions, these will lead to an increase in the resilience of the assembly9.

In the longer term, the acquisition by robotic systems of a capacity to manage their environment within the same area ofIn the longer term, the acquisition by robotic systems of a capacity to manage their environment within the same evolutionary zone suggests the use of collaborative ground and airborne UAV units as a first step. Their multiplication will induce a mass effect10 guaranteeing saturation while maintaining the precision of the effects produced.

Principles to be respected

First of all, robotics should not become a central element of the manoeuvre. We must not give in to the temptation to use robotics at all, despite the significant capabilities and potential offered, at the risk of compromising the force feedback capability in a degraded mode.

Similarly, the use of robotic systems, one of the objectives of which is the optimization of human resources, must not result in excessive consumption of operators. As such, the progressive improvement of automation, combined with a reduced logistics footprint, will make it possible to reduce the number of dedicated personnel or increase the number of systems deployed.

Finally, in order not to interfere with manoeuvring, the robotic tool must be of an appropriate size and be able to be implemented all the more quickly and easily as the "employer" moves closer to the contact zone. The improvement of endurance and the "availability"11 of the robots from the rear will make it possible to limit the vulnerability of the on-board or off-board operators during the critical phases of deployment.

While the Army is resolutely committed to modernity with the Future Land Action12 and Scorpion, it is nonetheless essential that it addresses the shift towards the integration of robotics in the widest possible sense in order to exploit its full potential for the conduct of operations.

Lhe Challenges of Force Robotics terrestrial

In the first place, this transformation calls for the overcoming of decisive conditions outside the direct field of action of armies. Secondly, the success of this movement requires the Army to face up to major challenges. Finally, despite the advent of artificial intelligence, the battle will remain a place of confrontation and "dialectic of wills", ignored by robots just as much as courage, audacity, desperate resistance or free will. Finally, this technological upheaval seems to have the unexpected consequence of reminding us of the very human nature of war and the central role played by decision-making.

Decisive preconditions for effective use in the field of operations: taking the choice of robotics

First of all, the budgetary logic of military programming laws and armament programmes conducted over years is antithetical to the time scale of innovative civilian technologies that meet the rules of Moore's Law13. In order to reduce this "industrial gap", it is imperative to combine a greater flexibility in committing armaments expenditure to a renewed interest in products developed for non-military purposes14.

Moreover, there is still a lack of rational reluctance: despite the probability of incidents being statistically as low as that of the civilian industries (automotive and aeronautics), the use of lethal automated response systems is not accepted for the time being.

Finally, the issues related to legalization still need to be clarified in order to avoid that tomorrow's combat will not respond to the adage "not one step without a robot". and that the military leader is accused of needlessly exposing the lives of his soldiers for not having accomplished all the due diligence that his means allowed him to do15.

15 But the most difficult step towards the integrated use of robotics is for the land forces to seize the opportunities for transformation brought about by the new operations paradigm to meet the challenges of robotisation.

Capability challenges for the Army's global integration of robotics

Even if the new generations will be better suited to multi-tasking, a recruitment effort will be required to have operators capable of handling complex machines while using

automated functions with discernment.

General maintenance workers integrated into the deployed units will have to be trained to approach equipment from the perspective of global systems for diagnostics.

The progressive integration of robotic equipment and combined man-machine training will play a key role in this process.The progressive integration of robotic equipment and combined man-machine training will also play a key role in the acceptability of this "mutation" by the military.

Operations will require new security and protection measures (dispersion, mobility, network mesh structure) to mitigate threats to CIS platforms.

Thus, the integration of this new capability will have multiple repercussions on the organisation of land forces, implying a "change of model". And to be fully effective, doctrine and warfare will also have to adapt, requiring a "change in thinking".

Decision-making: the invariant of war and the real challenge of robotisation

The ever-increasing volume of information, its processing, its man-machine exchange and its sharing adapted according to the level is a major challenge to enable military leaders to make tactical choices while maintaining the pace of the manoeuvre. In this field, several key elements must be taken into account to make robotisation a factor of superiority in the conduct of operations. Firstly, tests of decision support systems seem to show that the operator systematically validates the machine's proposals. It may be necessary to move away from the culture of reflex action to "reincarnate" decision-making and responsibility. This seems all the more relevant if we consider that in the medium term the chief will delegate the analysis of the "scientific" fraction of war to his "R2-D2"16 staff to concentrate more on the "art of war".

Furthermore, to facilitate the execution of the manoeuvre on the horizon of the Scorpion battle, the command and control echelon will have to accept the decompartmentalization of structures and the relaxation of command relations. This will result in a more flexible and modular organisation, as well as the sharing of robots in "plug and play" mode to facilitate the allocation of support from one unit to another according to the evolution of the tactical situation.

Ultimately, this technological progress is an opportunity to rethink levels of responsibility and promote objective-based command inspired by the German model. Coordination measures and robotic reinforcements will be able to adapt to the initiatives of units capable of dispersing and then concentrating on an objective of opportunity. The army of the future must still agree to deconcentrate decision making to intermediate levels, to assume the risks and to prepare its cadres for it.

The time is no longer ripe for debate on the definition of what a robot is, its degree of autonomy or the ethical nature of making it a vector of lethal effects. The Army must commit itself to robotization because it is a phenomenon that is already being imposed by both the advanced and the less advanced countries.The army must commit itself to robotization because it is a phenomenon that is already being imposed both by technological advances in the civilian world and by their diversion and the expansion of their use on the battlefield and soon at the heart of our societies, creating new threats.

Moreover, military robotics is an important element in accelerating "OPTEMPO"17 to break the adversary's decision-making cycle from within18 and to be in line with the "lightning" style of action. It also offers the opportunity to reduce the exposure of the combatants and increase their effectiveness while optimising the design and execution of the manoeuvre. On the other hand, this new capability should not be seen as the alpha and omega of tomorrow's combat, but rather as a complementary tool available to the joint commander, whose use will only be profitable under certain conditions: a dedicated human resource under control, organic and functional integration that speeds up the manoeuvre, and the maintenance of traditional know-how to be able to act in a conventional manner if necessary.

Achieving the full employment efficiency of military UAVs and robots still requires technological, societal and legal challenges to be met, but above all requires an assumed commitment of the armed forces in their structure as well as in their way of thinking and conducting operations.

Thus, by 2030, battlefield robotization does not suggest a break in the art of warfare, but rather focuses attention on the role of the leader and calls for a renewed understanding of the levels of decision-making and responsibility.

In the years to come, advances in artificial intelligence will provide a corollary subject for reflection on the collaboration between machines themselves and between man and machine, foreshadowing the advent of "cobotics"19. Although it will still take time for people to come to terms with this new situation, it will be essential to define the extent to which the army will accept decentralized decision-making at the lowest levels, as well as delegating some of it to robotic tools and assistants.

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