A New Way of War

The Swarmers

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Abstract: It seems that the future of warfare is in the hands of technology: drones and machines in general are likely to be among the major players in tomorrow's battlefield. However, those who believe that human beings will be completely deprived of the art of war are mistaken. In the future, humans will not be mere players from behind the scenes. The human factor will be decisive, just as it was in the days of Alexander III, Julius Caesar, and Napoleon Bonaparte. Obviously a "new military figure" is needed, one who is capable of combining different ideas in an efficient and successful way. This article seeks to outline this figure on the basis of two fundamental concepts. Consideration will be given to *swarming*, a tactic used since antiquity and now used primarily for drones, and human-machine teaming, a concept that is gaining momentum in the fields of military science and technology. The intent here is to understand if these ideas can generate a new player capable of interpreting—and winning—future warfare.

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A New (Human) Subject in the Age of Killing Machines

Today, technology occupies a prominent place in the world. Think, for example, of industrial production or commercial logistics. Of course, the military community has not stayed away from progress—in fact, quite the contrary is true. Machines are currently being used in every aspect of warfare, from reconnaissance to target elimination. It is here that one comes to a very important issue. This article will discuss a possible new subject for the future of warfare, but it will not be a machine—it will be a human being. This individual will be capable of great things because of a great technological advantage, but they will still be human.

Why use humans when there are machines? Consider drones, for example. Unmanned aerial vehicles (UAVs) are expendable, are inexpensive in terms of both money and training, and can do everything a soldier can do, perhaps even better. This is the thinking of some in technology and military circles. But is it really the case? Premising that it is not the intention of this article to discuss the weaknesses of UAVs, currently the drone warfare situation presents several issues. Studies have shown that remotely piloted aircraft (RPA) personnel display the same psychological problems (e.g., post-traumatic stress disorder, or PTSD) as do their colleagues who fly aircraft.[1] Moreover, the use of drones by the United States in the global fight against terrorism has not only radicalized and fomented its opponents but has also delivered results that are far from decisive in a strategic sense.[2] Certainly,

the costs of using drones are lower, both in economic and political terms (as it is more acceptable for a democratic country to launch a drone than deploy a handful of soldiers), but savings do not always mean victory. And while drones will no doubt continue to develop for the better, so will the hacking capabilities of the world's major powers.[3] Several flaws have already been identified in the protection of drones on the battlefield; for example, *spoofing*, in which an adversary sends fake communication signals disguised as real ones to hijack a drone, still poses a serious threat to UAVs.[4] Having a swarm of drones defect with just a few clicks is as inconvenient as ever.

But what if, in the future, as some foresee, drones gradually come to be commanded by artificial intelligence (AI)? In that case, humans would be far removed from the physical and psychological dangers of combat, and machines would be making the decisions. Setting aside the vast moral and humanitarian debate that this choice would entail, some problems remain. The approach according to which "machines do the work of humans rationally and infallibly" is questionable, to say the least. AI needs continuous up-to-date information to operate at its best, and a battlefield would present such a varied and nonlinear scenario that it would challenge AI's way of acquiring exact data, since this technology is tested on a limited sample of information.[5] But what AI lacks more than anything else is one of the most subjective and hard-to-calculate human characteristics: judgment. According to Avi Goldfarb and Jon R. Lindsay,

> In military terms, judgment encompasses command intentions, rules of engagement, administrative management, and moral leadership. These functions cannot be automated with narrow

> AI technology. Increasing reliance on AI, therefore, will make human beings even more vital for military power, not less.[6]

This is a key point. Technology, whether expressed through drones or AI, is unstoppable. Someday a machine will probably be able to possess the emotional intelligence of a human being, since humans place no limits on progress. But because this article discusses the near future rather than the distant future, there is a need to think about the most realistic and possible solution—a solution that could be provided by a complementary relationship between man and machine. After all, the battlefield does not present predictable ruts but rather something fluid that changes very rapidly. Moreover, as has been the case with other revolutions in military affairs (RMA), possessing technology has never been enough to win. Behind each piece of military technology must be a commander capable of judging its best use and evaluating all the tactical, operational, and strategic implications of its use in a campaign. This argument can be made about AI-guided drones. Machines may be unstoppable, automated, and cheap, but that does not mean that one should have blind faith in them. Machines can and will make mistakes in the future if there is no human ready to interrupt their operating cycle.[7]

In this sense, Paul Scharre talks about "centaur warfighting," an area in which people and machines can both give their best, complementing each other. There is, however, one point in particular in which he identifies a weakness in this pairing: speed.[8] An on-the-loop human decreases the likelihood that AI will make mistakes but slows down the AI's decision-making process—and pace is fundamental to warfare. Another potential

problem is the possibility of a lack of communication between the person and machine, which happens in the theater of operations. Assuming that Scharre is speaking generally about all kinds of weapon systems, this author believes that *swarmers* in particular could mitigate these issues.

The Swarmer: A Human-Machine Hybrid

The term *swarmer* is derived from the concept of *swarming*. Before getting into the heart of the topic, it is necessary to explain what is meant for the purposes of this discussion. *Swarming* refers to a military configuration that involves the convergent attack of autonomous or semiautonomous units toward the enemy; it consists of small independent groups that can use a very high level of information and a decentralized organization.[9] More than 20 years ago, John Arquilla and David Ronfeldt tried to define the concept:

> Swarming is seemingly amorphous, but it is a deliberately structured, coordinated, strategic way to strike from all directions, by means of a sustainable pulsing of force and/or fire, close-in as well as from stand-off positions. It will work best—perhaps it will only work—if it is designed mainly around the deployment of myriad, small, dispersed, networked maneuver units.[10]

This configuration is not new in military history. During their conquests in Asia in the thirteenth century, the Mongols applied swarming with great success. They mastered the art of riding and the use of the composite bow, but these were not their only strengths. Units of the Mongol army enjoyed great autonomy and power of initiative, which they used to

increase their mobility and decisiveness in battle. These factors, combined with great situational awareness, allowed them to swarm against any opponent effectively.[11] A more recent example of swarming can be found in the Battle of Britain during World War II. After the Axis conquest of France in 1940, German leader Adolf Hitler wanted to invade his last remaining enemy: the United Kingdom. To move his invasion forces across the English Channel, however, it was necessary to obtain air supremacy. The German *Luftwaffe* (air force) was tasked with annihilating the Royal Air Force (RAF) and its support bases. To defend itself, RAF Fighter Command coordinated autonomous groups of fighter aircraft that gradually weakened the German air raids against the British islands.[12]

In recent times, swarming has been applied primarily to UAVs, better known as drones. Swarms of drones could be effective in several roles; for example, their large number would allow for careful reconnaissance, and they could also overwhelm modern air defense systems that are not designed to hit a dense swarm of small enemies.[13] Tests by the U.S. military show that UAVs and swarming will be a profitable match for the future.[14] It is worth reporting that the U.S. Navy conducted an exercise in 2021 that involved a swarm of drones in the destruction of a naval target.[15] Even the United States' main competitors are investing in this field: China is investing heavily in the application of UAV swarming, while Russia is capitalizing on lessons learned in Syria, where Russian forces have deployed large numbers of drones in military operations.[16]

As stated in the opening section of this article, however, drone warfare presents issues that on the battlefield could become decisive in a negative sense. Contrary to a drone pilot, a swarmer would not be

thousands of kilometers away from its "technological partner" but instead would literally dress it up: it would be a soldier equipped with a high-tech exosuit, thus a true centaur of the future; communication would be immediate and speed would not be deficient because the two cores would be merged into one practically.

In terms of enhancement of the soldier, some talk about genetic modification and surgery.[17] Again, this author places no limits on what could happen in the future, but the same problem of dehumanization that would characterize a machine would arise in this case: a civilian in an occupied country would perceive this sort of "mutant" with terror; certainly, they would not see it on the same plane. Swarmers, therefore, would continue to be fully human, enhanced by a suit capable of providing them a major advantage on the battlefield. Unlike a machine, this new military subject would be, to use U.S. Army lieutenant colonel Robert B. Rigg's words, not only destructive but also possessive, meaning that it would have the ability to attack as well as to process and hold what it has conquered.[18] A General Atomics MQ-9 Reaper UAV may be lethal and induce fear among combatants and noncombatants alike, but it will never have the ability to motivate troops by example or empathize with locals, and it can never possess *esprit de corps* or display the same tactical-strategic acumen as a great warrior. Swarmers will not be special just because they have high-tech suits, but because they will also have above-average military capabilities in terms of tactics and leadership in the field. In particular, their strength will lie in maneuvering in swarms. Certainly, such application is also possible with UAVs, but as has been seen, to date, the most comprehensive solution may be that provided by a close human-machine connection.

The goal, then, is to take maneuver and swarming to an entirely alternative level. Conventional maneuver warfare is being studied and implemented by every major power in the world, as is the use of drone swarms, and the combination of maneuver and swarming is not new. But what if the modern understanding of these concepts were applied to enhanced humans? To better deal with this combination, it is necessary to clarify the concept of human-machine teaming, introduced earlier. As Margarita Konaev and Husanjot Chahal write,

> Human-machine teaming is a relationship—one made up of at least three equally important elements: the human, the machine, and the interactions and interdependencies between them.[19]

Ultimately, the major international players today are seeking fruitful links between humans and machines in a military way. On the one hand, machines are able to achieve a goal without suffering memory or concentration lapses and without feeling fear. On the other hand, a human being has a better ability than AI to perceive nuances and even formulate solutions in progress.[20] The aim of human-machine teaming must be to combine the strengths of both parties to make up for their shortcomings.

To make a difference on the not-so-distant future battlefield, the swarmer will need to make good use of technology to enhance their performance. This enhancement can be achieved with an exosuit, a type of wearable armor that works in synergy with its human operator. Human augmentation is a goal that people have always pursued, but in recent years there have been new projects related to exosuits that can help further

enhance soldiers' performances on the battlefield.[21] One such project was the Tactical Assault Light Operator Suit (TALOS), a combat suit designed by U.S. Special Operations Command. It included a full-body exoskeleton that provided protection from small arms fire, as well as enhanced situational awareness.[22] Although the project was canceled in 2019 due to ongoing issues with the suit's power supply, the race for a full-body exosuit has continued. For example, Russian conglomerate Rostoc is working on "Sotnik," a third-generation armored combat suit, and is already devising a fourth-generation suit to further increase the offensive and defensive capabilities of Russian military personnel.[23]

The swarmer will need a high-tech exosuit capable of increasing their situational awareness and providing full-body protection from small arms fire. But that is not all. It would also be useful to integrate into the exosuit a portable personal air mobility system (PPAMS), better known as a "jet pack." Again, this is a technology not yet fully explored. Richard Browning's Gravity Industries and Franky Zapata's Zapata Industries are already working in this area, even providing prototypes in synergy with some countries' armed forces, and the U.S. Defense Advanced Research Projects Agency has made it known that it is looking for effective solutions in the field.[24] These technologies will not be ready today, but they are far from science fiction.

The Employment of Swarmers

Swarmers could be insidious players on the battlefield in the near future. How? First, they should be divided into units in which quality prevails over quantity: small groups of swarmers should act with great autonomy, linked to a decentralized command and control and not stifled by hierarchy. They

would be structured in swarms of a few operators (ideally, a maximum of seven) each, led by tactical commanders who possess significant initiative capability. Swarmers should also be supported by a functional and essential logistical system.[25] For this reason, it is important that human-machine teaming be as easy and intuitive as possible; otherwise the swarmer would only be a technological ballast during military operations. In the past, swarm logistics were linked to terrain, effectively limiting the range of action of these units (the Mongols, for example, were limited by the presence of grazing land for their herds).[26] The technology of a PPAMS could overcome this historical limitation, giving swarmers the ability to refuel in the sky, to climb over ground obstacles to reach the sources of supply and maintenance, or to find one another to exchange supplies between themselves.

In general, swarmers must be as self-sustaining as possible. In this sense, the use of UAVs could be useful; just as unmanned systems are already being tested in the civilian world for delivery and medical purposes, drones on the battlefield could provide a viable solution for last-mile delivery, the most dangerous in war.[27] Swarmers could also provide intelligent, cost-effective, human-scale logistics that increase their operational autonomy. It should be evident here that swarmers and drones are not subjects in competition, simply because they would perform different tasks. Precisely because of this fact, the goal is for both parties to be strongly interconnected and complementary. Coordination between swarmers and drones would only be possible through a strong network capability. This must be one of the hallmarks of swarmer units, which must be highly connected to operate in coordination. Networks provide

information, which swarmers must have superiority over to possess situational awareness. Such superiority involves having a clean information flow and undermining enemy information. Unlike drone pilots, swarmers could become aware of the situation on the ground without undue danger due to their ability to fly; in fact, swarmers should stand high enough to avoid small arms fire and be light enough to avoid being marked as a target of surface-to-air or air-to-air weapons.

Another aspect worth mentioning is that swarmers should be able to withstand cyber or electronic attacks. A swarmer might have problems but would continue to operate with more traditional means of communication; in contrast, a swarm of drones needs a complete and continuous flow of information, without which it simply stops functioning, if not worse.[28]

Thus prepared, swarmers can operate tactically, remaining dispersed in the preparation and acquisition of their objective and then joining forces to attack the enemy with speed and decision. Combatting such elusive and dispersed units will be a challenge for any weapon system, no matter how lethal and destructive it may be; moreover, the ability to move in the air will contribute to the swarmer's ubiquity and nonsystematic nature on the battlefield. These units must not replace all other arms (e.g., infantry, artillery, or armor) but rather should work in synergy with them. Swarmers could be the decisive factor in breaking up the cohesion of an enemy force through shock, through direct or indirect standoff fire, or by disintegrating it or pushing it toward friendly conventional forces. If swarmers have primacy over information, technology, and maneuvering, they can certainly make a difference in future warfare.

The operational use of this new unit would certainly be in conventional warfare. To return to the improper drone-swarmer comparison, the former has been tested in counterinsurgency operations and has shown inconclusive results.[29] To win a war, it is not enough to kill with precision. But this view needs to be changed—drones are very useful but need to be combined with other elements. The conflict in Syria has shown that they can yield great results when placed in an articulated context in which they support, and are supported by, more traditional forces.[30] Swarmers would marry their technological superiority to great military capabilities, especially in the field of maneuver. With these new interpreters, maneuver warfare can take on new nuances. In today's multidimensional battlefield, where air, land, water, and network are extensions of the same struggle, the swarmers' capabilities could revive, for example, the concept of encirclement. According to Sean J. A. Edwards,

> Encirclement creates a perception in the target's mind that the battle is not going well. Soldiers who realize the enemy is in their rear become fearful that they will lose their means of sustenance and survival—food, water, ammunition, and a clear line of escape. For a soldier who is trained to fight linear warfare—to view the battlefield in terms of a single front, two flanks, and a rear—the appearance of enemy forces in the rear has a profound psychological effect. Frederick the Great liked to say that three men behind the enemy were worth more than fifty in front of him. So the goal for swarms is always the maximization of directions of attack.[31]

Encirclement, of course, is just one of the ways in which swarmers could operate. These units must be imbued with the idea of maximizing enemy deficits and minimizing their own; it is the field and the contingencies of the moment that will dictate how to apply this mindset each time. As mentioned above, swarmers, with their mobility and situational awareness, could operate in many different scenarios. They could perform reconnaissance tasks, just as the light cavalrymen of the Carthaginian general Hannibal did during the Second Punic War (218–201 BCE); this special mounted unit of the ancient world managed to ambush two Roman consuls during the Italian campaign and mortally wound them. Like them, swarmers could tail the enemy, obtaining information or compromising his flow of information. Moreover, by their very nature they could avoid the unconventional pitfalls of the urban environment. It would be psychologically frustrating for a force entrenched in the ruins of a city to know that they were dealing with an elusive enemy who could see them from above without being seen thanks to their superior technology and situational awareness. In such a scenario, the enemy could lose cover to hit the swarmers, becoming visible to other friendly units waiting for a target.

In addition to these capabilities (which admittedly could be carried out by a swarm of drones anyway), swarmers could process the situation with their real-time judgment, creating the loop themselves rather than supervising it or simply being part of it (as a drone operator would be). They could also be assigned to attack a conventional force on the flanks or rear, hitting it with standoff fire. Swarmers could move in height to hit, for example, a group of tanks that are out of range by fire response, or they could move in a maneuver in synergy with conventional forces. For this type

of tactics, it is useful to report a concrete historical episode: during the Roman-Seleucid War (192–188 BCE), the Roman leader Scipio led his army through Thrace (modern-day Bulgaria). With him was a Numidian mounted contingent, which spotted as many as 15,000 Thracian locals in arms obstructing their passage. The Numidians, only 400 strong (and a few elephants), used their great mobility to attack this large enemy force from the flanks and rear. They prevailed, and the main Roman contingent did not even become involved in the battle.[32] Swarmers could play the same role today; by exploiting their superiority in the skills discussed earlier, they could crush forces superior to them, striking the enemy where they least expect it. It must be remembered, however, that unlike the Numidian cavalry, whose best defense was in their speed (in fact, they did not have great armor), swarmers should have protection from different types of light weapons. Moreover, there is another difference among these "military ancestors": the ability to create shock. In Hannibal's army, for example, the assault troops were veteran Punic infantry; on the contrary, swarmers themselves could create shock, exploiting standoff fire.

There is no denying that the development of swarmers involves considerable economic expense and technological research. However, as mentioned above, warfare is evolving rapidly in all of its components. Several countries, most notably China, are investing money in the fields discussed in this article. For example, in 2020 China allocated $85 million (USD) for a variety of research, including human-machine teaming and swarming.[33] Sooner or later, a hegemonic state will arise in Europe, which will invest vast resources in these fields. If the United States wants to continue to maintain military primacy, it must think beyond the

conventional. Swarmers would allow the United States to project its military supremacy even more rapidly and powerfully in the not-too-distant future.

Conclusion

Drones will certainly be among the protagonists of future battlefields—there is no doubt about that. But they must not be a substitute for humans. As has been shown, both humans and drones give their best together, in a relationship characterized by synergy and complementarity. The best application of this pair might be that provided by swarmers: soldiers with great technological and informational advantages, but still human beings endowed with judgment and emotional intelligence. Their capabilities would allow for speed, shock, and flexibility of maneuver that could prove decisive on the battlefield of the future. Of course, it would be unrealistic to talk about the present. It has been seen that the road to this project is not without obstacles: the fate of the TALOS project must be a lesson kept in mind as well as one on which to lay new foundations. In general, it is necessary to have courage to invest time, money, and research in something that until a few years ago was thought possible only in science fiction movies. After all, if one does not want to fall behind, then one must look to the future, but without forgetting the past and who one is. Machines alone are not enough—for, as Antonio Calcara et al. asserts, "High-technology weapons demand high-quality personnel."[34].

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