Who Will Stop the Robots?

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Unmanned tools and systems play an increasingly large role in the modern battlefields, as these tools have significant advantages that encourage many countries and violent non-state actors to develop and use them. At the same time, this advanced technology raises moral, ethical, legal, and social concerns and questions. This article explains basic terms in the area of unmanned warfare, examines the developments made in the past twenty years, and presents the United States' future plans in the field. It raises various challenges facing the field, including technological, while making the claim that limiting the field's development will be difficult if not impossible due to the investments made by many countries, the large role unmanned tools and systems already play in today's battlefield, and the field's potential in the context of non-military uses, such as in science, medicine, services, and industry.

Keywords: robots; unmanned tools; unmanned airborne vehicles; autonomy; United States; Israel; battlefield; asymmetrical conflict

Introduction

Unmanned tools and systems play an increasingly large role in the modern battlefields. The United States and Israel, two of the leading countries in the development and usage of these tools, enjoy the reduction of risks to their soldiers' lives and the ability to carry out tasks that cannot be performed by human beings due to physical limitations. Alongside the pursuit of military power, these tools have significant advantages that encourage many countries and violent non-state actors to develop and use them.

This advanced technology also raises moral, ethical, legal, and social concerns and questions. The developing autonomy of these tools and their

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ability to act independently without human intervention also raises acute opposition, and has received media coverage, reactions from human rights groups, and governmental responses like the November 2012 US Defense Department directive on autonomous weapons. These reactions indicate that the field is becoming more central in the modern battlefields and is worthy of an in-depth discussion.

This article will review the field of unmanned tools and systems and its development, and examine factors such as the opposition of human rights organizations, or specific decisions taken by governments that could limit the development of the field more so than the technological difficulties it may encounter. The article will explain basic terms in the area of unmanned warfare, examine the developments made in the past twenty years, and present the United States' future plans. It will later raise various challenges facing the field, including technological, while making the claim that in light of the developments and investments made by many countries, limiting the field's development will be difficult if not impossible, both generally and in terms of autonomy. Limitation will also be difficult due to the large role unmanned tools and systems already play in today's battlefield, and also due to the field's potential in the context of non-military uses, such as in science, medicine, services, and industry.

Unmanned Military Systems

It is difficult to find one accepted definition for unmanned tools. There is also a tendency to confuse unmanned systems or tools with robots and various other types of autonomous tools. A review of current definitions shows an agreement on the idea that unmanned systems are manmade platforms that do not have a human operator but have the ability to carry out repeated tasks, be they mobile or stationary, guided or autonomous.[1] The most up-to-date document from the US Department of Defense, published in November 2012, defines an unmanned platform as "an air, land, surface, subsurface, or space platform that does not have the human operator physically onboard the platform."[2] This is a broad definition that allows for the inclusion of different levels of autonomy.

The platforms are usually capable of transporting a load of materials that were dedicated to the execution of the attack mission such as a camera, bombs, or missiles. However, some of the tools are intended for carrying out missions without a dedicated load, such as an unmanned

ground vehicle with a guided arm for bomb disposal. Missiles, rockets, and artillery are not included in the category of unmanned tools, nor are cyber combat systems.

The field of unmanned systems is highly developed today, and it includes a variety of tools used for executing many missions in different areas of warfare. Especially common in the ground dimension are bomb disposal tools and unmanned vehicles, which are used for patrolling specific areas and transporting loads. The tools in existence today, however, are still limited in their ability to carry out many of the tasks performed by manned combat tools.

Between fifty and eighty countries around the world are developing robots or have already been making operational use of robots in the battlefield. The United States leads in unmanned ground tools' development and usage. In 2010, the ratio of robots to soldiers in the battlefield of Afghanistan was 1:50 (a figure that is expected to increase to 1:30 within a few years),[3] with the total number of unmanned ground tools in America's possession at that time being 12,000.[4] The large majority of such tools are run by a human operator through various control mechanisms. In spite of the fact that their numbers are larger than those of aerial tools, unmanned ground tools are less well-developed than aerial tools. This is mainly because of the technological difficulties, or the difficulties in establishing cooperation between the tools and the soldiers or civilians who move in the same territory. Nevertheless, such tools operate in Israel during fence patrols on the southern border, for example, or by US troops for bomb disposal missions and for relaying images from within buildings.[5]

In the maritime dimension, unmanned tools are used mainly in policing missions. These tools are usually equipped with a camera and various means of navigation, as well as with controlled weapons that can also be installed. Subsurface tools are also operational and carry out diving missions like intercepting enemy ships, sweeping for naval mines, and performing underwater searches. The maritime dimension has its own limitations and difficulties, which its operators and developers try to contend with, such as waves, poor visibility, and loss of contact. Nevertheless, the great potential these tools hold in terms of execution of various maritime tasks that were hitherto the preserve of manned tools (such as maritime policing and patrolling) is close to being fulfilled.[6]

The aerial dimension of unmanned tools is by far the most developed one, being used both in the air and in space. Although US forces had already used them in 1919 to attack a German warship, these aerial tools only became widely operational by the US during the Vietnam War.[7] These tools had excellent intelligence-gathering capabilities thanks to their ability to fly over targets in a low altitude, photograph them, and return to their bases without risking the lives of the crew necessary for flying manned planes. The arming of unmanned aerial tools has gained momentum in the past two decades, as the appropriate technologies matured through the 1990s Revolution in Military Affairs (RMA), and is based on the use of information technologies. American forces are the leaders in the use of unmanned tools, which they employed in operations in Iraq and the currently ongoing operations in Afghanistan, Pakistan, and Yemen.

In Israel, unmanned aerial vehicles (UAVs) entered into operational use in the 1970s, carrying out tasks such as deception, observation, photography, and espionage.[8] The increasing Israeli use of UAVs was clearly demonstrated in the Second Lebanon War, when UAVs logged 15,000 flight hours versus 12,000 flight hours of manned combat aircraft.[9] The missions carried out by UAVs are controlled by human operators, and only some of them have certain autonomous capabilities.

Autonomous Tools

The word "autonomous" defines the operational independence of the tool or the system. An unmanned platform can be completely non-autonomous. Autonomy is commonly divided into four categories:

- *Platforms controlled by human operators:* The human operator makes all the decisions. The system has no independent control over its environment (for example, a toy car operated by remote control).
- *Platform authorized by human operators:* The platform performs actions independently when it is authorized to execute them by a human operator (for example, robotic vacuum cleaners that by being turned on, receive authorization to wander around the house and clean without outside intervention).
- *Platforms supervised by human operators:* The system can carry out a wide range of actions independently when it receives the approval or instructions from a human operator. Both the human operator and the system can begin an action based on information received from

sensors, but the system can do so only within the range of tasks that it is planned to carry out.

- *Full autonomy:* The system receives targets from human operators and translates them into tasks that will be performed without any human intervention, including the stage of planning and choosing the means of implementation. The human operator can still intervene and influence events when necessary.[10]

The majority of tools used today in the service of modern armies have only a limited degree of autonomy and belong to one of the first three categories mentioned above. American Predator UAVs, for example, are used to attack targets on the ground (as of 2012, particularly in Afghanistan) and to control and supervise the landing, takeoff, and time spent in the air with a high level of autonomy. However, the planning of the mission, identification of the target, and the attack itself are guided and controlled by a human operator in a control room on the ground (usually within the borders of the United States, even when the UAV is in Afghanistan).

Tools that are fully controlled by a human operator have existed and been in use on low levels since the beginning of the twentieth century. Dramatic changes will take place if the technological forecasts come true and the tools themselves will operate in full autonomy, requiring fewer operators than are necessary today. Such a technological change would also lead to a dramatic change in the battlefield.

Another term often heard in the context of unmanned combat is "robot." In order for a tool to be defined as a robot, it must enjoy a level of autonomy that would allow it to operate according to the basic principles of "feel-think-act" and include the following elements that enable it to operate:

- Sensors that monitor the environment and detect changes in it.
- Processors ("artificial intelligence"), which determine the robot's response.
- "Effectors" that operate in a manner representing the decision and create a change in the world surrounding the robot.

When these three parts work together, the robot has the functionality of an artificial organism. A tool that lacks one of these components is not a robot.[11] Even unmanned tools that are composed of simple sensors, processors, and effectors but have a human operating the tool's thought processes do not fit the definition of a robot.

Tools for Civilian Purposes

This article focuses on the military sphere, but one cannot ignore the civilian dimension, especially because these realms influence one another and their developments are being implemented and are relevant. Unmanned tools, beginning with industrial robots with various levels of autonomy, are becoming more and more common in civilian factories and manufacturing sites. These tools developed from machines, which are associated with the industrial and technological revolution.

Industry, however, is not the sole factor in the revolution of unmanned tools and systems. In recent decades, robots have been adopted in medicine, services, and housework. Medicine is the most prominent of these fields, and even today, many robots are being used in surgeries, wandering independently within the patient's body for medical purposes.

Advantages of Unmanned Tools

There are three prominent advantages to the usage of unmanned tools. The first advantage is unmanned tools' reduction of risk to soldiers' lives on the battlefield, as their use allows for an increase in the distance between soldiers and the dangers to which they were previously exposed. In such instances, the tools even allow the operator to be removed from the battlefield as in the case of a Predator UAV operator. In the liberal democratic countries that lead the development and usage of unmanned tools, human life is sanctified, and the reduction of risk to soldiers' lives becomes the foremost advantage.

Another advantage of these tools is their miniature size and precision. The multiple yet limited conflicts of the past two decades have been categorized as severely asymmetrical and as creating numerous situations of urban warfare. Current unmanned tools emphasize the asymmetry between modern countries, which make use of advanced technology for combat, and their adversaries, violent non-state actors, which sometimes fight using primitive means against states. The majority of today's unmanned tools are more suitable for achieving the goals of current conflicts as they are more precise and accurate, and are miniature in their size in contrast to tools developed at a time where all-out wars erupted between states. Their usage is helpful in confronting some of the challenges posed by the current type of warfare, and in particular, in reducing collateral damage and harm to non-combatants.

The third advantage of unmanned tools is economic. Though in this point development and procurement are expensive, in the future, the usage of these tools could significantly lower the modern army's maintenance costs. The current savings are reflected in the low cost of some of the tools, which results from the trend toward miniaturization and the availability of technologies. The savings are expected to grow, especially when the technology will allow a large number of tools to be operated by one person, or to become autonomous, saving money on a large number of operators' salaries. Elements of savings in such tools can also be found in cases where the unmanned tool is damaged, for example, as unlike human soldiers, these tools do not have a family that would be supported financially by the state. The trends toward future cost reduction are among those tipping the balance in the direction of a preference for unmanned tools due to the realization that in the long term, this solution will be cheaper than the existing situation.

Unmanned Tools in the United States: Development and Future Plans

The advantages presented above—among many others—have not escaped the US government, which, in 1999, announced the Future Combat System (FCS) program. The program was due to begin in 2015 and entailed far-reaching reforms to its ground divisions' structure, operation, training, and the replacement of manned tools with unmanned ones. Under it, both manned and unmanned tools were scheduled to operate in the air and on land and communicate among themselves through a unified information system.[12] The program ran into budgetary and deadline difficulties, and, in 2009, it was decided to reduce its scope, specifically in the area of unmanned tools. FCS was then replaced with Brigade Team Combat Management (BTCM), a program that also included a large number of unmanned tools, scheduled to be added to the forces, or to replace manned tools that are scheduled to be removed from use.[13]

The new program is in the implementation stages, but even before its full implementation, unmanned tools are already playing a major role in the battlefield. As noted previously, US forces that are operating in the air and on the ground in conflicts such as in the Middle East are making extensive use of such tools.[14] The mixture of soldiers and robots indicates a dramatic change within a relatively short period of time. Given its future

plans and the existing numbers, there is no doubt that the United States is the leading power in the realm of unmanned tools. In 2001, for example, when the United States entered Afghanistan for the first time, it had a small number of unarmed UAVs, and did not possess unmanned tools for terrestrial use. Approximately ten years later, the United States is making use of more than 8,000 unmanned aerial vehicles.[15]

The change in the United States applies not only to purchasing trends, but also to the mixture in the use of force. Until 2009, the Predator UAVs had racked up 295,000 flight hours, but in 2010, it had already crossed the million flight-hour line.[16] This increase in the Predators flight hours reflects a dramatic change in the use of unmanned tools. Considering that the number of clashes the United States was involved in between 2009 and 2010 did not increase this change, becomes even more significant. Reports written by the Obama administration prior to the November 2012 elections state the government's desire to establish regulations on the killings of terrorists using UAVs. It then becomes evident that this change was not coincidental but rather a result of decision[17] and indicates the importance the administration attributes to these tools and their usage in the war on terrorism.

The preference for unmanned tools is reflected in budgetary terms as well. According to the American roadmap for unmanned systems, a budget of more than 6 billion dollars per annum was allocated for the development of unmanned tools between 2011 and 2015.[18] This is almost 10 percent of about the total US defense annual budget of 70 billion dollar, allocated to research, development, testing, and evaluation.[19]

Unmanned Tools around the World

The development, production, and assimilation of new technologies require a significant monetary investment, and the United States is surely not working alone in this field. Israel is also a superpower in the area of unmanned systems, which is relatively surprising, given its size and economy. A number of Israeli companies are active in this field, exporting unmanned systems and related services to various countries around the world. In terms of purchasing and procurement, however, a number of other countries are equipped with larger numbers of medium or heavy UAVs, some of which are used in attack missions. Among the countries in possession of dozens of unmanned tools are Great Britain, France, Egypt,

Turkey, and Singapore, as well as other countries that operate an unknown number of such tools.[20]

It is troubling yet not surprising that the development of unmanned tools is also affecting the behavior and efforts of violent non-state organizations, such as Hizbollah and Hamas, which attempt to develop, purchase, and operate unmanned tools. They have had some successes, such as the Hizbollah-operated unmanned aerial vehicle that penetrated the Israeli airspace in October 2012,[21] or attempts made by Hamas, foiled in Operation "Pillar of Defense" in November 2012, to operate UAVs.[22]

Given the availability and accessibility of such technologies, alongside the reduction in price, these first attempts made by non-state organizations are not surprising. Tools and their parts can be easily purchased for a few hundred dollars on various websites or in electronic stores. They are controlled by smartphones, remote controls, or embedded sensors, and are sometimes produced by the same companies that manufacture military robots (such as the American company IRobot). These off-the-shelf technologies can be used by terrorist organizations for violent operations after the appropriate conversion and customization is performed.

From developments in a variety of fields, through budget allocation, to change in operating trends, the change in the field of unmanned tools that has taken place in the past twenty years is significant. Much more development is necessary, however, and the future of the unmanned industry today is equal, according to some researchers, to that of the automobile industry of 1910 or the computer industry of the 1980s.[23]

The Technological Challenges

The field of unmanned tools is relatively new and therefore still limited technologically in a number of ways. Although a great amount of resources are being allocated to its development, it still faces a number of technological challenges, which make it impossible for unmanned tools to execute the entire range of tasks that are performed by manned tools and soldiers today. This hurts the credibility of unmanned tools and the ability to depend on them, even for the tasks they are qualified to perform. The following are some limitations that create technological challenges for the developers of unmanned tools:

- *Limited visual range:* Unmanned tools are capable of reaching places soldiers cannot due to physical and physiological limitations. The

limitations of their sensors, however, do not allow the range and level of vision and identification that would be possible if a human being was present.

- *Difficulties in ground tasks:* There are two particularly conspicuous problems in ground tasks. The first is the difficulty unmanned tools have in coping with obstacles, particularly negative ones like sharp drops or cliffs, adapting their operation to the environment, identifying and coping with unfamiliar territories, and moving on them. Another problem is the difficulty in cooperation and operating interfaces (communication) between soldiers and unmanned tools and the difficulty in working side by side.
- *Difficulties in subsurface tasks:* Unmanned tools that work underwater are affected by problems such as pressure, and also by turbulence. Problems of communication and poor visibility are also common in maritime tasks.
- *Cyber threats:* A group of students from Texas succeeded in taking over US army UAVs with the minimal investment of less than a thousand dollars.[24] The report on this, alongside reports on other tools that have been taken over, and on information transmission that was intercepted, exemplifies problems of information security. An operational example of this issue can be seen in the claim by Hizbollah that its successful attack on IDF soldiers in the 1997 naval commando disaster (Shayetet 13 Disaster) was made possible by its success in intercepting information transmitted from an unmanned aerial vehicle belonging to the IDF.[25] Beyond the spillover of information to the enemy, the great fear of using unmanned tools is of a hostile takeover by various elements, which would remove the unmanned tools from use, or even turn them against their operators.

In addition to the challenges described above, the ability to invest in development is also influenced by budgetary constraints and the global economy. In addition, the duration of technological development is problematic, as it is sometimes drawn out, making it difficult to meet deadlines. This presents a difficulty, particularly when the tools are intended to replace outdated manned tools that are being removed from use. It would appear that technological challenges can be more easily solved than non-technological challenges.

Non-Technological Challenges and Lessons from the Past

In addition to technological challenges, other factors affect the development of unmanned tools. As noted above, the countries leading in the development of this field are liberal democracies, and a public discussion about these tools' nature and usage is present. After about ten years in which the United States and Israel have used unmanned tools intensely, particularly aerial tools, we cannot ignore the impact that the partial or full removal of the human factor from the battlefield will make on the nature of the fighting, and, even more so, on the definition of war.

These changes of definitions are evident already. Peter Singer, an expert on military robots argues that the 118 American unmanned attacks carried out in Pakistan until 2010 are not defined as a war. This is particularly interesting as the number of unmanned attacks in Pakistan doubles that of manned bombs carried out in the beginning of the 1990s military operation in Kosovo, which was defined as the start of a war. Singer wonders if this approach is based in the fact that the American operations were conducted by the CIA and not by the military, or perhaps because the American Congress was never asked to vote on them. This could also be the case due to public opinion that does not consider unmanned attacks as events with a cost, or because of the changing definition of war.[26]

The situation indicates that the removal of the human factor from the battlefield could change the conventional terms of war. The reduction in costs and the change in methods of operation could perhaps even indicate that we are on the verge of a paradigm shift, one that will revolutionize military affairs. The main challenge is in adjusting to the new terms and approaches, as well as in acquiring a profound understanding of the advantages and disadvantages of unmanned tools.

In spite of the challenge, various players from both in and out of the United States already understand the change that is taking place. Their arguments concern several aspects such as the slow pace in which international law adjusts to or addresses technological changes as treaties limiting the usage of this new technology have yet to be produced. This results in the possibility various international players such as states and non-state actors have to exploit legal loopholes and operate unmanned tools in ways they are not allowed to do with other tools. Human rights organizations are expressing concern over irresponsible use of unmanned tools as well as regarding future use of completely autonomous tools,

which could harm civilians without there being a human on the battlefield preventing this or held accountable. Various political figures and human rights organizations are calling for the establishment of a treaty that would monitor armed robots.[27] Fears stemming from science fiction speak of an autonomous system that slips out of control and harms its creators or operators, just like in *The Terminator* movies, where an autonomous computer system built for the purpose of protecting the United States goes out of control and attempts to exterminate the human race. The first movie, released in 1984, reflected the fear of computer technology, which was starting to become widespread at that time, but also sparked and inspired current fears of autonomous unmanned tools.

A moral question that is discussed and is also relevant to tools that operate through a remove control is whether robots make killing too easy. The operators of these tools are not physically present on the battlefield risking their lives, but still have the ability to end their enemy's life at the touch of a button, as if playing a computer game. This fear is supported by the large number of attacks and killings in Afghanistan, which also took hundreds of civilians' lives.[28]

The trend of self-defense and distance from the battlefield is not new. A historical review indicates there is a constant trend to develop tools that enable the protection of human beings by their removal from the battlefield while still providing them with the possibility of striking the enemy. As part of this trend, the ranges of weapons increased and the physical strength required for their operations has decreased. In current times, we are moving towards a new level—wars that are carried out by brain power as opposed to brute strength. The previous level of distance and self-defense, took place at the start of the 1990s with the revolution in military affairs, which allowed the use of counter munitions, like precision-guided munitions that could be shot from outside the threat range of surface-to-air missiles.

The US administration has attempted to answer the general public's reservations and concerns. The first, unofficial action of the Obama administration—which, since the 2008 inauguration, approved some 300 UAV attacks, resulting in 2,500 dead, including 153 citizens[29]—was intended to prevent the reservations from affecting the use of unmanned tools. The administration attempted to establish procedures for targeted UAV attacks even before the 2012 presidential elections due to concerns that Obama

would not be reelected. When Obama won the election, the initiative was postponed.[30]

The second action taken by the US administration came in response to the growing public fear of autonomous tools and to actions taken by human rights organizations on this issue. In November 2012, the Department of Defense published a directive declaring that it would not purchase or use manned or unmanned weapons systems that were fully autonomous in any attack mission and that there would always be a human operator involved.[31]

The fact that the administration voluntarily limited itself raises questions. Is this an action that stems from true fears and the desire to avoid unnecessary loss of life, or is it an attempt to silent the media and the public in order to allow for continued development of this field without interference? And is this limitation imposed on autonomous tools by the Department of Defense sufficient? It is difficult to provide unequivocal answers to these questions, but inspiration for this discussion can be drawn from previous restrictions imposed on other types of weapons.

Weapons of mass destruction, which include biological and atomic weapons, were previously limited internationally in their use through the Nuclear Non-Proliferation Treaty (NPT), on which most countries in our world are signed.[32] Nuclear weapons can be compared to unmanned tools as they can both serve for military and civilian purposes (Dual-Use). For example, nuclear technologies also run nuclear power stations, supplying most of the electricity in certain countries.

Autonomous unmanned tools have many possible applications in a range of civilian areas as well. In spite of the restrictions and the supervision on weapons of mass destruction, it has become clear over the last decade that it is very difficult—if not impossible—to prevent a state from developing these types of capabilities if it insists on doing so. We can conclude from this that even if there would be treaties and restrictions on the development and use of autonomous weapons, it would be difficult to stop a country from developing such technologies, especially if the development was done in non-military areas (and later converted into deadly weapons, or alternatively, slipped out of control and became deadly by mistake).

Even today, autonomous unmanned technologies are developed and researched not only for military purposes, but also for various civilian purpose like improvement of transportation, industry, medicine, home appliances, and so on. If the United States or any other country truly aspires

to restrict autonomous unmanned tools, it must first restrict the research and development of these tools in both academic and civilian companies, just as other sensitive scientific fields are restricted, such as genetic engineering. Restrictions are specifically important in the autonomous tools' field as a situation can occur where a fully autonomous humanoid robot with learning capabilities in research or services could turn deadly as a result of error or malicious intent. If this occurs, a robot, unlike a human, is unstoppable. If development of autonomous unmanned tools continued or increased without thought, supervision, control, the risks science fiction presents could become a real and firm reality.

Review of the history of the arming of states shows us that restriction of weapons is not an easy process—when one state achieves capabilities in a ground-breaking field, other countries usually aspire to acquire the same capabilities. In cases of existing conflicts and tensions, it even leads to arms races (such as the nuclear arms race). Lowered cost and availability of unmanned tools have made it easier for violent non-state actors to acquire them, which strengthen the hypothesis that stopping development would be difficult. Eventually, even countries that do not wish to participate in the unmanned arms race will be forced to do so for deterrence and self-defense purposes.

Alongside the fears mentioned above, there is an ethical dilemma as well: the people who operate unmanned tools will be required to make responsible and moral decisions on dilemmas connected to the machine's ability of taking human life with various levels of autonomy. Similar dilemmas will arise regarding any unmanned or autonomous tools that have the ability to make these decisions regarding human life, like the tools currently used in transportation and medicine. These dilemmas, along with legal dilemmas in the political and international realm, are worthy of an in-depth discussion in a separate article.

Conclusions

Unmanned weapons play a significant role in the twenty-first century battlefield. They have already proven themselves operationally, which leads to increased development attempts and purchasing of tools, particularly among fighting forces of democratic states. This modern trend raises questions in various areas, and the most conspicuous ones are that of moral and legal nature. In recent years, there have been calls demanding

to restrict the development and use of unmanned tools, but despite these moral concerns, the use of unmanned tools has grown considerably.

President Obama led the trend of increased unmanned tools' usage mainly to allow for aerial attacks in the asymmetric conflict between the US and violent non-state actors in Afghanistan, Pakistan, and Yemen. American declarations on restricting the use and purchasing of full autonomous weapons are a response to the calls asking to restrict these weapons. These declarations do not stop the US and other countries from developing this technology for both military and civilian usage.

One can conclude that under the current circumstances it is difficult to restrict unmanned tools, and perhaps there is a lack of desire to do so. Development of these tools will not cease even if some steps are taking to delay it. Though there is certainly a need to supervise and restrict this field, the anticipated difficulty of doing so is great as these weapons are inexpensive, available, and have current and future civilian uses. It is important for decision makers and for the public to be aware of the advantages and the potential inherent in unmanned tools, but also of the risks this field brings with it, which should be addressed in a serious manner.

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