Changing Trends in Unmanned Aerial Vehicles: New Challenges for States, Armies and Security Industries

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In recent years, the use of unmanned aerial vehicles has been on the rise. However, there is an evident change in constituent components. As the number of countries utilizing these vehicles continues to increase, the manufacturing process has been revolutionized, allowing many nations and commercial companies to manufacture and sell UAVs to the highest bidder. The changes in manufacturing processes have given rise to an expansion of their possible use, including terror. These changes require a reevaluation in order to face the dangers and enjoy the advantages created by them.

Keywords: UAVs, robots, states, aerial defense, terrorist organizations, military industries, technology

Introduction

The continuing increase in the use of Unmanned Aerial Vehicles (UAVs, also known as drones) is nothing new. Over the course of almost two decades, they have constituted a fascinating field in terms of technology, economy, and tactical and strategic impact. While the use of UAVs continues to grow, the factors influencing that use are changing, posing a significant challenge to international actors.

The current paper posits that the changes in trends regarding UAVs extend beyond the frequency of their use and acquisition in the military realm, as UAVs are entering the civilian and commercial spheres. Consequently, the paper examines these changes along with trends-within-the-trend

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at the state level, in the military, military industries and technological enterprises, seeing as the formulation of appropriate policies in the field and their correct implementation may generate many potential benefits.

It is the author's assertion that decision makers and the security establishment must pay attention to these changes, prepare for threats and exploit the opportunities stemming from technological developments in the UAV field.

Steady Growth in the Use of UAVs

Over the course of the past two decades, technological developments and the miniaturization of powerful computer capabilities have led to far-reaching changes in the machines surrounding us.

Consequently, the use of unmanned tools and robots has dramatically increased in diverse fields such as industry, transportation, medicine, household maintenance and security and military applications. A significant change took place when the United States engaged in offensive action in Afghanistan and later in Iraq, creating the need for military solutions, some of them in the form of unmanned vehicles, with an emphasis on the aerial dimension.

According to the US Department of Defense, "an unmanned platform" is "an air, land, surface, subsurface, or space platform that does not have the human operator physically onboard the platform."[1] There are currently many different types of aerial platforms used in the military, from miniature vehicles the size of a small bird or even an insect, through small and mid-sized vehicles that can be carried by a single soldier or small team and later assembled in the field, similar to or even larger than manned vehicles. These platforms differ from one another in their flight altitude, effective range, and most importantly the tasks and missions they are designed to carry out.

The United States was and remains (as of 2014) the leader in terms of UAV development, manufacture and use. In 2001, when US troops engaged in an offensive in Afghanistan, the United States operated some 60 UAVs. By 2012, the United States had more than 7,000 UAVs, representing about 31 percent of all aerial vehicles in the United States Armed Forces, including the small UAVs operated by ground forces.[2]

As a result of the growing operational use, there has been a significant increase in the budgets allocated by the US administration for UAV research and development, acquisition and training. In 2001-2013, the US

administration allocated $26 billion to the field, a significant increase from the 1988-2000 budget of $3.9 billion.[3]

The United States is not the only country with a long record of developing, manufacturing and using UAVs: Great Britain, Germany, France, Israel, India, Turkey and Italy have also been involved in UAV development and manufacturing. The European nations, for instance, have accumulated operational experience in deploying these vehicles during the war in Afghanistan.

The systems' proliferation (mainly small UAVs) and the reduction of costs and obstacles to entering the field (such as the ability to make effective use of them) currently allow a more widespread use by private individuals, companies and countries with limited financial resources.[4] This constitutes a change from the past decade, in which UAVs were used for military purposes by an exclusive group of nations. Between 2005 and 2011, the technologies' reduced cost caused an increase in proliferation, as the number of countries operating UAVs grew from 40 to over 70. Some of these countries have the capability to independently develop and manufacture these vehicles.[5] Consequently, several trends have emerged in the field and shall be discussed in the following sections.

Factors Facilitating Change

Changing trends are often the result of certain factors and are facilitated by others. The following section will discuss the factors facilitating the changing trends in unmanned platforms.

a. **Rapid technological development:** over the course of the past decade, the rate of technological development has been accelerating in perhaps the fastest pace in human history. The current changes are based on a revolution in information technologies beginning in the 1980s. During the 1990s, information technologies ripened into the "information revolution," catalyzing extensive changes in various fields, including military doctrines of warfare.[6]

b. **Reduced cost:** improvements and advances in research and development lowered the costs of technologies. While some technologies remain very costly and relatively rare (e.g., supercomputers), what was once considered a "supercomputer" (for instance, during the "Space Race") is now at the fingertips of anyone with a smartphone.

c. **Globalization:** despite some limits, the impact of the global village often minimizes the geographical distance between individuals.

d. **Availability:** Technologies are becoming increasingly available not only because of their reduced cost but also because of the ability to trade and transport commodities, whether via the Internet or by other means. In other words, lowered costs along with globalization give rise to availability.

e. **Lack of legislation and regulation:** Technology is outpacing law, since the legislative and legal systems must become acquainted with technology and must engage in long bureaucratic processes in order to produce relevant legislation and enforcement. As a result of the incongruent development speed, technology with harmful potential may develop to the point of no return with neither local nor international legislation being able to limit its development or use.

New Manufacturing Actors

Another change is taking place among UAV manufacturers. In the past two decades, the two leaders in the manufacturing and sale of UAVs have been the United States and Israel. Both countries have large UAV industries and enjoy significant operational experience.[7] The United States is the leading country both in the development and manufacturing of UAVs and in their use around the world. Throughout the years the main designation for US-manufactured UAVs has been military, and currently the US armed forces are in control of a fleet of over 7,500 UAVs.[8]

Although it is a relatively small country, from 2005 until 2013 Israel was the world leader in UAV export.[9] According to various unofficial reports, Israel exported UAVs to almost 50 nations including Australia, Croatia, France, Germany, Singapore, Thailand, Turkey and the United States, and these are just the tip of the iceberg.[10]

Both the United States and Israel have introduced new models in the past year, such as the Israeli Super Heron and the US X-47B. These are generally large platforms and sometimes have advanced capabilities such as very long flight ranges, aerial attack capabilities, stealth capabilities and autonomous (i.e., requiring no human intervention) takeoff and landing capabilities. Nevertheless, as of the middle of 2012, almost 50 countries were manufacturing roughly 900 different types of UAVs.[11]

Europe

European nations, mainly Germany, Great Britain and France, have also been developing, manufacturing and selling UAVs, though their industry was not as developed or large as that of the United States and Israel. A prominent example is the unique joint effort between Britain and France announced in 2010[12] whose first product is a UAV called the nEUROn- a combat UAV with stealth capabilities.[13] Other countries involved in the project were Italy, Sweden, Switzerland, Greece and Spain. Similarly, Germany and Spain are working together to develop a combat UAV called the Barracuda, supporting capabilities that are similar to the nEUROn. These ambitious programs are evidence of a European attempt to collaborate in order to close the gap and enter the market currently controlled by the US and Israel.

Russia

The Russian leadership is well aware of the contribution of UAV technology to US military capabilities and operations, including the extension of its operations to regions in which it is not physically present at a fraction of the cost of military intervention and with little to no media attention. Along with economic factors, this served as an impetus for the Russian national program in the field of unmanned platform development. Russia intends to invest $9 billion by the year 2020 in a project to develop UAVs with intelligence gathering, communications and combat capabilities. These platforms are intended to join the fleet of some 500 UAVs, primarily manufactured by the United Arab Emirates and Israel.[14] The Russian initiative indicates a trend common to large, powerful nations seeking to control and assert their power in the international arena.

China

Another national program, perhaps even more worrisome to the west than the Russian one, was initiated in 2011 by the Chinese government. At the time, the Chinese regime announced its intention to match the United States' UAV fleet and even create a larger one.[15] The Chinese have articulated a plan of action and are working assiduously to realize it, the products of which are presented in various military parades.[16]

China is currently equipped with hundreds of UAVs, and in 2011, for instance, it operated 280 vehicles.[17] Furthermore, it is a member of the

relatively exclusive group of nations manufacturing UAVs with attack capabilities. However, unlike other nations making such vehicles, China is not a signatory to treaties restricting their sale (such as the MTCR or WASSENAAR agreements). Consequently, these vehicles may find their way to various buyers, and may even undermine the familiar balance of power in the international arena. In addition, nations that for ideological reasons are opposed to purchasing technologies from the United States or Israel may use China to acquire such equipment. Moreover, according to several reports, Chinese hackers are busy breaking into and stealing US drone software and technology, which could enable China to utilize similar programs.[18] However, the Chinese conduct is not the only worrisome factor in this context. Another element liable to undermine the familiar balance of power is the entrance of small countries into the field of UAV manufacturing, which until now was reserved for nations with great industrial and military strength.

Small Nations

Technological changes may give rise to the introduction of small nations into the field. If, in the past, the privilege of utilizing unmanned capabilities (for operational military purposes rather than in amateur settings) was reserved for advanced nations with highly developed military industries – the superpowers and their allies – the current trends indicate a change, mainly due to the lowered cost of the technologies involved. However, such nations joined the group of states using UAVs already in the middle of the first decade of the 21st century. By the beginning of the second decade, another change had occurred: small nations began to develop and manufacture these vehicles themselves. The new phenomenon is also the result of lowered costs as well as globalization and the rapid and free transmission of information and data theft.

The trend is affecting each and every continent. Today, UAVs are manufactured virtually everywhere, including Ethiopia[19] and Nigeria[20] in Africa, who have both unveiled domestically produced unmanned platforms, along with Colombia[21] and Venezuela[22] in South America, in addition to North America, Europe, the Middle East and Asia.

One of the most intriguing countries riding the bandwagon is Iran. Iran is not considered a superpower, and in recent years it has been subject to economic and military sanctions. Nonetheless, on more than one occasion

over the past few years it has unveiled domestically developed UAVs. Iran is developing – individually, or with, for example, Venezuela – several types of unmanned platforms, including those with combat and even stealth capabilities. If indeed its statements are true, Iran would be the most prominent demonstration of the change in the field: the economic embargo placed on Iran, previously preventing it from acquiring platforms such as UAVs, can no longer prevent the attainment of such technology, even combat UAVs with a flight range of 2,000 kilometers.[23] Domestic scientific and technological capabilities, global changes, and possibly the use of stolen technologies have allowed Iran to circumvent the international sanctions. The new vehicles are essentially different from the first Iranian UAV called the Ababil, a relatively simple explosive UAV put into service in the 1980s which is still being manufactured.[24]

These changes are leading to a proliferation of unprecedented scope. The ability to acquire military vehicles is becoming a greater challenge due to civilian manufacturing for amateur use. In this niche, too, there are many manufacturers and a host of sources from which one can, for just a few hundred dollars, purchase vehicles equipped with sophisticated capabilities. The ability of civilian and military technologies to cross borders and/or be developed in nations not necessarily considered military superpowers also limits the ability to supervise the number of vehicles on the market, whether acquired by states or non-state entities.

Changing Users

The fact that many nations not only use unmanned vehicles but also manufacture and can sell them without any special restrictions means that the user base has expanded; UAV users now include non-state entities, such as terrorist and guerrilla organizations, among them Hizbollah.

Hizbollah, a Shiite Muslim terrorist organization operating in Lebanon, relies heavily on Iran in many ways. The organization operates a fleet of about 200 UAVs supplied by Iran and used for multiple purposes. Until recently, Hizbollah's use of UAVs primarily consisted of executing terror operations against Israel by means of UAVs bearing explosives. However, over the course of the past year, it has become clear that Hizbollah is using its UAVs to gather intelligence much in the same way as nations do. This, for example, enabled the organization to prevent attacks against Hizbollah targets in Lebanon- it detected and thwarted an attempt to detonate a

booby-trapped vehicle.[25] Hizbollah makes similar use of its UAVs to help President Assad's forces fight the rebels in Syria,[26] and it is not the only terrorist organization that has used or is attempting to make operational use of UAVs. For instance, Hamas has been trying to acquire the capabilities to independently develop and operate UAVs for military use.[27] At least one such attempt was identified, and the UAV in question was destroyed by Israel in 2012.[28]

These two examples reflect the attempts by non-state actors to make military use of sophisticated platforms. There is evidence that they also have smaller, simpler tools that any individual could find on the internet for just a few hundred dollars. Previously, the acquisition of UAVs required a large budget and their use was limited. At present, UAVs with video and audio recording capabilities are on the market for a low price, sold to the highest bidder without inquiry into their intended use.

Changes in manufacturers and users create a significant challenge for nations attempting to preserve superiority in their airspace. Aerial defense is currently based on several aspects, as the most fundamental factor is intelligence threat assessment. In the face of extensive proliferation and the introduction of non-state actors, the challenge of ascertaining possible threats and defending against them becomes more salient. Another challenge in defending a country's airspace is balancing between civilian airspace uses and protecting against potentially harmful vehicles. Not only is the detection of a hostile vessel in one's airspace challenging, but UAVs pose an additional challenge due to their size, low altitude and low radar cross-section.

Civilian Use

One cannot ignore the extensive robotics and UAV acquisitions. Many companies have identified the commercial potential in the field, and in the past year there were numerous reports of future plans for using UAVs for a myriad of civilian applications.

The civilian market is far more extensive than the military one; its potential is huge and largely untapped. An economic research group estimated that from 2014 until 2024 the field will be worth some $89 billion.[29] This market's ability to realize this potential depends in part on legislation and regulation. AUVSI, a prominent organization in the UAV field, claims in an official report that the assimilation of UAVs in the US

air traffic system (a long, complex and costly process) in a way that would allow legal, regulated and safe civilian operation of UAVs could generate some $13.6 billion for the US economy in the first three years and create 70,000 new jobs. According to the organization, every day that such a move is not made costs the US. economy some $27 million.[30]

UAVs can have countless non-military applications such as traffic and weather monitoring, search and rescue, environmental protection, firefighting, research, aerial deliveries, and various uses in communications, the press and film. These are but a few of the uses predicted for these vehicles, though the largest market today is agriculture, which may be worth some $2 billion in 2015 in the United States alone.[31]

To this effect, it seems that no nation would want to relinquish the potential benefits of this market, and the lucrative benefits of allowing UAVs to operate in non-military capacities in national airspace shall outweigh the inherent risks. Nonetheless, such operation is not self-evident and creates many challenges for any state seeking to enable it. According to the authors of the AUVSI report, there are several preconditions of which the most prominent is the development of new FAA regulations to incorporate UAVs in national airspace.[32] The dangers vary according to country, as, for instance, the US airspace is not as easily affected by the presence of UAVs while Israel must defend itself from rockets and mortars launched into its airspace, therefore the presence of UAVs may hinder aerial defense capabilities.

The most recent example of an ambitious civilian program to make commercial use of UAVs seems to be Amazon's announcement that it intends to deliver customer purchases at great speed using a fleet of UAVs. For Amazon to be able to operate a fleet of delivery UAVs, there is need for further technological progress, but the technological barrier is not the factor that will curb Amazon's ambition. Rather, laws and regulations currently restricting the use of such vehicles are liable to be a much more significant obstacle. Moreover, because Amazon is hardly the only company seeking to use UAVs, and complex regulation is needed before UAVs can be commonly used in any airspace, it will be extremely difficult to formulate legislation and regulation, not to mention their enforcement and application.

The need to regulate such issues in democratic states such as Israel, the United States, European countries and other developed nations requires a lengthy process. To regulate the field, the following components are

indispensable: thought processes, legislation, regulations, creation of jobs, manpower training, and more. Such processes may take anywhere from a few months (at least) to several years, depending on the scope of regulation one seeks to effect and the amount of resources allocated to that end.

Nations seeking to regulate civilian use of UAVs must take into account several points that can be grouped into three general categories:

a. Safety: The reliability of the vehicles, separating aerial spaces and routes to prevent collisions between UAVs and prevent damage and harm to people, animals, buildings and objects.

b. Security: IFF (Identification, Friend or Foe), appropriate defenses against cyber-attacks and break-ins designed to disrupt the flight of authorized vehicles; preserving aerial preference for military and internal security vehicles in routine situations and emergencies; preserving aerial preference for civilian vehicles, conveyances of passengers and goods; preventing malicious and/or criminal use.

c. Optimal use of aerial space: Maintaining privacy and quality of life (such as the reduction of noise and other environmental impacts that the operation of UAVs is liable to produce).

Lack of Policy and Technological Solutions

It is safe to say that developments in the field of UAVs and their possible effect on threats and challenges in airspace were not sufficiently assessed in the last two decades, nor was any appropriate policy ever applied in order to prepare on the technological, regulatory or legislative levels. Support for the claim that it was possible to foresee the change and prepare for it may be found in the fact that in the military field, US forces' doctrines included references to the development of UAVs for military purposes and the additional operations this required. As part of these plans, the United States could clearly assess the potential in the field and advance and assimilate it in the FCS and BTCM a decade ago. Even if these were not fully realized, and even if they changed over the years, they were very influential in the field and included reference to a wide range of topics that require handling in order to assimilate and make use of these vehicles.

The lack of general preparation has led to a situation in which nations do not passess the technological as well as the legal and systemic solutions to confront the change currently taking place. In terms of defense against possible UAV attacks by hostile nations, non-state entities (such as terrorist

organizations) or criminal outfits, there are currently few solutions providing insufficient coverage, such as the US solution – deploying laser cannons on ships in the Persian Gulf to defend against the threat of Iranian UAVs.[33] To defend larger areas, nations such as Israel train their fighter pilots to identify and bring down UAVs.[34]

Both the American and the Israeli solutions are considered problematic, particularly because of their high cost and inherent threat. Moreover, the ability to take out a hostile aerial vehicle does not depend only on having the weapons that will allow one to do so. It is also necessary to be able to identify the vehicle, to ascertain whether it belongs to a friend or a foe, and to do so within sufficient distance and time to allow a response (such as scrambling fighter jets, which requires several minutes). Currently, there are not enough of technological systems and manpower with the right training to operate them, enabling the identification of such vehicles entering and operating in one's airspace, as well as insufficient systems that can distinguish enemy vehicles from friendly ones, should a decision be made to expand the use of civilian vehicles.

Current radar systems have trouble identifying smaller vehicles flying at low altitude (a category encompassing many combat UAVs and almost all civilian UAVs freely available on the Internet). One may assume that the lack of appropriate systems is also one of the factors affecting the difficulty in allowing the operation of such vehicles in the civilian commercial market: it could be genuinely difficult to identify and follow them, as is the case today with manned vehicles.

Creating regulation and providing licenses for civilian operation of UAVs lags behind the technological feasibility, causing discontent among civilian companies and even leading to court cases against the authorities as well as to attempts to bypass the authorities and appeal to others to approve such use, which in turn is liable to lead to other dangers.[35]

Further evidence of the complexity and salience of this danger may be found in the case that was documented by television cameras in the beginning of 2014. A small UAV, of a type that may be purchased for just a few hundred dollars over the Internet, came within two meters or so of the head of German Chancellor Angela Merkel.[36] The event, which resulted in a smile on the face of the Chancellor, is a clear illustration of the fact that such vehicles are currently being operated without any authorization and are liable to represent a threat with which even the most advanced nations are unprepared to deal.

Policy Requirements

The fundamental assumptions for formulating policy include the following:

a. The existence of free commerce and the difficulty in limiting it as a result of the complete lack of current restrictions are primarily damaging to nations that are signatories to agreements in the field. By contrast, nations that are not signatories and have acquired the ability to manufacture such vehicles in recent years enjoy the current situation, leading to the opposite of the initial intention of these treaties.

b. Acceptance of the extensive proliferation of UAVs as well as a genuine difficulty in keeping up with this proliferation given the ability to build vehicles or buy them via non-state entities and turn them into platforms for espionage, explosives and more.

c. The effect of the above on non-state entities that, under current circumstances, have increasingly greater ability to buy and operate more sophisticated vehicles, posing potential danger to states and the international community.

d. The vast economic potential inherent in civilian and commercial operation. This potential raises the question: when will such operation be legally approved by states? The assumption is that no nation will want to be left behind. Any entity that prepares in time (states or companies producing solutions, both products and services) is likely to benefit significantly.

Recommendations

Given the need to confront a new reality created by the proliferation of UAVs and the desire to make use of their civilian operation, it is necessary to develop new systems with capabilities of UAV identification, location and distance retrieval. This must happen in tandem with efforts by nations, commercial companies and armies to develop or adapt existing technologies to allow for defense against UAVs operated for combat or criminal purposes. In addition, it is important that armies define doctrines and methods for dealing with aerial threats of a new type and train manpower to do so, as well as assimilate suitable tools and technologies.

Furthermore, it is necessary to act at the state and international level to enact legislation and regulation that will allow, to an extent, the regular operation of UAVs for non-military purposes (civilian and commercial) in order to enjoy their potential. To this end, nations should cooperate on

international legislation in the field, defining uniform safety standards, regulating the operation of UAVs in international airspace, and preventing or keeping up with proliferation of vehicles with high potential of becoming a threat (such as armed vehicles). Adopting these recommendations and implementing them could facilitate the defense against threats inherent in these trends as well as benefitting from the advantages these trends can afford humanity.

Conclusion

The use of UAVs has been an increasing trend for the past few decades. However, their use has changed in recent years to include smaller nations and non-state organizations, a larger group of manufacturing nations, and civilian vehicles about to become operational in a wide array of applications in the next few years. It seems that the economic forecasts and the many possible applications of UAVs in the civilian market will result in increasing UAV use despite the dangers they entail and the opposition they sometimes generate.

The combination of widespread proliferation and military use or, alternately, terrorist use, as well as the many future civilian uses, will create a complex airspace arena requiring in-depth understanding and analysis to create solutions, both in the military and civilian fields. States that wish to enjoy the field and reduce the risk generated by progress must consider changes in legislation and regulation, and create technological systems and solutions and deploy them. These are lengthy processes, especially in democratic nations with organized bureaucracies.

In order to locate, create and apply the best solutions in a cost efficient manner, nations would be wise to consider cooperation in regards to international legislation and standardization of the field. States, armies and commercial companies that fully appreciate this complex challenge and that can create the technological solutions as well as assimilate them will be able to enjoy great economic advantages while minimizing the dangers inherent in the changes taking place in any case.

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