INFERENTIAL FOCUS

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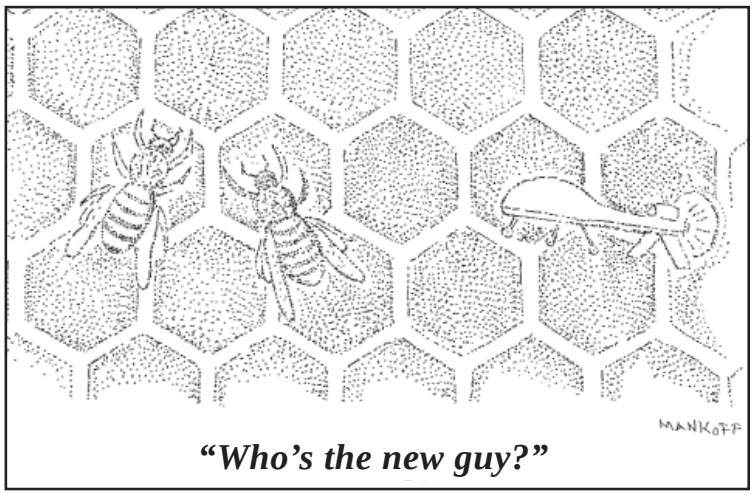
UAVs / Robotics

ATTACK OF THE DRONES!



"Who's the new guy?"

It's the Attack of the Drones! Ad agencies, filmmakers, university researchers, sports teams, humanitarian organizations, public-safety departments, farmers and some of the world's largest technology companies all have something in common: They are using or actively exploring ways to use unmanned aerial vehicles (UAVs), also known as drones. But with privacy concerns and safety issues, both highlighted by a hobbyist recently piloting a drone over the White House fence and crashing it on the President's lawn, drones are also set to become a multifaceted new battlefront in the World of Permeable Borders.

TAKEAWAYS

- The digital-consumer-products revolution has created components that have enabled manufacturers to shrink the cost, size and weight of unmanned aerial vehicles (UAVs, or drones for short), making them available not only to national armies but also to a much broader range of users, including hobbyists.
- An aspect of the Man-Machine dynamic, drones are tools that expand human capabilities and offer companies cheaper and/or more efficient ways to carry out some core functions.
- With their accessible prices and an ability to easily cross borders, drones contribute to the World of Permeable Borders, or what we have called World War III.

IMPLICATIONS

- Drone use continues to expand and replaces some forms of ground-based delivery services and human-piloted aviation services.
- Investments in infrastructure and technology for an air-traffic-control system for drones will be needed.
- Imminent regulations in the U.S. could determine the breadth and appeal of drone capabilities.

COMPANIES

Start-up Companies	
AirDog	Private
Hexo+	Private
Zano	Private
Trace	Private
Ehang	Private
Companies	
Ascending Technologies	Private
DJI Technology	Private
Parrot	(EPA: PARRO)
PrecisionHawk	Private
3D Robotics	Private
AVIC	(SHE:000768)
Northrop Grumman	(NOC)
General Atomics Aeronautical Systems	Private
AAI Corp	Private
Israel Aerospace Industries	Private
AeroVironment	(AVAV)
Elbit Systems	(ESLT)
DHL (Deutsche Post AG)	(FRA: DPW)
Facebook	(FB)
Amazon	(AMZN)
Google	(GOOG)

From the Military to Commercial and On to Hobbyists

Over the last decade, drones have garnered a great deal of attention for their military applications, primarily in America's overseas wars and counterterrorism efforts. American drone strikes in Pakistan, Yemen and Somalia have killed between 3,200 and 5,400 people since 2002, according to the Bureau of Investigative Journalism. France, China, the UK and India are now all investing heavily in unmanned aerial systems of their own. The permeability of borders has been exemplified as U.S. drone pilots, sitting safely on U.S. soil, carry out missions to assassinate terrorist targets overseas. Those missions raise previously unexplored issues, from the legality of invading a country's airspace, to the ethics of technokilling, to the psychological effects the missions have on some pilots, who are physically removed from the theater of war. (*New York*, 10/19/14; *Aviation Week and Space Technology*, 12/29/14)

However, drone usage has gone well beyond such military and intelligence applications. The revolution in smartphones and digital consumer products has helped bring down the price, size and weight of basic components used by drones, including chipsets, GPS, gyroscopes, cameras and other sensing equipment – a shift simultaneously occurring in the manufacture of small satellites. Some drones, like the Zano, are so small they fit in the palm of an adult hand but can capture HD video with a built-in camera. And the market, already replete with 1,500 models of drones, is growing. For instance, GoPro, the maker of small hobbyist video cameras, has begun developing its own line of drones to compete with Chinese drone maker DJI Technology, which recently unveiled a line of hobbyist cameras. (*Verge*, 1/9/15; *Core77*, 12/1/14; *Wall Street Journal*, 11/26/14; *New York*, 10/19/14)

As an extension of human capabilities, drones also represent a facet of the Man-Machine dynamic – what we call "man through machine" – that we explored in a recent *Briefing* (see **IF 3518**, "Once You Have Cyborg Sex…" 12/29/14). UAVs can get a bird's-eye view of the ground, and they are able to move around in ways people and other airplanes cannot. Moreover, they can often do the work of a person less expensively or can be automated by sophisticated software to operate autonomously. Consider some applications where drones are augmenting or replacing human capabilities:

• Agricultural drones can be purchased by farmers for less than $1,000 and flown over fields to monitor crops. Using GPS, they can fly autonomously over a predefined area, much as a Roomba robot can autonomously vacuum the floors of your home. Hiring a manned aircraft for crop imaging can cost $1,000 for a single hour of service. (*MIT Technology Review*, 6/14)

• An archaeological team from the University of Arkansas is using a fleet of drones equipped with high-resolution heat-sensing equipment to fly over archaeological sites and detect buried formations and structures. Notably, a drone with an infrared system costs less than the standard archaeological tool, a magnetometer, and can cover a square kilometer in an hour, an area that a magnetometer would take six weeks to scan. (*BBC History Magazine*, 8/14)

• Similarly, drone/infrared heat-seeking technology was used to fight wildfires in Alaska last summer, helping firefighters locate hotspots, and operating during huge flare-ups in which manned aviation had been banned. (*New Scientist*, 9/20/14)

• China's Ministry of Environmental Protection is using a fleet of drones to monitor industrial pollution from the sky in order to cite polluters for violations. (*South China Morning Post*, 3/11/14)

• The Syria Airlift Project seeks to use drones flown from Turkey to deliver medicine to areas of war-ravaged Syria. Bhutan has launched a similar program to deliver medicine via drones to isolated parts of the Himalayas. (*Venture Beat*, 1/13/15; *New York*, 10/19/15)

• Boat-tour companies have used drones to make ads touting their adventures, real-estate firms use them to film and market large estates, and the Cannes film festival has used them for promotional video shots. (*Ad Week*, 6/23/14)

• UCLA, Miami, Tennessee and Louisville are all college football teams using drones to analyze plays from overhead vantage points. (*Associated Press*, 11/4/14)

• DHL, the global logistics company, has announced plans to use drones to deliver packages to small islands in the North Sea, while Amazon has suggested the potential to use drones on a large scale for same-day delivery. (*New York*, 10/19/14)

Grand Ambitions from Tech Giants

Amazon's stated drone ambitions represent but one of several giant tech firms and institutions that see potential in drones for various purposes. Like Amazon, Google is interested in delivery capabilities. Its long-term projects division, Google X, has unveiled its Project Wing, featuring a hybrid plane/copter that can deliver items to the ground. However, Google is going beyond delivery drones to also invest in technology that can provide the infrastructure to make widespread use of commercial drones possible, including technology for drones to detect and avoid other objects. At NASA's Silicon Valley-located Moffett Field, the agency is developing an air-traffic-control system that could be used for vehicles that fly below the level of conventional civilian and commercial aviation. Rather than use human air-traffic controllers, the system's algorithms would keep drones away from each other, other aircraft and buildings in an elaborate automated ballet. In other words, this is technology akin to Google's autonomous-car efforts, but applied to drones. (*New York Times*, 9/1/14)

Facebook, meanwhile, launched Connectivity Lab, a division of scientists whose goal is to bring Internet connectivity to remote regions. The team includes employees from NASA and Ascenta, the latter being a company that developed the world's longest-flying unmanned solar-powered aircraft, which could be deployed as a form of roving wireless hotspot in the air to deliver Internet connectivity to rural and developing areas of the globe. Facebook has teamed up with Ericsson, Samsung and Nokia in an Internet.org initiative to bring wireless Internet to the billions of people in developing nations who lack it. (*Wall Street Journal*, 3/28/14; *Bloomberg Businessweek*, 4/28/14)

Drones Contribute to the World of Permeable Borders

Recently, a DJI Phantom drone, operated by a drunk hobbyist at 3 a.m., crashed on the grounds of the White House. The drone, which retails online for as little as $420, was not detected by a White House radar system designed to pick up flying objects, perhaps because the two-foot-diameter hobbyist quad-copter is as small as some birds. Coincidentally, the same week, the Department of Homeland Security held a conference to present how hobbyist drones could be used in a terrorist attack, and curiously enough, the presentation used the same model of drone that the hobbyist crashed onto the White House lawn, with a three-pound payload of fake explosives added. A Defense Department official noted that aerial threats over Washington typically result in fighter jets being scrambled, but such a response would not be typical for a toy. The Secret Service, meanwhile, admitted that it had not yet determined how to bring such small drones down if and when they approached the White House or the President. (*New York Times*, 1/26/15)

With their low cost and widespread availability, drones put a new range of tools in the hands of everyday consumers, and as of now, operators of those new tools do not need a license to put their flying objects into the air. Moreover, operators of drones are capable of intentional criminal acts, or, like the drunk hobbyist in Washington, accidents with consequences.

• In January, a six-propeller drone carrying more than six pounds of crystal meth crashed in a parking lot in Tijuana, close to the California border, suggesting drones are being used to smuggle drugs over the U.S. border, in spite of fences and ground-penetrating radar used to curtail trafficking. (*Los Angeles Times*, 1/21/15)

• An athlete participating in the Endure Batavia Triathlon claims a crashing drone struck her in the head, although the drone's owner claims the drone crashed because it was hacked and did not hit the athlete's head at all. (*Ubergizmo*, 4/7/14)

The owner's self-defense suggests another potential risk from remote-controlled UAVs: cyber attacks.

• This year, the Consumer Electronics Show featured several drones that could function as a personal cinematographer, locking onto a single person, and following and filming him or her, all automatically and autonomously. The technology is touted as something one could use to take the ultimate "selfie," but it could similarly be used as an automated stalker or paparazzo. (*Verge*, 1/9/15)

Right now, there is no licensing program or official training required to operate small drones for non-commercial purposes within the U.S., and some models cost as little as $80. We are currently living in a Wild West of drones, but considering the above transgressions and interest by the U.S. Congress, the sheriff may be coming to town. The FAA has been charged by Congress with coming up with new rules for drone operation by September of this year, and has set up six regions in the U.S. where drone testing is under way. (*New York Times*, 8/3/14; *New Scientist*, 9/20/14)

There are so many useful applications of UAVs that regulators will be hard pressed to set up a framework in which drones can be used. However, one could imagine a variety of potential rules, including licensing, mandatory GPS tracking the inclusion of a "black box," or rules prohibiting operation in thickly settled areas. In anticipation of more regulation and a growing use of drones for commercial purposes, Google and Amazon have set up a "drone lobby" in Washington. Meanwhile, investors have established a $2.2 billion fund for drone infrastructure. Given drones' widespread commercial utility and the potential for an explosion of drone uses, how regulations take shape and what they limit and control will be important. The drone lobby and urban administrators will have their say. More than likely, safety and commercial use will find a balance. (*Fortune*, 12/6/14)

"Switching to drones has made having to be everywhere at once much more manageable."