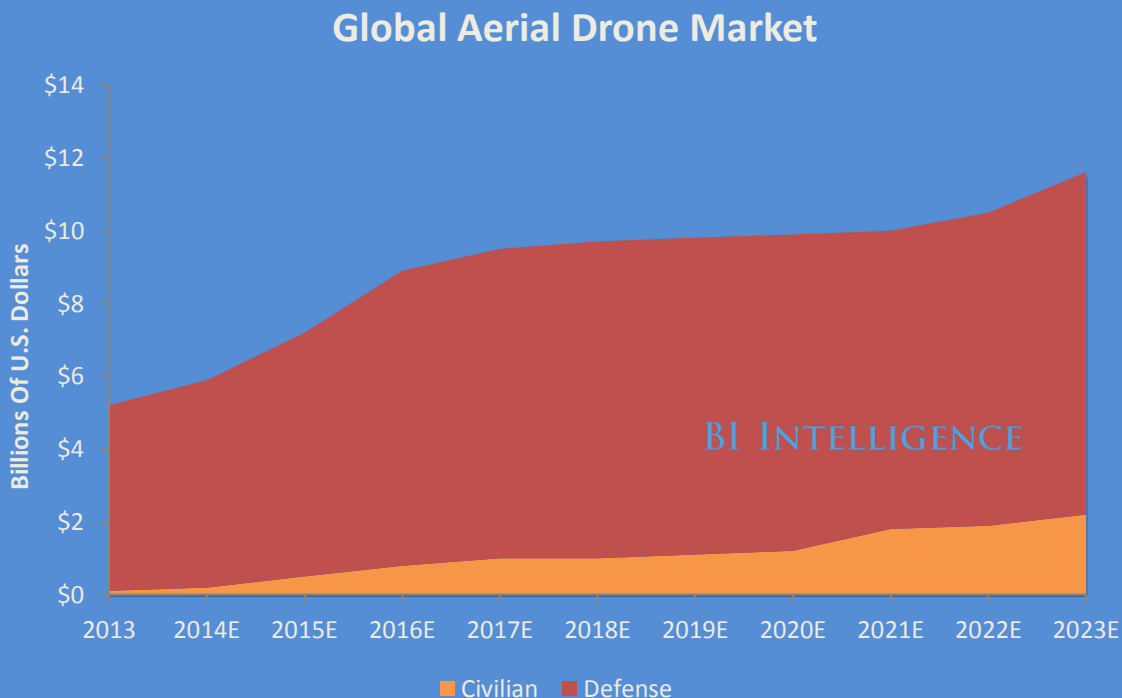


BI Intelligence

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DRONES: Quickly Navigating Toward Commercial Application, Starting With E-Commerce And Retail

Ross Rubin | January 23, 2014



Sources: Teal Group, Michael Toscano, BI Intelligence Estimates

Business Insider

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KEY POINTS

- **The regulatory and technical hurdles for widespread commercial drone applications are numerous, but not insurmountable.** American regulators plan to phase in commercial drone flights beginning in 2015, starting with limited flights of small drones weighing 55 pounds or less.
- **Retail and e-commerce — along with the related logistics and shipping industries — arguably have the most at stake in the wide deployment of civilian and commercial unmanned aerial vehicles, or UAVs.** Drones might be the missing link in the shipping chain that allows for nearly immediate e-commerce deliveries. Amazon's “Prime Air” drone delivery research program aims at deliveries 30 minutes after a customer order is placed.
- Currently, military applications dominate the global UAV market, but commercial applications will quickly ramp up over the next 10 years, particularly after 2020. **We estimate that 12% of an estimated \$98 billion in cumulative spending on aerial drones over the next decade will be for commercial purposes.**
- **Privacy and safety concerns still pose the risk of chilling commercial drone flights in many markets,** but if UAVs are rolled out gradually we believe the benefits of drone-powered commercial applications such as environmental monitoring and shipping will ultimately win public opinion over.

INTRODUCTION

Not too long ago, when most people heard the word “drones,” they thought of unmanned military aircraft engaged in highly controversial clandestine operations. Now, a lot of those same people think of Amazon package deliveries.

When Jeff Bezos announced on the TV news program “60 Minutes” that Amazon was testing the idea of delivering packages via drones, he not only kick-started a good bit of media attention for Amazon, he also made the idea of drones with popular commercial application suddenly seem like a viable proposition — one that might be right around the corner.

Drones are unlikely to become a part of our daily lives in the immediate future. But they will soon begin taking on much larger roles for businesses and some individual consumers, from delivering groceries to revolutionizing private security, to changing the way farmers manage their crops — perhaps even aerial advertising.

There is a strong intersection between drones and “[The Internet of Things](#),” as more devices become Internet-connected and are operated remotely, often by smartphones or tablets. Drones can be viewed as the ultimate mobile Internet-connected object, and many of the technologies that will be used in the Internet of Things may eventually incorporate information received from drones.

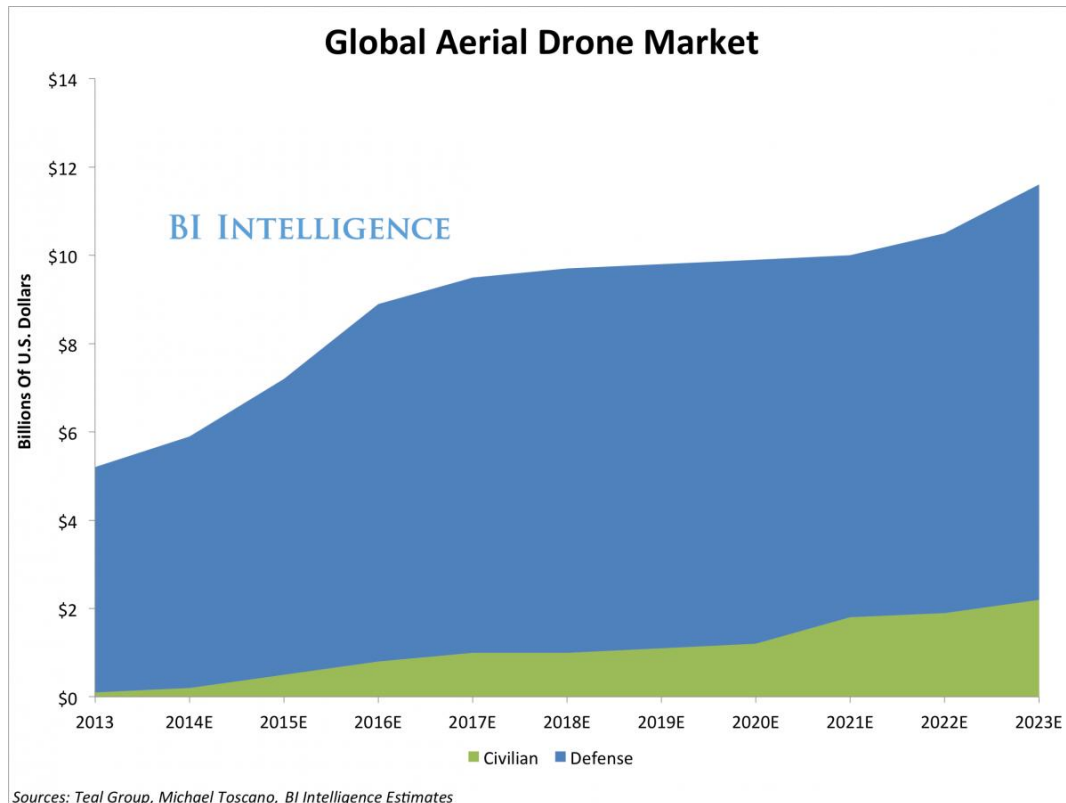
(For more on the IoT, [check out our in-depth recent report](#).)

Drones still aren't legal in commercial airspace. Small drones like [Parrot quadricopter](#) are legal, but only for recreational or hobbyist purposes and they can only be flown below 400 feet.

But the advent of commercial drones is closer than many think it might be. In the United States, [the Federal Aviation Administration, or FAA, is already working on a plan to integrate unmanned aerial vehicles into the national airspace system](#). On Dec. 30, 2013, U.S. government officials [announced](#) six test sites for the development of commercial drones and support systems. These test sites will operate for three years, and determine the rules and timetable for wider commercial drone deployment.

Meanwhile, plenty of companies and startups are experimenting with developing applications for drones, and improving commercial drones' technology and capabilities.

In this report, we survey the industries that seem most likely to embrace drones, as well as examine why Amazon in particular would like to adopt drones for delivery purposes. Regulatory concerns are steep — and rooted in safety and privacy concerns — but when drones are cleared for flight, the potential commercial applications are quite substantial.



And drones aren't even limited to the sky. Unmanned water-borne vessels and terrestrial vehicles could also have significant commercial impact.

Sizing The UAV Market

The aerial drone market will be dominated by military applications for the foreseeable future. But commercial uses will begin to take off around 2020.

- The Teal Group has forecast that annual spending on aerial drones, including civilian and military applications, will reach \$11.6 billion in 2023. That's up from about \$5 billion in annual spending now (with barely any significant spending on commercial UAVs.)
- In all, Teal believes there will be about \$89 billion in cumulative spending on UAVs globally over the next 10 years. Some \$8.2 billion of that amount will be spent on commercial and civilian drone uses.

Our own estimate builds on Teal's numbers and that of other industry observers and comes up with a slightly higher forecast. We believe some countries will adopt drones into national airspace faster than others, and that privacy and safety concerns will fade once the convenience and power of drone technology is demonstrated in certain applications, such as shipping and environmental monitoring.

We believe there will be \$98.2 billion in total cumulative drone spending over the next 10 years to 2023, and \$11.8 billion of that will be spent on commercial/civilian applications.

Delivery By Drone: Why Amazon? Why Retail?

On Dec. 1, Amazon released an [80-second video](#) highlighting what drone package deliveries might look like, and dubbed the service “Prime Air.” Amazon was clear that this drone initiative was still in development at its “next generation R&D lab,” but the video and the “60 Minutes” interview shifted the concept of what a drone is, and its value to society.

Amazon, which has marketed its Kindle devices as being able to deliver books in less than a minute, now has as an explicitly stated goal, the ability to deliver packages by drone in [less than 30 minutes](#). Obviously, Amazon drones would face one important constraint: weight. Small unmanned aerial vehicles or UAVs of the types Amazon is testing can't carry very heavy packages. However, 85% of Amazon's orders weigh 5 pounds or less and so would be deliverable by small drones, according to “60 Minutes.”

UPS, which Amazon relies on for much of its shipping and which would be cut out by such a program, also [announced exploration of its own drone program](#).

Such a delivery method would have a profound effect on UPS's business.

Executives at FedEx, another delivery and logistics giant, have also spoken in the past about how UAVs could make the company's operations more efficient, according to press reports.

[UPS and FedEx drone delivery would not necessarily need to be the same as Amazon's](#). For example, FedEx could use large drones to fly packages from distribution hubs to out-of-the-way airports. There could be huge cost savings in terms of pilot hours and cargo space. UPS might use terrestrial, car-like drones to drive into neighborhoods, as The Verge has written. These vehicles would then release a swarm of Amazon-style small drones to deliver packages to residences.

Why Drones Might Be Key To Retail And E-Commerce

It is easy to see why Amazon would want to start a drone program.

Historically, the retail business has been dependent on transportation innovations for major advances, as tech analyst Horace Dediu [pointed out in a recent podcast](#). Railways ushered in the era of order-by-catalog shopping,

trolleys and subways brought customers to urban department stores, cars spurred the growth of strip malls and suburban shopping centers.

E-commerce would not have been possible without modern air and ground shipping.

Amazon understands that the next winner in retail will be the company that pioneers the next phase in the logistics race.

Beyond increased customer satisfaction due to timely delivery, a service like Prime Air would allow Amazon to control its distribution, rather than rely on FedEx and UPS.

The two shipping companies were [roundly blamed](#) for delivery delays this Christmas, which meant that some of Amazon's customers didn't receive their packages in time for Christmas, as Amazon had promised.

(UPS and FedEx, meanwhile, don't want Amazon to leap too far ahead and cut them out of the logistics market.)

Finally, with 30-minute drone-enabled deliveries, Amazon would counter the threat both from emerging instant delivery services, as well as from bricks-and-mortar stores, killing two birds with one stone.

One advantage of shopping at physical stores is instant gratification. Notably, both Apple and Microsoft operate retail stores where customers can instantly purchase their devices and take them home the same day.

Amazon and its competitors are also locked into a same-day delivery race. Google with [Google Shopping Express](#), and eBay with eBay Now — have launched or are testing express delivery services.

These instant delivery services will bring goods from local retailers straight to your doorstep. For example, if you're working on a home improvement project and need a certain type of light bulb, you may not want to waste an hour going to your local hardware store or wait for a traditional e-commerce delivery.

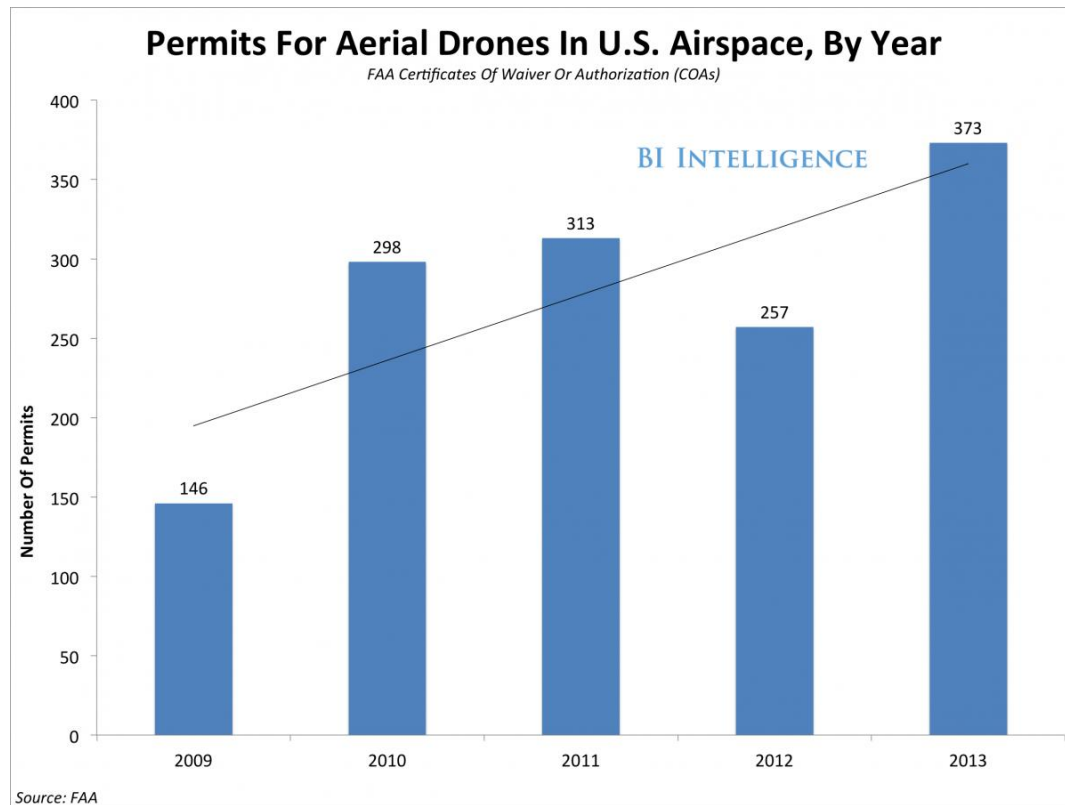
Rolled out slightly more than a year ago, [eBay Now](#) delivers goods from local retailers in about an hour, and is active in San Francisco, Chicago, Dallas and New York.

Amazon also offers same-day delivery, which it calls “[Local Express Delivery](#),” but orders must be placed before early morning in many large cities to guarantee same-day shipping.

Google Express, which also offers same-day delivery, is still only available in the San Francisco Bay area.

If Amazon achieved its goal of 30-minute drone deliveries before its competitors, it would enjoy a considerable advantage in the near-instant delivery race.

Regulatory, Safety, And Technical Hurdles



Currently, the only way an aerial drone or UAV can be cleared for flight in U.S. airspace is to receive a special permit from the FAA.

The [FAA](#) has issued 1,387 of these Certifications of Authorization, or COAs, for limited UAV flights, to government, educational, and research entities since 2009.

As of Dec. 4, 2013, there were [545 active COAs](#), according to the FAA.

The FAA wants to allow aerial commercial drones to fly without these special permits and has put together a plan to make that happen. But there's a big stumbling block: safety. The issues are technical and complex, but they boil down to the very basic question of how pilotless drones will avoid colliding with one another, other aircraft, buildings — and people.

So the FAA is overseeing the gradual development of rules and systems that will guarantee safety, as well as privacy.

(We'll look at the privacy issue in more detail, below.)

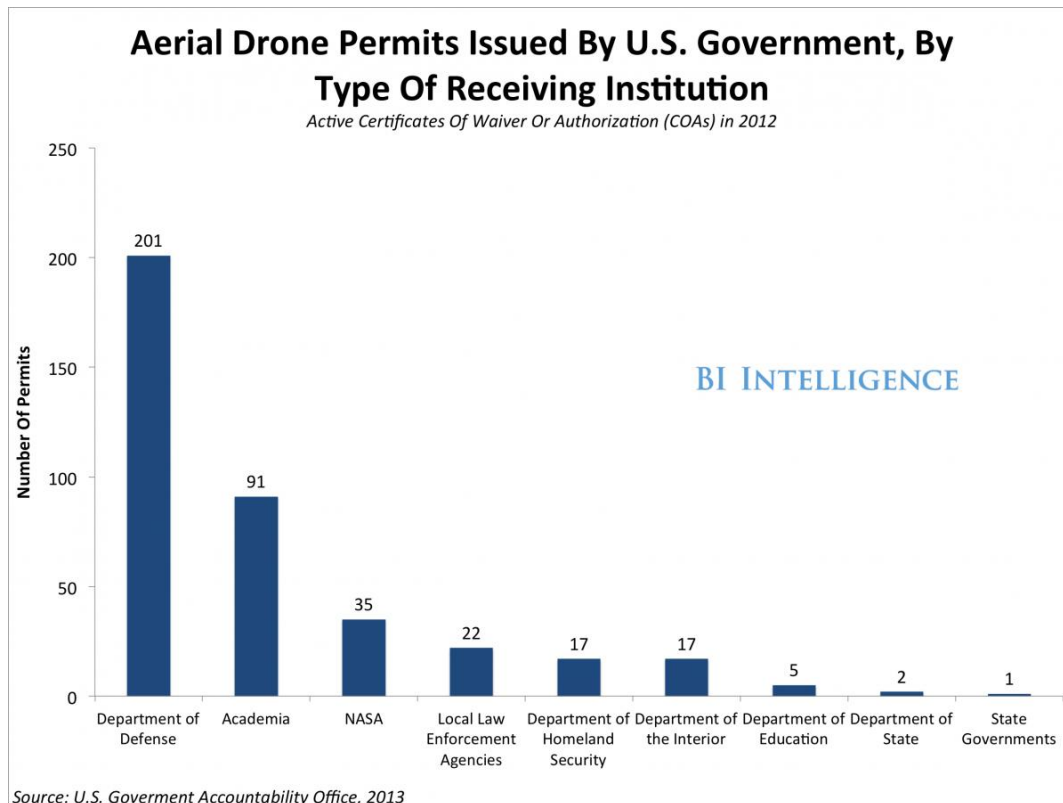
The United States Congress had originally asked the FAA to finalize its plan for widespread commercial drone flights by 2015, but experts agree that it won't be until the 2020s that UAVs will be used routinely for commercial applications such as e-commerce deliveries, security, and environmental monitoring.

“Full integration of UAVS will probably take a full decade and will be done in stages,” Phil Finnegan, Teal Group’s director of corporate analysis, told Business Insider Intelligence.

The process for the integration of commercial UAVs will take place in small steps.

- Small aerial drones will be cleared for flight before large UAVs.
- Drones operated within view of ground-based pilots will be cleared before remote, long-distance flights.
- Commercial UAVs will be allowed in sparsely populated areas and lightly trafficked airspace before they’re cleared for congested skies above cities and airports.

If the FAA rule-making process goes as planned, small commercial UAVs weighing 55 pounds or less, *and* flying within view of a ground-based pilot, will be cleared for flight in certain swaths of airspace by 2015.



The FAA recently chose [six test sites](#) — most of them universities in Alaska, Nevada, New York, North Dakota, Texas, and Virginia — from among 24 applications to further test drones.

Would-be commercial aerial drone suppliers — including firms that are currently defense contractors — will be among the companies allowed to conduct their own test flights and experiments at these sites.

It's important to keep in mind that the commercial UAV plan might be sped up or delayed depending on political, regulatory, or technical factors.

FAA head Michael Huerta said in late 2013 that his own agency believes there will only be [7,500 small unmanned aircraft flying in U.S. airspace](#) “within the next five years, provided the regulations are in place to handle them.”

In Europe, [a similar effort is being led by a group of aviation authorities and overseen by the European Commission](#).

Even promoters of commercial drones acknowledge the interrelated technical, regulatory, and safety hurdles.

“A company like Amazon or UPS could have a safe, operational fleet in 18-24 months,” Colin Guinn, North American CEO for drone manufacturer DJI, [was quoted as saying in The Verge](#). “What we need in terms of tech is improved object detection and avoidance, because GPS coordinates alone won't cut it if you got a car or some kids in the driveway.”

Amazon CEO Jeff Bezos echoed these concerns: “The hard part here is putting in all the redundancy, all the reliability, all the systems you need to say, ‘Look, this thing can't land on somebody's head while they're walking around their neighborhood.’”

Drone Applications

In the meantime, a number of industries are readying for disruption from drone technology, including restaurants, supermarkets, local retailers, courier services, and e-commerce giants.

Michael Toscano, CEO of the Association of Unmanned Vehicle Systems International, [claims](#) that the expansion of drone technology would create more than 100,000 U.S. jobs and generate more than \$82 billion in economic impact in the first decade following their integration into U.S. airspace.

Here are the commercial applications of drones that seem most likely in the near future:

- **Security and monitoring:** Drones could complement or replace static security cameras. In New York, former [Mayor Michael Bloomberg](#) said drones will ultimately supplement or replace the many security cameras operating throughout the city. Security drones might also replace or supplement foot and vehicle patrols at large commercial facilities like factories, office parks, and power plants. Another likely application is the monitoring of ecologically sensitive areas for fires, illegal logging, poaching and other environmental threats such as invasive species. Drones have the ability to cover large chunks of territory very quickly, and cheaply. They can also be outfitted with sophisticated sensors depending on particular needs. For example, [a thermal sensor](#) is an obvious choice for a fire-lookout drone or a UAV patrolling a power plant.
- **Exploration, aid efforts, and disaster recovery:** Drones and other robots could conduct searches to find lost vehicles or enter situations that are too difficult for humans. At a drone competition in Australia, a group developed a drone that was able to scan a 2-mile-square area and locate a dummy “lost hiker.” The technology was believed to be about five years away from use in real search-and-rescue missions.
- **Entertainment:** The [DIYDrones](#) website, started by former Wired editor Chris Anderson, boasts a robust community of hobbyists. Hobbyists account for much of the non-regulated drone activity that has been conducted so far. There are some caveats, though. The FAA forbids flying your Unmanned Aerial Vehicle (UAV) higher than 400 feet in the air. And these drones must be used for recreational rather than commercial purposes. Recreational drone flying is already a fairly established category in the toy industry. There are more than 550 results for “drone” in Amazon's “Toys & Games” section, although only some very high-end models feature GPS capabilities. The quadricopter by Parrot was a trailblazer in developing technology that allows toys to be remote controlled by an iPhone. And one gyroscope-equipped helicopter manufactured by [Syma](#) places routinely among Amazon's top 20 best-selling toys.
- **Delivery and Errands:** Amazon may not be the only company to eventually use drones for carrying everyday items. Drones could be deployed to deliver items such as prescription drugs from pharmacies, meals from restaurants, and food from supermarkets. They could also be used as message couriers, a mechanical reimagining of the carrier pigeon. They could replace the bike- and motorcycle-borne couriers who now ferry legal and corporate documents across large cities. While not able to fly yet due to the FAA restriction, the “[TacoCopter](#),” designed in Silicon Valley, is already able to deliver tacos right to doorsteps in San Francisco via unmanned helicopter.
- **Logistics:** On the other end of the spectrum, [military contractors](#) are already delivering more than 6,000 pounds of front-line supplies via aerial drone to remote locations in Afghanistan. This suggests that delivery via UAV isn't limited by weight. Theoretically, large drones could travel between Amazon's warehouses for use in inventory management, rather than just final customer fulfillment. Of course, the bigger drones get, the more likely they are to become significant airspace hazards.

- **Journalism, filmmaking, and photography:** Recently, a local publication in Washington state published a video of a [polar bear plunge](#) that was shot using an unmanned helicopter equipped with a camera flying about 30 feet above the ground. Because publication of the video constitutes commercial use, the [FAA has responded](#), saying that this activity is decidedly illegal, though they do not intend to pursue action against the paper or the filmmaker (and the video is still available). The recording gives a sense of the possibilities for video journalism and even potentially documentary filmmaking if and when the FAA does approve limited commercial drone usage. As mentioned earlier, the FAA has said that this approval could come as [soon](#) as 2015. At the [Drone Journalism Lab](#) at the University of Nebraska-Lincoln, students and professors already “explore how drones could be used for reporting.”
- **Farming:** The Environmental Protection Agency is apparently already using drone technology to monitor livestock farms, and some farmers will likely eventually begin using drones to [manage agricultural crops](#). Drones could monitor crop conditions from above. That information would then be fed into big data software that could help farmers more accurately harvest their crops.
- **Military.** There’s really no hiding the fact that the highest profile use for drones today is destruction of property and human life. Of course, some of that comes with the intent to protect the lives of pilots and soldiers who might otherwise carry out these missions. According to [Peter W. Singer](#), a Brookings Institution drones expert, the military now has 8,000 UAVs in the air and 12,000 on the ground. The U.S. Air Force now trains more UAV operators than fighter and bomber pilots.

The diversity of these different fields suggests that there are few industries that couldn't potentially be touched by drones, especially on the enterprise side.

It's conceivable to imagine drones flying around workplace campuses monitoring operations or providing a seeing eye to employees who are located remotely.

A Product of Convergent Technologies

The idea of an unattended flying robot servant doing one's bidding may conjure feelings of wonder or fear. But if one takes a step back, it becomes clear that unmanned flight is at the intersection of a few related fields that have been evolving over many years, if not decades.

These are also fields that will likely benefit from wider commercial drone application, as industry investment accelerates innovation.

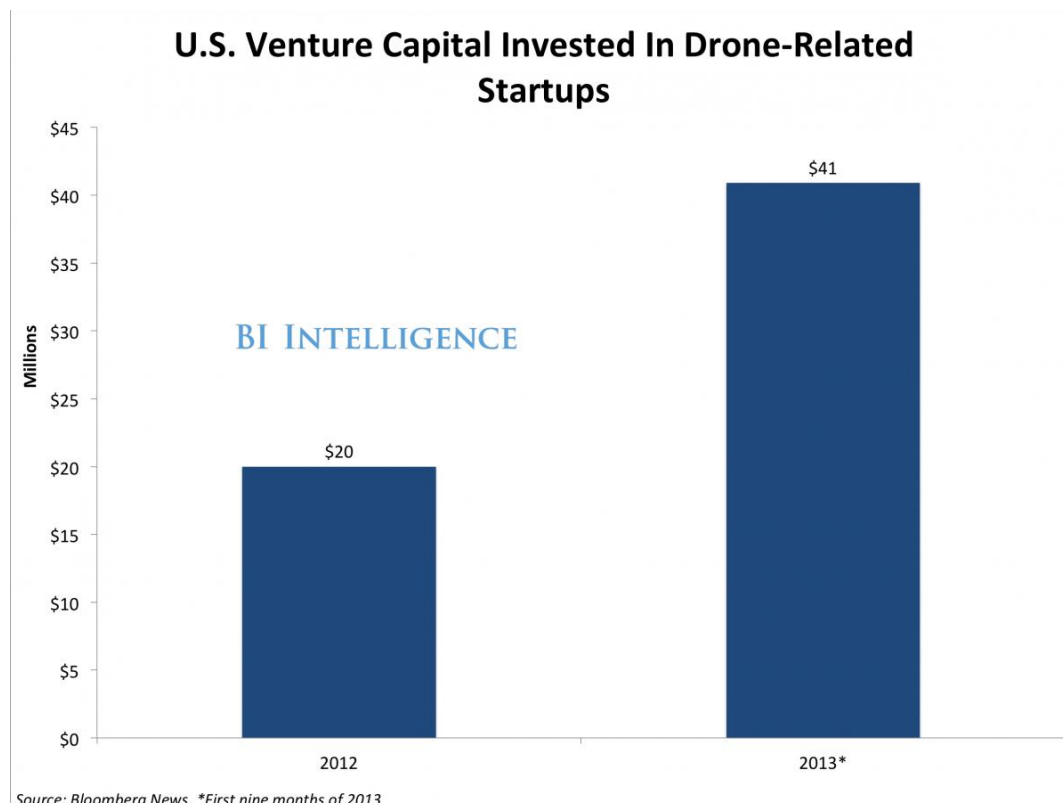
- **Materials.** Since drones need to fly, the availability of light but strong materials is key.

- **Imaging.** Imaging is a key application for drones. The availability of small, high-resolution sensors driven by the phone camera market will help drones take high-quality photos.
- **Power.** Many flying drones have four or even six propellers. These consume a lot of power. Batteries need to be strong, and long-lasting.
- **Sensors.** Drones are used to collect a wide range of information and stabilize themselves using gyroscopes.
- **Location-awareness.** A drone must be able to find its way in order to navigate without active human steering. Clearly, GPS is a key technology for this outdoors, but there are other methods, such as cellular triangulation and Wi-Fi hot spot tracking, which are used by smartphones as well.

For drones to be used on a large scale — whether by e-commerce players, transport companies, or one of the other industries we'll look at below — they will eventually have to take on a variety of sizes and shapes.

[Unmanned aerial vehicles can have wings as large as a sports field, or be as small as insects.](#) The variety of shapes and sizes that UAVs will assume — from tiny hummingbird-sized nano-UAVs to cargo plane-sized gliding drones — means there will have to be accompanying innovations in aeronautics, both on the manufacturing and design sides.

UAV Startups And Innovators



A full survey of companies active in the UAV market is beyond the scope of this report.

But since the defense industry and its contractors have historically dominated the aerial drone market, we thought it would be useful to spotlight a few players that are focusing on commercial rather than military UAV applications.

- **DroneDeploy** is a startup that's building software to make drone operation “simple and reliable,” according to its website. According to Bloomberg News, DroneDeploy received financing from venture capital firm [Draper Associates](#).
- **Airware** is a Newport, Calif.-based firm building hardware and software-based platforms for manufacturers to develop their own custom drones. The company's motherboards start at \$3,900.
- **Parrot's AR.DRONE 2.0** has emerged as a top-of-the-line hobbyist drone, operated by a [full suite of Android, iOS, and Windows apps](#).
- While Boeing-owned **Insitu** markets its drones primarily to militaries, its [ScanEagle](#) UAV surveillance system has a lot of potential for civilian applications. It was used on Sept. 12, 2013 by energy giant ConocoPhillips to survey environmental conditions in the Arctic, in the first commercial drone flight [sanctioned](#) by the FAA.

The breakout success in the commercial UAV market could emerge from the activities of one of these firms.

Beyond The Air

In the popular imagination, the idea of drones combines the images of an automated robot and a flying machine, but there is no reason why their travel has to be confined to the sky.

Nautical drones have been an area of great military and civilian interest. An underwater drone called [Ziphius](#) won a crowdfunding competition last year.

Taking on deeper work, the 10-foot-long [Saildrone SD1](#) completed a 3,000-mile journey from San Francisco to Hawaii in December using wind power. Its journey could create a model for saving much of the \$100,000 per day spent on fuel and crew on larger, manned research ships.

It seems there are nearly limitless possibilities in terms of drone function, design, and application. For now, it is government-sponsored entities that are engaging in some of the most groundbreaking work with drones, but even this usage has already moved beyond traditional military application in conflict zones.

Drones have the capacity to advance significant economic and scientific goals as well. Not to mention taco delivery. At this point, technology is not the issue. The challenges lie with questions of safety and privacy.

Privacy Concerns

Besides the safety hurdles drones must overcome, [they have also stirred considerable privacy concerns](#). At the drone test sites recently designated by the FAA, each individual site will create their own privacy policy, which will be made publicly available.

But this is unlikely to be a long-term answer to the question of privacy and civil liberties. The FAA itself will have to address these concerns in a more robust way when they issue their plan for commercial drones. And even once they do, it will hardly put the issue to rest.

Why do drones stir such concern over privacy? Drones will be able to collect continuous information about activity going on around them, giving them an unprecedented store of data on people and behavior. And the data will not only be visual. Some [drones may also be able to hack Wi-Fi networks and intercept phone communications](#).

Surveillance of people's Internet and phone activity continues to be a top news story, as revelations from Edward Snowden about National Security Agency activity keep unfolding. While these issues do not apply to drones in particular, privacy remains one of the biggest issues Congress is struggling to define and protect adequately. Some states have already moved to ban the use of drones.

We expect that commercial drones will ultimately fly, but they will face some of the steepest regulatory and societal hurdles of any new technology that has yet come on the scene.

THE BOTTOM LINE

- The regulatory and technical hurdles for widespread commercial drone applications are numerous, but not insurmountable. American regulators plan to phase in commercial drone flights beginning in 2015, starting with limited flights of small drones weighing 55 pounds or less.
- Retail and e-commerce — along with the related logistics and shipping industries — arguably have the most at stake in the wide deployment of civilian and commercial UAVs.
- We estimate that 12% of an estimated \$98 billion in cumulative spending on aerial drones over the next decade will be for commercial purposes.
- Privacy and safety concerns still pose the risk of chilling commercial drone flights in many markets.

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