
The Promise of Drones

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The Promise of Drones



I am a United States Air Force C-17 pilot, entrusted to deliver cargo into the heart of war zones. I am also an Arabic-speaking Middle East specialist, and in March 2014 I was doing research among Syrian refugees in eastern Turkey. At the time, the Syrian government was besieging entire neighborhoods to break their will. Children were starving, snipers were allegedly shooting teenagers foraging for weeds, and clerics had given besieged civilians permission to eat cats and dogs.

Syrians asked me why the United States could not simply airdrop aid. Political challenges aside, the truth is that we cannot usually fly big cargo aircraft such as the C-17 into hostile airspace without kinetic operations to destroy air defenses like radars, surface-to-air missiles, and anti-aircraft guns. This became apparent a few months later, when the United States launched its first

air strikes against Islamic State militants to facilitate airdrops to the Yazidi population trapped on Mount Sinjar.

The sieges haunted me. Surely in the twenty-first century there was a way to fight back against those who used starvation and medical deprivation as weapons. It occurred to me that advances in drone technology might open up a new paradigm: using large numbers of small drones to slip past air defense systems and deliver small packets of cargo.

I assembled a team, and we spent the next year and a half trying to make that vision a reality. Ultimately, we failed — at least this time around. I still believe the swarming airlift concept is sound, but our team was ahead of its time. Drone technology is in its toddler years, and soaring expectations are giving way to a truth that experienced drone developers often recite: drones are hard. According to

Mark Jacobsen Syria Airlift Project Founder

the Gartner Research “hype cycle,” this is normal for any new technology. The good news is that hype and disillusionment eventually yield to a new stage: a steady climb up the slope of enlightenment. This is where a new technology shows its true value.

Humanitarian drones have a strong future. The day will come when flying robots deliver aid in locations too dangerous for humans. However, attaining that future will take time, energy, and grit. We need to look past the hype and build on a sober, realistic understanding of the challenges and opportunities that drones present.

The Drone Revolution

Two years ago, the word “drone” would have conjured up images of Predators firing Hellfire missiles

Photos courtesy Reuters

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“Drone sales have grown a hundredfold in just a few years. Consumers spent an estimated US\$100 million on drones in 2015, and various reports anticipate the unmanned aerial vehicle (UAV) market will spend in excess of US\$1 billion within five years”

at terrorists in remote corners of the earth. However, a revolution was quietly underway. The same technologies fueling the rise of the smartphone — miniaturization, more processing power, better sensors, and batteries — are the same technologies needed for autonomous flight. New robotics companies and even do-it-yourself hackers were developing inexpensive autopilots and bringing drones to ordinary users. Drone sales have grown a hundredfold in just a few years. Consumers spent an estimated US\$100 million on drones in 2015, and various reports anticipate the unmanned aerial vehicle (UAV) market will spend in excess of US\$1 billion within five years.

Just like smartphones, drones are versatile platforms capable of innumerable tasks. The sky really is the limit. A diverse array of companies have appeared, selling drone technology and services. These startups offer training, imagery and mapping, services, infrastructure inspection, and even drone-delivered pizza. The commercial potential of drones is extraordinary.

Humanitarian organizations have been quick to realize the potential applications of “drones for good,” which include natural conservation, disaster relief, and crisis mapping. Conservation Drones has run many projects to map forests, monitor wildlife, and prevent poaching and illegal logging. Kathmandu Living Labs and drone maker DJI recently taught ordinary Nepalis how to map villages and assess damage af-

ter the June 2015 earthquake. Digital Democracy’s Gregor MacLennan helped Wapishana villagers in Guyana build their own drone using indigenous supplies to monitor illegal logging and deforestation. The Humanitarian UAV Network, led by Patrick Meier, has brought together diverse stakeholders to establish a humanitarian UAV code of conduct and collect best practices. The Sentinel Project has experimented with drones to monitor land use and help prevent disputes. The list could go on. The humanitarian applications of drones are boundless.

However, the rapid growth of the drone industry has also brought challenges. The Federal Aviation Administration (FAA) and its international equivalents have been slow regarding UAVs to create effective regulation, fostering an atmosphere of confusion, ambiguity, risk, and frustration. Regulators are in a bind. Drones present dangers incomparable to any other consumer electronics, but the technology has proliferated so fast and so far that it can hardly be controlled. While the vast majority of drone operators are committed to safe, responsible, and legal operations, a reckless and irresponsible subset is triggering a backlash. For every NGO delivering vaccines in sub-Saharan Africa or monitoring rhino poaching, a reckless drone owner is flying through the final approach corridor of JFK airport, slashing unsuspecting triathletes, crashing into the White House lawn, or terrorizing a forest with a flying handgun or flame-

thrower. Chris Anderson, CEO of drone manufacturer 3DR Robotics, coined the term “mass jackassery” to describe this phenomenon. In the absence of FAA regulation, states and cities are enacting their own patchwork laws, throttling the growth of legitimate drone businesses.

Aside from the raucous debates about safety and privacy, the market is still learning to properly value drone products and services. New drones funded through Kickstarter campaigns have largely been disappointments or outright failures, but these projects continue to generate hype and draw enormous investment. Many companies sell shoddy products at high cost. In one notorious example, Piora Robotics sold hobby-grade foam aircraft to the US government for US\$240,000 apiece. The situation is gradually changing as higher-quality drones and components appear, but it will take time before the market learns to separate proven drone solutions from substandard products and services.

Drone package delivery has generated tremendous interest, and has obvious implications for humanitarian organizations, but the paradigm introduces even more uncertainty. In most cases drone delivery only makes sense at scale, which requires large numbers of aircraft, high levels of autonomy, and a complex logistics system. The logistics of building, maintaining, storing, and flying large fleets of vehicles are far from trivial. The legal ambiguity makes any drone delivery initiative a gamble, and future insurance availability and costs are anyone’s guess.

No one is sure how much drone delivery would cost. In one report, ARK Invest estimates drone deliveries could range from US\$1-6 per package, but these numbers are highly speculative. Even if the economics were feasible, no one is sure what scale is achievable. 86 percent of Amazon packages weigh less than



Rebel fighters escort a Syrian Arab Red Crescent aid convoy heading towards the villages of al-Foua and Kefraya in Idlib province, Syria on February 17, 2016.

five pounds, and 70 percent of people live within five miles of a Wal-Mart. Those statistics make drone delivery look attractive, but the author of a recent review of drone delivery economics points out that a single United Postal Service (UPS) truck makes around 120 stops a day and delivers hundreds or thousands of packages. Compared with an armada of drones, the humble delivery truck begins to look like a singularly impressive piece of technology.

The major drone delivery companies are all experimenting with making the paradigm work, but all are still in the research and development or pilot phase. California-based MatterNet is arguably the farthest along, using its MatterNet One prototype to deliver blood samples and medicines in Haiti, Bhutan, the Dominican Republic, Papua New Guinea, and Switzerland. On July 17, 2015, a startup called Flirtey delivered medical supplies to a clinic in West Virginia, the first FAA-sanctioned drone delivery in

the United States. DHL has begun servicing the small German island of Juist. Google and Amazon are iterating through numerous aircraft designs, while marshalling armies of lawyers to push for favorable drone legislation.

These are exciting developments. The initial hype surrounding drone delivery has begun to fade, and these companies are now doing the real work that will fuel the growth of the drone industry: experimenting, learning, and climbing the slope of enlightenment. It remains to be seen which paradigms will prove to be the winners.

Making the Moonshot

I founded the Syria Airlift Project with a very different use in mind: moving humanitarian aid deep into regions inaccessible any other way. My team and I had little experience with drones when we first conceived the idea, so we had to do plenty of learning as our high aspirations met with reality. My initial hope of delivering fifty-pound

packages was wildly unrealistic; we settled for two pounds, with a later goal of five pounds. We shifted our vision towards high-value, low-mass goods like medical supplies and water purifiers. We hoped to gain mass through numbers. We estimated one team with ten aircraft could move 400 pounds per night in a conveyor belt fashion. Feeding neighborhoods was out of the question, but perhaps we could keep besieged medical clinics running. If the paradigm worked, we could build more capable planes later.

We learned that, while it is relatively easy to build and fly a drone, it is very difficult to attain high levels of reliability. Just like manned flights, safe and reliable drone flights require the successful management of hundreds of little details. A single overlooked detail could mean a crash. This necessitated quality engineering, rigorous preflight inspections and checklists, good training, well-designed human interfaces, and clear operating rules and processes. As an Air Force pi-

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lot, I was experienced in these best practices, and we systematically applied them within our team. Our reliability dramatically improved over time, but the complexity of our

“Our passion for Syria proved to be toxic; few large organizations dared to help us because of liability concerns.”

engineering, launch process, and flight procedures grew beyond anything we had initially imagined.

No matter how safe or professional we were, we could never mitigate risk entirely. In our worst mishap — which we never fully recovered from — a battery caught fire during a crash. Three acres burned. This was a frightening and sobering experience. Developing aviation technology has never been easy, and such setbacks are the price of admission, but the fire forced us to confront our limitations as a small, grassroots, all-volunteer organization.

Despite the challenges, we made considerable progress. We were the only organization working on drone delivery using fixed-wing aircraft, which offered much greater range than multicopters. Discussing the use of humanitarian drones in conflict zones was taboo because of their violent origins, but our project ignited a rich discussion about how drones could be safely and responsibly used for good. We developed our own aircraft firmware, adding new “responsible use” features to the open-source ArduPilot project. These features would allow responsible actors to mitigate the threat of hacking, theft, or misuse while operating in conflict zones.

Our proudest accomplishment came in March 2015, when we taught a group of Syrian and Iraqi families the basics of operating our planes. We flew four aircraft on approximately 20 flights, airdropping packages that children decorated and packed with medical supplies.

We also showered candy on crowds of delighted kids. It was a beautiful event. We gave the world a compelling demonstration of what swarming airlift might look like and

showed how drones might empower communities as they delivered aid. Our paradigm was labor-intensive, so our vision was to give Syrian refugees ownership in bringing hope and healing back to their country.

Unfortunately, we had one final lesson to learn. When we approached governments and humanitarian organizations for help organizing a pilot project in Turkey, the response was tepid. Our project was too strange and different. Our passion for Syria proved to be toxic; few large organizations dared to help us because of liability concerns. We also found little interest among traditional investors because we never found a way to make

our vision of serving besieged populations profitable. Without further help, we soon found ourselves dead in the water and eventually had to dissolve our organization.

Since that failure, I have spent a great deal of time thinking about the concept of value. Drone services will only be viable when the world puts sufficient value on what they can offer. It will take time to convince the skeptics that drones are worth the investment, and even then, drone projects must be sustainable. That has always been a challenge for aid organizations, and drones will not be exempt.

The Real Opportunities

Drones provide value when they can perform services safer, faster, and cheaper than the alternatives. This is true of humanitarian services as well as commercial services.

Based on that insight, doorstep package delivery may be a distraction from the real potential. Small delivery drones offer the most value when there is a need to quickly move high-value, low-mass goods into locations where access is im-



Intel CEO Brian Krzanich holds up a new Yuneec Typhoon H drone, which he said was the first consumer drone equipped with Intel's RealSense sense and avoid technology, 2016.

possible or difficult. Drones are ideal for moving life-saving supplies to targeted groups when critical shortfalls exist. In Syria, diabetics have died because they could not get insulin, and small, besieged medical clinics have been forced to reuse blood bags or manufacture their own because of severe shortfalls. Hospitals in Yemen have faced shortages of many medications due to the civil war, including insulin, antibiotics, and painkillers. Following the Nepal earthquake, many isolated villages urgently needed water purification. In rural areas, drones are ideal for moving perishable items that require cold storage, like blood samples and vaccines, particularly if central clinics serve broad areas. It is no surprise that Matter-

extremely effective for mapping, damage assessment, wildlife conservation, search and rescue, surveying, and many other tasks. The agricultural drone business is booming. Japan has used drones for crop spraying for 20 years. Drone surveys of farmland can identify blight or irrigation problems and help farmers increase crop yields. These services will grow dramatically in the next few years, with a high return on investment.

Most likely the future will include a blend of diverse capabilities, each targeting different needs.

The Road Ahead

Before commercial and humanitarian drones reach their full potential, several things need to happen.

“Drones are extremely effective for mapping, damage assessment, wildlife conservation, search and rescue, surveying, and many other tasks.”

Net has targeted that use case.

The real potential of unmanned cargo delivery may not lie with small drones at all, but with significantly larger vehicles. In Afghanistan the US Marines have used Lockheed Martin's unmanned K-Max helicopter to haul up to 6,000 pounds of cargo at a time. The Mist Mobility Integrated Systems Technology (MMIST) SnowGoose UAV is portable, rugged, and can carry 575 pounds of cargo. A K-Max or SnowGoose won't be delivering packages to your door, but might be perfect for bringing tents, blankets, and foods into disaster-struck villages in the mountains of Pakistan or Nepal. However, the cost and complexity of these systems means that only large, experienced drone operators will be able to deploy them.

Finally, although this article has emphasized delivery drones, most humanitarian drone applications will not involve cargo. Drones are

First, we need to collectively learn how to safely integrate drones into our skies. The aviation safety industry is a remarkable achievement. Rigorous safety practices and attention to detail have contributed to exponential decreases in fatal mishaps. Drones require no less care. At the same time, we need to impose the smallest feasible burden on drone operators. We must find the appropriate balance, but at the end of the day, drone integration will only happen when it can be done safely.

Second, we need a social compact surrounding the place of drones in our society, and we need to codify that compact in sensible legislation. This will take time, patience, and a good-faith effort to listen and understand competing perspectives. Drone operators need to understand and respect legitimate concerns, while skeptics need to recognize the potential good that drones

can bring. Humanitarians will need shared standards for using drones in a way that does no harm.

Third, the full potential of drones will only be unleashed when a robust ecosystem arises to support them. Currently, lone innovators or small teams are leading most humanitarian drone projects, often in relative isolation. It will be easier for humanitarian organizations to stand-up sustainable drone operations as an ecosystem of retailers, operators, and maintainers takes form, operating within a supportive regulatory environment. As such an ecosystem grows, it will become increasingly feasible for humanitarian organizations to operate small fleets rather than single drones. Progress will also accelerate when more high-quality and easy-to-use drones become available. Most drones still require a great deal of tinkering, although polished new consumer drones like the 3DR Solo and DJI Phantom III are beginning to change that.

Drones are an exciting new technology, opening up entirely new paradigms for both commercial businesses and humanitarian organizations. Digital humanitarians have already proven what drones can do, ranging from medical deliveries to anti-poaching efforts and damage assessment. Like the mobile phone, drones are easily portable and can add value everywhere from the mountains of Nepal to the forests of Guyana. I still believe the day will come when flying robots will deliver aid to locations too dangerous for humans.

But drones are hard. Industry watchers need to shrewdly cut through the hype or they will face disappointment. The industry is rapidly innovating and learning, and drone technology is quickly improving. As with any new technology, it is the long, patient process of growth and refinement that will unlock the potential of drones. When that happens, the sky really will be the limit. ■