### **Drone Package Delivery: Newest member of the supply chain**





#### Who are the major players in Package Delivery?













PERCEPTION IS EVERYTHING

#### The Public Perception of Drones







REALITY CHECK AHEAD







### **Public acceptance of Drones**







**Regulatory barriers for autonomous drone package delivery:** 

-Line of sight rule which prohibits drones from flying out of the operator's sight.

-Drones are not permitted to fly over "non participants."

-One operator to one drone

#### **Rural areas:**

-One billion people lack access to all season roads, preventing them from receiving medicine or critical goods in a timely manner.

-Matternet's transportation network is comprised of drones that can carry a 2 kg payload and travel 10 Klms in 15 minutes.

-Automated ground stations can swap and recharge batteries, load and unload cargo and matching supply with demand. Stations are located 10 Km apart and connect villages so drones can cover a large area.

-The cost to transport 2 Kgs over 10 Km is only \$.24 and the ground station investment is a fraction of the cost of infrastructure.

-Chinese retailer JD.com uses drones to deliver packages to rural areas in Jiangsu province. -The drones can deliver 15 Kg each, fly up to 10 Km and manage up to 200 packages daily as well as load/unload packages autonomously. Packages are delivered to local village delivery agents who manage final delivery.



#### **Mega-City**

-A mega-city has a population above 10 million people.

-Congested roads are a major problem.

-Americans spend 6.9 billion hours stuck in traffic which is up substantially in the past 30 years.

-Congestion is major problem when life saving drugs, critical supplies or organs need to be transported urgently.

-Dronlife has developed a drone capable of transporting organs in plastic containers at a maximum speed of 90 km/h and keeping the cargo cool.



#### **Asset Tracking**

-Tracking assets is a key component of the Supply chain. -PINC Air has developed drones to keep track of hard to reach assets in crowded stockyards, trailers in a yard and counting inventory in warehouses.

-Cycle counting is used to track inventory in warehouses because products are spaced vertically and horizontally.

-Remotely controlled drone captures 30 frames per second of products in aisle and alerts the user when product is low or incorrectly stocked.





**Studies which sampled the public on several issues related to UASs** 

**Risk Perception and public acceptance of drones.** 

Managing uncertainty in the System Safety Assessment of UASs.

**Development of a template safety case for UAS operation over populated areas.** 

Surprising drone study shows how people really feel about drones

**Opinion Survey to Reduce Uncertainty in Public and Stakeholder Perception of Unmanned Aircraft.** 



**Opinion Survey to Reduce Uncertainty in Public and Stakeholder Perception of Unmanned Aircraft** 

Lauren Bowers Reddy and Daniel De Laurentis

Public opinion will inevitably shape this framework, but that community's perception of how the public perceives unmanned aircraft is considerably uncertain.

The survey was taken by 400 individuals representing the general public and 135 individuals representing key stakeholder groups.

Most respondents reported that their support or opposition to unmanned aircraft is conditional.

In the general public, women were generally less supportive of unmanned aircraft than men, and respondents younger than 36 were more supportive than older respondents. Of the stakeholders, pilots and employees of the airline industry were less supportive. The statistical findings reduce the uncertainty of opinions about unmanned aircraft.

#### **Participants**

The survey was launched to the general public in May 2015. Qualtrics, a private research software company that specializes in online data collection, was used to host the survey and recruit a panel of 400 members of the general public.

Gender breakdown was set to 50% male and 50% female. Age breakdown was set by using the U.S. Census Bureau's projection of the population by age group in 2015

The survey was launched to stakeholder groups in July and August 2016. The following stakeholders were targeted:

Researchers of unmanned aircraft in academia,

• Employees at government agencies (e.g., NASA, FAA),

• Employees in the aerospace and unmanned aircraft industry (e.g., Boeing, MITRE), Potential investors in unmanned aircraft, UAS test site managers, Pilots, and UAS hobbyists. **Stakeholders** were contacted by e-mail or recruited on online message boards frequented by pilots or UAS hobbyists, with 135 completing the survey, which was identical to the survey for the general public.

Iransportation Researc



FIGURE 1 Responses to "How well informed do you feel that you are about unmanned aircraft?"

Few participants had learned about unmanned aircraft from trade literature or personal experience. In contrast, most targeted stakeholders had heard of unmanned aircraft from trade literature or personal experience



General public Stakeholders







#### **Conclusion: Drones in the Supply Chain**

-Public acceptance of drones is on the rise.

-Commercial applications will transform the public's image of drones as hackable, privacy invasive, killing machines to devices which benefit consumers with rapid delivery of products, medicine and life saving drugs.

-The FAA will act quickly on waiver requests to Part 107 such as night flights, BVLOS operations and allowing UAS flights over crowds.







The results from the stakeholder population indicate that stakeholders are well informed about unmanned aircraft, and many receive their information from scientific sources (trade literature or personal experience). Stakeholders are conditionally accepting of unmanned aircraft. They are very sensitive to the risks associated with unmanned aircraft and also sensitive to application, environment, and benefits. Like the general public, stakeholders expressed strong approval of unmanned aircraft in public service, land management, and earth science applications but had divided approval of homeland security and commercial applications.

The caution expressed by the stakeholder group may be highly beneficial in the long run. The Committee on Autonomy Research for Civil Aviation stated, "unless [increasingly autonomous (IA)] systems are implemented in a careful and deliberate manner, the actual benefit of IA systems could be limited or they could even reduce safety and reliability or increase costs". By proceeding cautiously with the development of the regulatory and market structures for unmanned aircraft, stakeholders may ensure that benefits are maximized while costs and risks are minimized.



Unmanned Aircraft Systems (UAS) at Airports: A Primer

#### Discussion of Findings

Overall, the findings indicate that the public is generally familiar with unmanned aircraft, primarily by exposure through fictional sources and the media. Most people are open to the use of unmanned aircraft but only under certain circumstances. The application for which unmanned aircraft is put to use is one factor that dictates supporter opposition. High public approval for public service missions and earth science and land management applications of unmanned aircraft may indicate that these are good areas in which to test the safety and efficacy of unmanned aircraft.

Because the public expressed divided approval and opposition to unmanned aircraft for commercial use and homeland security, stakeholders must proceed with caution in using unmanned aircraft in these applications. The public also identified operating environment, benefits, and risks as factors that affect support or opposition. A future stated preference survey will further explore how application, environment, benefits, and risks affect support and opposition.



There were 300 drones dancing behind Lady Gaga during the Super Bowl halftime show. They're called Shooting Stars and were previously used in a holiday show at Disney World.

These hundreds of Shooting Star drones flash, fall and flock in unison and are all controlled by one person — or rather one computer.

#### **Advanced Ground and Aerial vehicles for Drone package delivery**









#### Mercedes is reportedly pouring \$562 million into delivery van drones.

Mercedes-Benz has announced a \$562 million investment in a self-driving van which will which house a drone nest built into the roof. The vehicle will deploy the Workhorse autonomous drone that can carry 10 lbs. packages. The trunk is capable of supporting a "one shot loading" system to get products to the customers faster.



The trunk is capable of supporting a "one-shot loading" system to get packages in the trunk and out to customers faster. The all electric van has a range of 168 miles.



A drone will accompany the van by sitting on a landing station on top. When the van approaches a drop-off location, the shelving system will push the package to the drone so it can be flown to its final location.



The interior of the van has a fully automated cargo space. It features a mechanical shelving system that loads packages and knows where each package is going. The driver will get a notification when approaching a dropoff location for a package.



Matternet's autonomous drone, the Matternet M2 drone, can travel 12 miles on a single charge.



Matternet M2 is designed to be safe around people and infrastructure. It is engineered with encrypted communications, a parachute, precision landing and a host of other safety features. Our technology has been certified by leading aviation authorities around the world including NASA and the Swiss Federal Office of Civil Aviation. Although the drone would aid in package delivery, Mercedes still sees the driver playing a role as well. The Vision Van has a specialized compartment where the driver can grab packages without going to the back of the vehicle.



Mercedes is developing a telematics unit for the van that can relay the status of a package to the distribution manager so last-minute delivery changes can be made easily.



The airships wouldn't just send information to the drones; Amazon's patent includes the capability to send information to devices inside households, too — "such as personal computers, electronic book reading devices, audio players, mobile telephones, tablets, desktops, laptops, etc.," says the patent. "For example, the mesh network may be used to deliver electronic book content to electronic book reading devices of users." They'd be equipped with cameras, antennas, lasers, and weathermonitoring equipment. The cameras could be used to track and manage the drones, either by recognizable images, light beacons, or some other recognition tool, and watch for weather changes. Images could be sent back to a central server.

### Google Project Wing





#### **UPS prototype**



# The future of drone delivery hinges on more accurate weather predictions.

The push is on to develop forecasting weather conditions down to a city block and elevations as low as 400 ft. That will clear the way for the holy grail of drone service automatic flights that make their rounds without pilots controlling them from the ground. The drones themselves will be collecting weather information on their journeys through the atmosphere ,relaying that information to computer weather models and other drones. An instrument that records six variables such as wind speed, wind direction and humidity would cost about \$2,500 which does not include installation, maintenance and transmitting data the sensors collect over the internet.

Urban areas present the greatest challenges. Tall buildings create channels of wind that can clash and swirl into tight eddies and heated sidewalks can produce uneven heat causes downdrafts and updrafts.





### OFFICE OF INSPECTOR GENERAL UNITED STATES POSTAL SERVICE

Public Perception of Drone Delivery in the United States

#### **RARC** Report

Report Number RARC-WP-17-001



### **Executive Summary**



**Drones are on the horizon:** The American public anticipates that drone delivery will be offered within the next 5 to 10 years.

**An ambiguous reception:** More Americans like the concept of drone delivery than dislike it, but a large number have yet to decide.

**Americans do not yet trust drone technology:** Drone malfunction is the public's primary concern — far more than fears about intentional misuse.

*Different groups have notably different perspectives:* Different age groups, genders, important postal customer groups, geographic regions, and residents of urban, suburban, and rural areas all display differing levels of interest in drone delivery. *Knowledge drives enthusiasm:* Exposure to information about drone delivery correlates with greater interest in the idea.

**Speedy delivery piques the public's interest:** 1-hour delivery is the public's most interesting application, and delivery speed is the technology's most believable benefit. Emergency delivery also garners interest.

**Too soon to launch:** It may be too soon for any organization to offer drone delivery, as offering the service now leads to a drag on overall brand positivity.

**Drone Delivery could improve the Postal Service's ratings as an innovative company:** Despite its drag on overall brand positivity, association with drone delivery makes the Postal Service look more innovative.





### SURVEY

The OIG fielded a confidential online survey targeting a national sample of 18-75 year old residents in all 50 states and the District of Columbia. Respondents were solicited by email and managed by the Survey Sampling International (SSI) as per their procedures. The survey was conducted in English.

Field Dates: June 9 – June 19, 2016

Total Respondents: 1465

- National Sample: 1207
- Oversample of residents from Rural or Remote areas: 258
  - <u>Note</u>: This oversample was excluded from all analyses except those comparing Urban, "Suburban or Small Town," and "Rural or Remote" groups

Median Interview Length: 9 minutes 59 seconds

95% confidence interval (National Sample): +/- 2.8%\*



 Drones are on the horizon: The American public anticipates that drone delivery will be offered within the next 5 to 10 years.

Expect drone delivery by 2021 (5 years)	2026 (10 Years)	2027 (11+ Years) or Never		
75%	9%	16%		

 An ambiguous reception: More Americans like the concept of drone delivery than dislike it, but a large number have yet to decide.



 Americans do not yet trust drone technology: Drone malfunction is the public's primary concern — far more than fears about intentional misuse.







• Different groups have notably different perspectives on the concept of drone delivery.



• *Knowledge drives enthusiasm:* Exposure to information about drone delivery correlates with greater interest in the idea.

 Speedy delivery piques the public's interest: One-hour delivery is the public's most interesting application, and delivery speed is the technology's most believable benefit. Emergency delivery also garners interest.

#### Ranked Interest in Drone Delivery Applications



#### Believability of Drone Delivery Benefits



 Too soon to launch: It may be too soon for any organization to offer drone delivery — the public would view each company included in the survey less positively if they were to offer the service today.



Amazon is overwhelmingly associated with drone delivery by the two in three that had previously seen or heard something about the concept.



While more than eight in 10 feel that drone delivery is coming in the next decade, the public has mixed feelings about the concept.



The more that members of the public have heard about drone delivery, the more they report liking the idea.



Amazon is by far the most trusted brand for drone delivery, likely due to their strong association with the concept.



The public does not yet trust drone technology: about three in four respondents selected some form of malfunction as one of their concerns, and nearly half cited malfunction as their <u>primary</u> concern.



Americans find one-hour delivery and delivery in cases of emergency to be the most interesting applications of drone technology. There is least interest in Sunday and evening delivery.

	<u>Avg</u>				Ranking (	Canking of Most Interesting Applications for Drone Delivery National Sample (n=1207)									
<u> </u>	<u>Rankin</u>	g	Top Ranked	Ran	ked Second	Ra	nked Thire	d 🛛 Ra	inked Fou	rth 🔳 Ranke	d Fifth	Ranked	Sixth	Bottor	n Rankea
One-hour delivery – Top Ranked	3.39		Top i 2	Ranked 4%		17	7%	1	3%	15%		12%	8	% Botto	n Ranked 10%
Delivery in cases of emergency	3.42		18%		15%			22%		17%		15%	6	7%	6%
Delivery to hard to reach locations (mountains, islands, etc )	3.93		20%	6	15%	, 0	10%		10%	13%		15%		18%	
Delivery to wherever I am, not just my home	3.95		15%		13%		13%		18%	17%		11%		14%	
Delivery to remote locations where few people live	4.06		10%		18%		15%		12%	13%		18%		13	%
Sunday delivery	4.55		8%	11%	13%		14%		14%		19%			21%	
Evening delivery - Bottom Ranked	4.70		5% 9%		15%		13%		17%		22%			19%	

The public's expected timeline for drone delivery is consistent among residents of Suburban/Small Town and Rural/Remote areas. Urban residents are divided; however, they are the most likely to believe that delivery will never occur and also that it will begin to be offered within the next year.



Millennials expect to start seeing drone delivery sooner than Generation X, who expect the service sooner than Boomers.



Millennials tend to like the idea of drone delivery, while Generation X has mixed feelings; and Boomers strongly dislike the concept.



Men and women report similar expectations about the long-term timing of the drone delivery concept, though men are more likely than women to believe that the service will be offered within the next year.



As is the case with other high-awareness groups, Postal Regulars and Ecommerce Frequents believe the drone delivery concept will come to fruition sooner than the general population.



USPS finds its best ranking as a trusted brand for drone delivery in the Northeast, where it was ranked third by respondents. In contrast, USPS was ranked 5<sup>th</sup> in both the West and Midwest.



# From Domino's pizza to full implementation of Package delivery in the U.S.





#### **Drone Advisory Committee (DAC**



Andreas Raptopoulos, CEO for Matternet see the inflection point around 2020.Matternet has already transported medicine and medical-diagnostic products in New Guinea, Malawi and other remote locations.

In 2016, the RTCA Inc., the FAA's outside technical advisory organization agreed to start defining technical standards for ground based radar and airborne collision avoidance sensors along with advanced communication links, that are bound to provide impetus for expanded drone flights. RTCA documents project the majority of the work will end sometime in 2020. Richard Heinrich of Rockwell Collins told fellow RTCA officials that we should have an operations system by 2020.

Amazon declined to comment on full operability however Google has stated that it would likely be in the early 2020s.

Radio Technical Commission for Aeronautics (RTCA, Inc.) is a <u>United States</u> volunteer organization that develops technical guidance for use by government regulatory authorities and by industry. It was founded in 1935, and was re-incorporated in 1991 as a private not-for-profit corporation. It has over 200 committees and overall acts as an advisory body to the FAA. In 1948 <u>Special Committee 31</u> recommended that a common air traffic control system be developed for all aircraft flown in the United States.



