case study

Get the Door. It's Drone: The future of flying food deliveries

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Introduction

Drones, also known as unmanned aerial vehicles (UAVs), remotely piloted vehicles (RPVs) or unmanned aerial systems (UAS) or remotely piloted aircrafts. These are aerial vehicles, automatically controlled by wireless applications and cameras, without having an on-board operator. Drones vary in sizes and can be as small as an insect or as large as mini airplanes. Some have fixed-wings while others have rotating fans. They can use runways or can take off and land vertically. Drone's flights can be controlled by a pilot, on ground, in another vehicle, by a navigator, or directly through remotely held computers. They are predominantly deployed for military purposes, however they are being used and experimented for various civilian and industrial use. Ongoing explorations are directed towards the use of drones in various fields to assess convenience, access, and profitability to businesses by reaching their customers or beneficiaries situated in rural or non-traditional locations. The market for UAVs is predicted to be worth over $89 billion by next decade, with 10 percent of that market for commercial and private use. Although legislation to allow commercial use of drones are still under consideration, over one hundred different types of drones are on sale at Amazon, primarily for public use or as toys. Drones have the potential to revolutionize the way businesses operate and reach their consumers. However, a serious dilemma exist when drones are used to deliver foods to customers, since there are significant pros and cons.

Different Types of Drones

There are numerous types of drones, simply classified as fixed wing or rotary wing drones. The newer models have both kinds built into one. Fixed wing drones tend to be larger and can carry heavier load to considerable long distances. Smaller drones can fly short distances and can deliver loads within sight. Although several systems are being studies, the current favorite seems to be a machine that's part airplane and part helicopter. It can fly at 50mph (80km/h) for 10 miles (16km) or more away from base, at a height of around 350ft (100m). When it reaches the delivery address, it comes down vertically onto a special landing mat that the buyer will place on their property (Westcott, 2016).

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Functional Attributes of Drones

Drones have attributes that make them indispensable for a variety of applications. Drones have the advantage that they can be equipped with a variety of useful devises. The capabilities of drones depend on their use. They can be mounted with still cameras and videos, audio monitoring devices, sprayers, GPS (Global Positioning Systems) depending on how much weight can be sustained by the type of the drone used. When equipped with high-definition digital cameras and the GPS positioning, they can be controlled to perform autonomous cruising, simultaneously avoiding obstacles or hazards. They can be programmed to avoid high electric wires, power lines, trees, humans or other obstacles. They have proven indispensable in handling emergencies and relief operations. Considering the ubiquitous applications of drones, scientific discoveries and explorations have taken a different shape. Similarly their use in food deliveries may revolutionize the way businesses reach their customers using automation which was never imagined before.

Application of Drones in Food-Related Businesses

The period starting from the year 2010 marks the beginning of the "food-in-air" era. A variety of reports started pouring in showing the potentials of utilization of drones in product delivery within the supply-chain process. TacoCopter, an airborne taco delivery system allowed customers to have their food delivered by drones. The Yelp-sponsored Burrito Bomber was introduced as the world's first airborne Mexican food delivery system, delivering burritos using Quadcopter. The Burrito Bomber is just the latest in Mexican food delivery drone technology; its creators said they got the idea from the Taco Copter (Koebler, 2012).

Domino's Pizza experimented using a fly-by food delivery system using drones. In 2013, Domino's UK, tested the possibility and feasibility of their evolutionary octocopter named as "DomiCopter" to ferry pizza deliveries. Reducing delivery times and fuel costs were apparent reasons for using this system. Domino's pizza credited their growth during the 2016 financial year to the massive investment in "disruptive technologies" which includes the Domino's Robotic Unit (DRU) as the world's first autonomous delivery vehicle. In collaboration with other international companies, ongoing efforts focus on the commercial drone deliveries of pizza. Domino's envisions people ordering pizzas using an app on their smartphone and the drones zeroing in on the

phone's GPS signal. Drones will fly at an altitude of about 200 feet while the customer is notified as the delivery approaches. The pizzas are then lowered out of the air, ensuring the drones remain a safe distance from the public (Bloomberg, 2016).

On May 11, 2014, Francesco's Pizzeria declared that they had tested drone pizza delivery to an apartment roofing in Mumbai, India. At about the same time a Russian pizzeria, DoDo claimed to be the first to offer pizza delivery by drones within 30 minutes using unmanned delivery service to residents in the northern city of Syktyvkar. The drones used by DoDo was eight-rotor octocopters provided by CopterExpress, which is a Russian firm. These initial testing, although successful, were for public relation and promotional purposes. Serious efforts to use drones for food delivery are ongoing. Domino's seems to be very serious in using drone technology for delivering pizza in the US and several other countries including Australia, Japan, The Netherlands, France, Belgium, and Germany.

Flirtey, a Nevada-based company envisions building a "drone delivery" industry teaming up with 7-Eleven, the world's largest convenience retailer and the Nevada Institute of Autonomous Systems (NIAS). They claim to have made 77 deliveries by drone in the state of Nevada. 7-Eleven relied on Flirtey, since they were involved in helping Domino's in New Zealand. Flirtey also conducted the first FAA (US Federal Aviation Administration) approved store-to-home drone deliveries in the United States. This fully autonomous drone delivery represented the "first time a US customer has received a package to their home via drone and marks a historic milestone in both US and global commerce."

In 2016, Google's parent company Alphabet Inc., cooperated with Chipotle Mexican Grill Inc. to test burrito deliveries by drone to customers at selected locations on the campus of Virginia Tech in Blacksburg, Virginia. This was a limited test of the plans to quicken deliveries using unmanned aircraft. This project under the code name, "Google's Project Wing" is an ongoing exploration using drones for food delivery. In the tests, drones from Alphabet's research lab, X, ferried burritos from a Chipotle Mexican Grill Inc. food truck several hundred feet away. The test entailed a few hundred deliveries to students and staff from a nearby office building. The drones flew on an automated route over a fenced-off field near Virginia Tech's campus and remained in sight of an operator who could take control of the aircraft if necessary. Studies were focused on how people's reactions, handling deliveries at the busy periods of time, delivering hot meals and in right shape, while protecting the cargo. Along with consumer attitudes, managing several hundreds of deliveries, the aviation electronics involved, operational infrastructure, time, food packaging, and delivering hot foods are all under study (Fitzpatrick, 2016). Alphabet, Inc. was reported to be in advanced talks with Starbucks and had even tested delivery with the coffee-chain operator, although this was not confirmed (Bloomberg, 2016a).

Successful outcomes of the efforts to date show-promising applications of drones for food deliveries, which have made many food companies to seriously look at this option. The reason behind this excitement is the potential for faster food delivery to consumers' doorstep beating traffic, as well as reducing fuel and in-person delivery costs. Although, drone delivery seems to have apparent benefits, it is too early to predict their extensive utility for food delivery. Inevitably, drones can be very effective in delivering material goods; however, the delivery of foods has its own challenges. Considering this aspect, the pros and cons of the use of drones in food deliveries need careful assessment.

Oklahoma City-based Orange Leaf tested its first drone delivery of frozen yogurt to the campus at Hope College, Holland, Michigan, in a program dubbed "Project Flying Orange Unicorn." It was reported that having proven that drone delivery can be done safely and within current U.S. Federal Aviation Administration guidelines, Orange Leaf is now offering it on an appointment basis for events and parties (Jennings, 2016). According to the reports, the drone can carry up to 30 to 35 pounds, or up to about 30 servings of pre-packed cups of yogurt. The cups are packed in a modified catering box and wrapped in an ice blanket. The costs of drone delivery were unclear since it may vary based on the distance and flight time. It should be noted that the FAA regulates all U.S. airspace and there are strict rules governing unmanned aircraft systems. At present, virtually all commercial use of drones is prohibited without a very difficult-to-obtain "Certificate of Authorization (COA)."

Pros & Cons of Using Drones for Food Delivery

Technology is changing rapidly. Because the use of drones is still at a stage of infancy, drastic changes may occur in the near future. Some experts are skeptical of their use since regulations are still not in place (Koebler, 2013). It is too early to predict if advantages outweigh the disadvantages or vice versa. Such comparative assessment is important for food delivery by drones, since there are different complex operational parameters that need consideration. Based on the available information some of the pros and cons are listed below.

Pros

a. Reduction of costs

One of the primary reasons why drone delivery is considered is the reduction of costs. Cost reductions are dependent on the type and reach of the drones. It is proven that the fuel costs when using drones are less compared to other forms of transportation used for delivery. The other costs are associated by reducing delivery by drivers and involved savings in labor costs. Delivering foods by drones are very different than using drones for surveys. Savings therefore needs to be evaluated in comparison with derived benefits.

b. High efficiency

Drones used for other uses such as surveys were found to be faster and cheaper compared to other delivery methods. If proven, labor savings can be substantial when drones are used to provide faster service, overcoming all traffic hurdles, and precisely reaching the targeted customers. Automation can result in convenience for the customers who can order using phone that can be transferred directly to production, and directly loaded on drones for delivery. Predictably this will save time and eliminate intermediate handling.

c. High Accuracy

Drones have shown to produce aerial maps with survey-grade accuracy. This has led to broadening of the horizon and scope of scientific and technological development, employing measures that are more efficient, effective and verifiable. Since there is direct conveyance of customer orders and computerized delivery system, the chances of errors due to misunderstandings are limited. In addition, customer preference information can be stored within the computerized system. This accuracy also extends to delivery to the right address.

d. Unrestricted food delivery

Food delivery, particularly ready-to-eat food, can reach customer faster with very few restrictions if any. One of the major problems in food delivery is the amount of traffic in most urban areas. This hurdle increases labor costs associated with delay and number of orders to be processed and delivered to the consumer in a timely fashion. With the help of drones, food can be delivered to consumer's doorstep quicker, beating the traffic on roads and avoiding hurdles. Being airborne, drones would be able to traverse any kind of terrain without encountering any problem (Holman, 2016).

e. New markets

The flexibility of avoiding surface hindrances can help in delivering food to far-flung areas as well as remote areas in relatively short time. The use of drones thus provides for the possibility of opening new markets, particularly in rural areas, where the reach was not possible using traditional delivery methods. This can be a considerable increase in the size of the market. Consequently, market expansion will result in brand exposure, brand recognition, and most likely customer loyalty for the business.

Profitability

In conjunction with other attributes listed above, the use of drones can prove to be profitable. Sales from commercial drone-based software is predicted to be in multimillion dollar range. Considerable savings are predicted for drone based food deliveries. The only major investment is the initial cost of drones, which varies, based on the type of the drones used. It is predicted that the initial investment will not be prohibitive. Other than labor costs other investments related to cars, motorized bikes, and other modified transport equipment will add to the savings. Customer anxiety, curiosity, and satisfaction are non-tangible constituents of profitability.

Cons

a. Food Safety

Food delivery by drones poses some of the most difficult challenges, ranging from food preparation, packaging, and delivery. Each step within the system needs careful assessment before this delivery method can be used by the operation as well as accepted by the consumer. This is complicated since perishable goods and health safety are involved. Both time and temperature need major consideration for food safety. As a general rule, hot food should be held at 135°F (57°C) or higher and cold food should be held at 41°F (5°C) or lower (ServSafe, 2014). Since drone fly at higher altitude, air temperature should be considered, which changes 5.4°F/1,000 feet (9.8°C/1,000 meters) under dry conditions and 3.3°F/1,000 feet (6°C/1,000 meters) if it is snowing. Drones fly at an altitude of about 200 feet and so temperatures may be slightly lower than those on ground. Thus, food when packaged and sent should have slightly higher internal temperature for hot foods to compensate the colder temperature at higher elevation. Similar adjustments are needed for cold foods. Humidity and air pressure also have impact on the temperatures. In addition, the food should preferably remain at safe temperatures for at least two 2 hours but no longer than 4 hours, whether inflight or sitting in front of the customer's door. This requires insulated packaging materials or containers to preserve safe temperatures. Packaging should also be such that it keeps dirt, water and pests out. Delivery time and safe temperatures need to be conveyed to the consumer. Food deliveries will get more complicated if different menu items and drinks are used. Thus monitoring temperatures of food inflight may be necessary. Any violations of these conditions may result in public safety hazard.

b. Public Safety

If drones become so prevalent that they fall out of the sky on people or homes, this becomes a problem for the safety of people and/or property. Crashes can virtually destroy what is promising to be a prospective industry of commercial drones. There is a need to find a way to prevent injuries on the ground before anyone will support the burgeoning industry in any significant way (Anonymous, 2016a). However, drones may be safer for people on the ground in a crash scenario because they are usually smaller and therefore likely to do less damage on crashing than larger aircrafts. In addition, it is possible to install safety features to allow the drones to abandon a mission; however, being pilotless they are more prone to crashing than piloted aircraft (Finn & Wright, 2012).

c. Food Quality

Quality of food delivered by drones is of paramount importance since their use depends on the acceptance by the consumers. In addition to the right temperatures at delivery other organoleptic properties need to be tested for acceptance. Due to the inflight movement or jerks in landing, food quality may not be as good as intended. Flipping of the package may turn food upside down. This will restrict the type of prepared foods that can be delivered maintaining both safety and sensory qualities. For Project Wing, Chipotle was chosen because selected food items will stay warm and can be delivered in one piece. Burritos were selected due to their compact packaging and that they do not suffer much if inadvertently flipped upside down. Thus, food items selected for delivery should be able to retain food quality at least until food is delivered, unpacked and consumed by the consumer. Food items selected should retain safe temperatures for a longer period of time. Although it is too early to predict, at some point a check of the nutritional quality of delivered foods may need assessment to ascertain that there is no undesired loss of nutrients. Considering all aspects of food quality and ingredients there may be a need for changing the labels on packaging.

d. Weather conditions

The major drawback in using drones for food delivery relate to flying during unfavorable weather conditions. Rain, snow, heat, sand storms, and wind can have an impact on the drone and the cargo it is carrying. It is predicted (Holman, 2016) that if the wind speed exceeds 12 mph there is a chance that the drone may not remain airborne. Rain can cause it to malfunction, in addition to damaging the food packaging. Weather conditions will be a major consideration if restaurants adapt drone delivery as the only mode of transportation. Seasonal variations and use of drones can also put a dent on profitability in addition to adding unpredictability of service.

e. Payload

Most drones that can be used for food delivery are not capable of delivering heavier items. Thus, the weight of the payload is important. The existing drone technology available to date is not capable of delivering heavier items. However, food delivery may not require heavier types of drones since the weight of the packages may not exceed 10-15 pounds. A safe keeping device to hold packages intact is needed while delivering food by drones. One or two cartons of pizza is not an issue, but carrying over a dozen pizza in one trip for a party may be a problem. Again, this may not be an unsurmountable problem considering the development of technology. In any case, there are still technological challenges in designing a delivery drone that is dependable and durable to distribute enough packages, generating sufficient profit considering the fact that most drones can only carry a few pounds' package. This also raises the question whether multiple deliveries in one trip are possible.

f. Source of Energy

Drones require considerable battery power to remain airborne and travel long distances (Holman, 2016). If food is to be delivered long distance, this can be a problem. The worst scenario would be if the battery power goes down while inflight. Power failure or malfunctioning will result in drone falling off creating havoc and possible injuries. Schenkelberg (2016) points out that there are still technological challenges in designing a delivery drone that is dependable to distribute enough packages to justify sufficient profit. Any failure of sensor, gearbox or motor due to an impact resulting from accidents or logistics can damage the subsystems, battery life, or lead to a fire. Repairing a drone is very costly.

g. Legislation

The Federal Aviation Administration (FAA) and its international equivalents have been studying to create effective regulations. Drones present dangers incomparable to any other consumer electronics, but the technology has proliferated so fast and so far that it is difficult to control. The legal ambiguity makes any drone delivery initiative a gamble, and insurance and costs are anyone's guess (Jacobsen, 2016). For the most part, open-use policies are in effect worldwide, except in the US, where drones are mostly banned. The US is more restrictive and it could take months, even years before the FAA offers preliminary guidelines on the commercial use of unmanned aircraft systems (Anonymous, 2016a). Regulations for package delivery have not yet been finalized; although the FAA did release new commercial rules that do not allow drones to fly outside of the line of sight of the operator. This rule will make the mass delivery impractical. Existing rules also do not allow for flying over densely populated areas — all of which require a waiver or new rules to be formulated. Upon approval by the FAA other food safety and health license requirements need to be drawn. Interstate deliveries also need consideration primarily for adjoining Border States. Once the rules are relaxed and approved, the sky is the limit for fast food delivery (Anonymous, 2016b).

h. Noise and privacy concerns

Regulatory agencies are moving carefully because the technology is potentially dangerous and raises complex privacy concerns. Google aims to have the drones flying programmed routes at altitudes of 130 to 200 feet. Precise navigation is required to pick the most efficient routes while controlling noise, respecting the privacy and safety of people on the ground and delivering items to an area the size of a doorstep. Commercial drones use faces legal and practical hurdles. Experts have questioned the legality of operating drones within homeowners' airspace and raised insurance issues (Barr & Bensinger, 2014). It should be noted that the fixed-wing drones are less noisy but they are not likely to be used for food delivery.

i. Human Aspect

There are some philosophical arguments related to the use of drones, which are worth mentioning. The primary question raised is whether a headlong embrace of drone technology is diminishing the boundary separating human and machine intelligence. There is a worry that drones might have an impact on human creativity due to their enthusiastic embrace by many. Major concerns deal with drone's capacity to reduce the need for human judgment, creativity, and thought. Since drones can act flexibly, reliably, and with a quasi-human intelligence, humans find them irresistibly useful. However, drones are not susceptible to emotions, fatigue, or distraction, which eliminates some of the humanistic consideration (Berkowitz, 2014). Drones might also negatively affect relations with local people where they replace face-to-face interactions (Sandbrook, 2015). These thoughts becomes noteworthy since human touch is so important in hospitality. Consider the difference when a metallic machine replaces the personal touch of a pizza driver knocking the door, smiling, and handling hot pizza. The replacement of face-to-face touch points in hospitality remains to be a topic of discussion.

j. Other Issues

The use of drones in interstate deliveries will become a major concern for regulatory agencies. This issue will get more complicated once liquor and other regulated products are considered for delivery. With the increased use of drones, traffic control, speeding, and collision with telephone poles, windmills, trailers, etc. will need consideration. Another issue raised is about the technology itself. According to Queenan (2014), technology always starts out being prohibitively expensive and then becomes ridiculously cheap. So if cheap drones start crowding the airspace that will complicate problems. Another aspect, which may sound minor but can have some impact, is the possibility of causing fear, confusion, anxiety, or hesitation when drones reach with their food delivery. This may occur during the earlier stages of drone usage and may even cause crowding of curious neighbors and onlookers. Even if limited, hackers might steal data from drones, since they can be shot down and dismantled. (Hartmann and Steup, 2013). Packages are also susceptible to theft and interruption while inflight. Hackers may also shoot down or redirect drones to intercept food deliveries.

Amazon requires a landing mat to be used as a helipad for the drones to land. This pad is small and lightweight, which can be moved and stored when deliveries are not expected. It is not sure if a landing mat will be needed for food deliveries. Also, if deliveries have to be made in multiple storied flats inside a building, it will be hard for drones to reach or find a landing site. In many urban areas, it will be difficult to deliver foods by drones in apartments located inside large building complexes.

Discussion Questions

1. Drones have proven to be indispensable for scanning environments and use in military, agriculture, and relief operations, however, do you think they will be as useful in the delivery of commercial foods?

2. Defend your discussion points selecting either the pros or cons for using drones for commercial food deliveries.

3. Is drone-related technology anywhere close to ready for mass deployment? Are drone deliveries has a realistic prospect in the hospitality industry?

4. Do you believe that using drones for food deliveries will be cost effective or cost prohibitive compared to traditional methods of food delivery? Discuss reasons for your answer.

5. Will it be exciting to see drones all over the sky bringing different packages? What traffic problems, if any, do you foresee?

6. As a consumer, are you in favor of replacing traditional deliveries for drone deliveries?

7. From legal standpoint, do you think it will be easier to get clearance or certification for using drones for commercial food deliveries? If not, what hurdles do you foresee?

8. Who would benefit the most by using drones for food deliveries: drone manufacturers, food service providers, or consumers?

9. Will there be a need to change marketing or branding strategies if food deliveries by drones are used?

10. Considering food safety and hazards, do you consider using drones for food deliveries is a good idea?

11. Do you think the quality of the foods delivered by the drones will be at risk?

12. Personally, will you be interested in getting food delivered by drones? Support your answer?

13. Will hacking and privacy be of concern to you if food delivery by drones is used?

14. From human resources point of view, is it economically feasible to deliver foods by drones rather than by delivery personnel?

15. Using drones will reduce the personal touch, which is so important in hospitality. Argue for or against this statement.

Conclusion

Drones symbolize up-and-coming technology, which can literally be used for unlimited applications. Several types of drones are currently in use for a variety of purposes, mainly on a test basis or research. Drones are extremely useful for carrying loads avoiding hurdles such as traffic or access to remote areas. Although drones are used in other businesses, their use for food delivery is at investigative stage. Several experiments were and are being conducted primarily by Domino's Pizza and Chipotle Restaurants. The advantages of drone delivery

include reduction of costs, high efficiency and productivity, accuracy, profitability, unrestricted food delivery and access to new markets. Major disadvantages include food safety, food quality, weather conditions, public safety, noise, privacy, and lack of rules and legislation. All indications are that once approved by authorities food deliveries by drone can prove to be a profitable mode of transportation. However, further research is needed to formulate processes and methods. Much depends on how and when rules are approved for use of drones for food deliveries. Many uncertainties need resolution before drones can be seen at consumer's doors. All pros and cons mentioned are good debating points relating to a potential technological marvel.

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