

Comparative analysis between Drone delivery system and conventional delivery system for online food orders.

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Abstract: Drones are touted to be a game changer in the field of logistics and supply chain management . Out of the in numerous applications , the most fascinating and within the reach of the near future is the use of Drones for Hyper Local Delivery of Food from Restaurants to Customer's Location. Food delivery is an growing trend , with the sector growing at a staggering 15 % quarter on quarter , this exponential growth has engendered interest in both Corporations as well as academicians . Both the Customers as well as restaurants have unequivocally benefited from this trend . The restaurants get a wider access to customers while not having to expand their seating capacity and the customers can obtain restaurant food from the comfort of their home or office. Even though food delivery companies in India register 400,000 per day they aren't able to turn a profit [1] , this can be attributed to certain inefficiencies of the conventional delivery system (Bikes or Scooters). This has opened up an opportunity of an alternate mode of delivery to make the sector profitable and sustainable. This Paper is a critical comparative analysis between the Drone delivery of food to the conventional delivery system . The two methods are evaluated based on parameters like Initial Investment , Depreciation, Operating Cost, Time and environmental Cost. While these parameters vary with distance , order size etc , certain standard assumptions have been made for the process of comparison.

Keywords : Food Delivery , Drones , Scooters/motorcycles , Comparison

I. INTRODUCTION

A drone, in a technological context, is an unmanned aircraft. Drones are more formally known as unmanned aerial vehicles (UAVs) or unmanned aircraft systems (UASes). Essentially, a drone is a flying robot. The aircrafts may be remotely controlled or can fly autonomously through software-controlled flight plans in their embedded systems working in conjunction with onboard sensors and GPS.[2]. Drones are known to have wide applications for armed forces and is also occasionally used by general public for recreational purposes , on the contrast their applications in commercial activities is a recent phenomenon. With the ever increasing prices in fuel and wages , drones are seen as a viable alternative for Logistics and last mile connectivity. Conventional systems are increasingly becoming unsustainable not just in terms of environmental aspects but also because of carrying capacity of current infrastructure (Roads and Highways). Sensing the opportunities many companies have been developing drones for this very purpose. Companies like Amazon ,Google ,UPS, DHL started experimenting on drone delivery systems way back in 2005. DHL launched the first commercial drone delivery in 2014 at a German island . The first drone delivery in USA was run by Flirtey for delivering food , medicines and bottled water in 2015 , subsequently companies like Amazon were granted FAA approval for research and development for drone delivery. By the end of 2018, FAA estimates that about 7500 drones to obtain commercial operating license for drone delivery [3].

Even though drone delivery system sounds promising , with the current technological limitations of battery capacity and motor efficiency , long range delivery system is unviable but it has potential in the hyper local delivery system especially local food delivery segment. The segment is expected to grow from 700 million dollars revenue to 2.5 billion dollars in revenue by 2021 in India alone. These numbers aren't without its credence , some of the reasons for the explosive growth are

- Increase in disposable income among Indians especially in tier 1 cities has created a surging demand for luxuries like eating from a restaurant.
- Convenience of food delivery is one of the main reason that people have embraced this idea, particularly by the people who endure through a fast paced and hectic lifestyle ,as they cannot afford to leisurely visit a restaurant or cook at home.
- Our eating habits have been morphed with globalization , people are craving for alternate cuisines apart from the regional everyday food.[4]

Even with this staggering growth in this segment, food delivery companies are struggling to maintain adequate profit margin , this is because of certain inherit problems with conventional delivery system. Conventional delivery system generally consists of an

online order aggregation system where the orders of the customers are recorded and processed. The system identifies the nearest delivery executive and transfers the information of the order accordingly. The delivery executive then travels on his/her motorcycle or scooter to deliver the food from the restaurant to the customer. At the face value of this system itself we can observe why its inefficient, the time taken to complete the order is extremely high because of increasing vehicular traffic during peak hours, magnitude of time taken affects customer satisfaction and also reduces the profit margins of the company. The fuel spent on travelling also adversely impacts the environment that we are striving to preserve and nurture. A recent survey indicates the reasons as to why consumers are apprehensive about trying food delivery systems, two major reasons were cost and time. These problems begs the question, is there a better alternative for this system. All these reasons points towards drones as the alternatives. Drones can make deliveries cheaper and faster hence addressing more than 50% of customer's apprehensions in trying drone delivery.



Figure 1, Ref [5]

Drone Delivery consists of a quadcopter that is parked in a regional facilities across the city, when a order is assigned to the drone by the aggregator. The drone autonomously flies to the desired restaurant based on the GPS location provided. The food is then placed in the drone by a restaurant employee and drone autonomously takes off and delivers it to the customer location. Drone selects the nearest safe landing location near the customer like terrace, lawn or an empty road.[6]. Barring certain technological challenges like autonomous control, safe landing of drone and customer authentication, this paper shall be comparing the economic viability of this system compared to the conventional system. Further the fast paced research in consumer electronics will continue to shrink the size of drones and also bring down the cost in the coming years

2. COMPARATIVE ANALYSIS

2.1 TIME

Typical food delivery time in India for a order to be delivered was about 42 minutes in 2017 for delivery range less than 5kms, it has been reduced from the average order time of 47 minutes in 2016 by efficient handling of personnel and better order processing techniques. Long delivery time of 42 minutes taken per order is a cause of resentment for customers and these high delivery times impact the number of orders an executive can fulfill, if an executive is able to fulfill fewer orders, it impacts the returns obtained from the wages paid for the executive. The reason for such long delivery time can be mainly attributed to vehicular traffic that a delivery executive faces, at a point of time sizeable number of delivery executives will be stuck in traffic, the new orders will be piling up, which increases the delivery time.

On the contrary Drone delivery system has the unique advantage of negating problems of traffic also unlike conventional delivery systems, which saves sizeable amount of time. the drones can travel in a straight line directly to the point of delivery which reduces the total distance to be travelled, while in conventional delivery system the roads don't lead straight to the delivery point, there the delivery executive must take multiple roads that travel in different directions to reach there.

Considering an order distance of less than 5 km and average drone speed of 35-45 kmph [7], a drone can cover that distance in less than 9 minutes and adding about 5 minutes for collecting order from the restaurant and about 5 minutes for fixing on customer location and landing near them, the total time taken by a drone to execute a order of < 5km range is less than 19 minutes. This shows that for an average drone delivery time is less than 50% of the time taken for conventional delivery system. With increasing advancements in Artificial intelligence and drone hardware the time taken per order by a drone can further be reduced in the near future.

2.2 INITIAL INVESTMENT

Initial investment for a food delivery business mainly consists of two parts a) App/Website and Backend processing b) Equipment for delivery. App/Website and Back end processing for both conventional delivery system and drone delivery is very similar and hence the cost associated with both will be the same.

But the cost of equipment differs between conventional delivery and drone delivery system. Conventional delivery system uses scooters/motorcycles, in India the price range varies from 50,000-70,000 Rupees. Drones that can carry up to 500 grams of payload cost about 80,000 - 1,20,000 Rupees. Even though drone delivery requires higher initial investment that cost is offset because of shorter delivery time taken by drone. As drones can complete an order within 19 minutes compared to 42 minutes of conventional system, fewer drones are required to complete same number of order as conventional delivery system. Since the delivery companies have to buy fewer drones when compared to scooters/motorcycle, the total initial investment would approximately remain the same for both drone delivery system and conventional delivery system.

2.3 OPERATING COST

2.3.1 Fuel/ Electricity

Conventional delivery systems consists of scooters/motorcycles which runs on petrol. An average delivery executive completes about 20 orders per day, considering a distance of 4-5 km per order. Therefore the delivery executive would travel 80-100 km per day, the scooters/motorcycles would return a mileage of 35-40 km per litre. Hence the one scooter would utilize about 2-2.5 litres of petrol per day which would cost **150-180 Rupees per day**.

Drones operate on electrical energy, which is stored in a battery on board. Let us consider a standard drone containing a battery of 5000 mAh 15 V which would be capable of a range of 10-12 km on a full charge. Assuming one drone would be able to complete 3 deliveries per hour and it operates for 10 hours per day, therefore it would travel about 110-120 km in a day. Therefore one drone would require about 0.9 to 1.1 kWh per day, which would cost a mere **4 - 5 Rupees per day**. [8]

2.3.2 Spares and maintenance

As the scooters/motors are continuously driven throughout the day, the scooters would bill higher maintenance and spares cost than a private vehicle. The cost for one scooter/motorcycle would come to **4000-5000 Rupees per vehicle per year**.

Drones require high amount of maintenance and frequent replacement of parts. A standard drone requires new propellers every 300 km, new batteries after 2500 cycles etc. Therefore the spares and maintenance cost of drones is every expensive and would come up to about **13,000-15,000 Rupees per drone per year**. With rapid advancements in drone technology and commercial electronics every year there will be tremendous reduction in cost of spares of maintenance of drones.

2.3.3 Salaries and wages

Conventional delivery systems would require a number of delivery executives to pick up orders from restaurants and deliver it to customers. An average pay for executives including incentives would come up to **13,000 to 15,000 per month** for one employee.

On the other hand Drone delivery system is fully automated and hence would require no human supervision or piloting. This means that there would be **no salaries or wages** associated with drone delivery system.

2.4 DEPRECIATION

For any mechanical and electronic devices and vehicles there will be depreciation in its value. Two wheelers are said to depreciate about 10% each year [9], while drone depreciate about 20-25% each year [10]. We can observe that the depreciation of drones is much higher when compared to scooters/motorcycle, this is because drones contain sensitive electronics that have a very short lifespan. By this data we can infer that drones have to be changed every 4-5 years while scooter/motorcycle have to be replaced every 10-12 years. But with rapid development in drone technology and composites, the depreciation estimate of drones would be reduced and its lifecycle will be increased.

2.5 ENVIRONMENTAL IMPACT

While cost cutting and profit margins are important for a commercial enterprise, they also have an obligation to adopt measures that is environmentally friendly. Climate change and global warming is a threat to entire humanity and emissions by vehicles play a huge part in it. Vehicles used in food delivery business burn fossil fuels and release green house gases to the atmosphere that contributes to global warming. Drone delivery system on the other hand requires electricity and doesn't emit any green house gases. Recent advances in renewable technology (Solar cells and Fuel cells) has made it possible for it to be integrated into the

drone itself , to create a self sustainable drone which has a smaller carbon footprint . Recent study in Korea by Jiyeon Park, Solhee Kim and and Kyo Suh calculated that the Global Warming Potential(GWP) for 1km travel of motorcycle is about $2.85 \times 10 \text{ kg CO}_2\text{-eq}$ of Co2 and for 1km of drone travel is about $4.41 \times 10 \text{ kg CO}_2\text{-eq}$. This shows that motorcycle is 24 time more harmful to environment than a drone during 1 km of travel. [11]

3. CONCLUSION

Out of all the retail industries , food delivery is one of the fastest growing segment fuelled by great demand by young and urban population . The conventional delivery system has failed to meet this demand in a effective and a sustainable manner. As an alternative to this, the drone delivery system has displayed significant advantages over the conventional systems . Drone delivery system takes half the time for a delivery when compared to the conventional delivery system , its operating cost is also extremely low because of cheap energy cost and no requirement of human labour. The short delivery time and cheap service charges can make it attractive for new customers and help accelerate the industry to greater heights. It also leaves room for adequate profit margins for delivery companies that were struggling to turn a profit using the conventional system. More importantly environmental benefits of using drone delivery is tremendous when compared to conventional delivery system , this is a small but a significant step towards building a greener future.

But the drone delivery system is not without its challenges , as we can observe that the cost of spares, maintenance and depreciation is very high, which affects the viability of drone delivery to a great extent. These drawbacks don't seem to be a deal breaker as these setbacks will slowly be mitigated with the ongoing research in commercial electronics and drone technology by many companies and universities . However there are still some technical hurdles to be cleared before this technology is suitable for full scale commercial activities , like software for finding a suitable landing location or customer verification before delivery etc. Whatever the hurdles may be , there is ample proof that drones will be future of food delivery business and will be in the skies delivering food and other products sooner or later.

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