

The Use of Drones in Air Cargo Transportation

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Abstract: The aim of this article is to examine the possibility of introducing drones when transporting cargo and analyse their impact on society.

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1. Introduction

The use of drones is becoming increasingly interested for private organizations, businesses and researchers who use them to collect spatial and environmental data on natural and artificial phenomena. Hollywood wants them to make films, police on patrol in the air; the journalists for capturing attractive shots and farmers for watch their crops and dusting. The advantage of drones is that data can be recorded or measured remotely. Other benefits can include low operational costs and ease of use compared to manned aircraft or satellites.

2. Drones

Drone was a term used for guided missiles, which were used to simulate aircraft or enemy missiles. Therefore, it is also sometimes used acronym for UAV (Unmanned Aerial Vehicle), which is a plane without a pilot on board. Unmanned Aerial Vehicle is defined by the ability of controlled, sustained horizontal flight, which is driven by electric or combustion engine. Cruise missiles can also be considered as a UAV, but on the basis that the missile itself is just a weapon, we rank missiles in a separate category.

UAV should operate fully autonomously during the flight and independently on any external signals. Theoretically, there could be autonomous aircraft to fly without the influence of a hostile signal and interference and could perform a variety of complex tasks. The disadvantage of autonomous flight control systems is possibility to simulate flights on a computer. That would allow the enemy to penetrate the system and change the course of the flight. (Barnhart, R., 2012)

2.1 Fixed-Wings

Drones of this type usually have wheeled landing gear adapted for the runway. The advantage of UAV with fixed wings is that it offers operators the possibility of long-range and long-lasting flights in the air. Another advantage over drones with vertical take-off and landing is the ability to fly at much higher altitudes. The disadvantage of these drones is the requirements for the runway. (Austin, R., 2010)

2.2 Vertical Take-off and Landing

VTOL (Vertical Take-Off and Landing) drones bring lot of benefits in contrast to previous category. VTOL drones can take several different forms. The most common are in the form of a helicopter or a tilt motor. The biggest advantage of these drones is that the most of them do not need any runway for take-off and landing. For most drones there is no need for extra facilities for launching or landing, for example starting rockets, catapults or network for landing. Unlike drones with fixed wings, VTOL drone can operate in a smaller space, or even on one place. This feature is used primarily for monitoring. (Austin, R., 2010)

2.3 Types of drones

Unmanned aerial vehicles have enormous potential for performance on numerous tasks in inaccessible terrain and other difficult conditions, hazardous for human operators. Therefore drones are currently used for tasks whose fulfilment is for humans risky, costly and repetitive. The basic types of drones are used to as a target or bait, military, monitoring, designed for development and for commercial purposes. Another possible use is in agriculture for accurate and timely application of fertilizers and preservatives. Experts are also working on micro drones that could enable the detection of a gas or chemical leak or for artificial pollination.

3. Elements of Unmanned Systems

This chapter describes the elements that make up unmanned aerial systems. Most civil unmanned systems are composed of unmanned or remotely piloted device, method of launch and recovery, the human element, payload, command and control element and communication data link.

Command and control element of unmanned system is divided into autopilot and ground control station. Fully autonomous unmanned systems are able to fly without operator intervention entire flight from take-off to landing.

Ground control station is a control centre on the ground, which provides facilities for the management of human drones in the air. Drone may be controlled by a small hand-held transmitter, or it can be controlled from a multi-site centres. The most common use is the combination of these two because removed operators, what could preserve before drone crash. Although the autopilot controls everything from take-off to landing, the ground station operator can intervene in the event of an emergency or in order to avoid danger.

For communication data links are distinguished radio frequency for visibility range and beyond visibility range. The most frequently used payloads are cameras for monitoring and sensors for measuring the values. The most important element for the operation is the human factor that is required for the safe operation of the drones. Unfortunately people are clumsy, not careful and especially they are vicious. Therefore it is necessary to invent a lot of measures to prevent intentional or unintentional accidents in the future. (Austin, R., 2010)

4. Legislation in the Czech Republic

Under current rules, the flying drone does not need to be registered or must not be licensed to fly when the weight of drone is less than 20 kg. No license is also required for recreational and sport purposes. But if you are using drone to earning, experimental or research activity, license is required. Flying is forbidden above suburb area or above a place where is lot of people. The most common offenses are flying over people at concerts, sport events and other meetings or public flying over populated areas without permission.

The traffic of unmanned systems in the Czech Republic is stated by the Supplement X - Unmanned systems. The supplement X contains basic common rules and requirements for unmanned systems. Also provides comprehensive instructions for users for safe operation of unmanned systems. Supplement divides unmanned aircraft and drones into four categories according to take-off weight. These categories are: to 0.91 kg, from 0.91 kg to 7 kg, between 7-20 kg and the last category is over 20 kg. (ICAO Annex: L2, 2014)

An important aspect, to which should be emphasized is an education of the public, because unfortunately, people do not even know the rules and occasionally disrupt forbidden flight zones. For example, it would help to introduce an obligation for the seller to give to drones products a leaflet warning with requirements to respect the privacy of others and with restricted areas. Another measure would be compulsory insurance for any damage and determine the minimum altitude above foreign property.

If someone wants to operate unmanned aerial activities for profit, he must meet certain conditions to obtain this permit. First, you must get a license to fly and then you can apply for a permit to operate air work for profit. In table 1 we can see an overview of applications and issued licenses to flying unmanned aircraft for purposes other than recreation and sports. To the date 3.4.2015 there was at CAA recorded 94 pilots of unmanned aircraft. On the list of operators of aerial work there was registered at CAA 12 permit holders until 31. 3. 2015.

Table 1 - Permit issued by the civil aviation authority in the Czech Republic

	2012	2013	2014
Requests for permission to fly	20	43	88
Issued permits for flying	3	26	41
Requests for aerial work	0	2	12
Issued permits to carry out aerial work	0	0	9

(Source: <http://ihned.cz/c1-63401520-dron-az-do-vasi-loznice>)

People are still dealing with how to prohibit drones to fly into restricted areas. A solution could be to create a database of restricted zones. The database would contain coordinate locations, which drones would avoid them or warn the operator that the area is prohibited airspace.

5. Amazon – Prime Air

Prime Air drones are designed for transporting goods ordered from Amazon Centres directly to the customer. The drones will be able to deliver mail to customers weighing up to 2.3 kg within a radius of 16 km from the warehouse within 30 minutes. Shipments below 2.3 kg represent 86% of all shipments of the Amazon. During the delivery process, drone will pick up the shipment at the supply point. Then use GPS to deliver package on desired address. Upon arrival package is released at the delivery address. At first glance, it seems that Amazon is simply trying to offer customers a new service to cover up problems with their employees. According to reactions from the press and on social networks, they are successful in this task.

6. Flying Donkey

Flying Donkey is preparing to implement cargo transportation services using drones in Africa. The project is being implemented because of underdeveloped and poor road network. Because in Africa people live without regular access to medicines they use drones in developing countries to deliver medicaments against HIV / AIDS, tuberculosis and other epidemics. The main reason why projects UAVs begin in developing areas is due to high level of need and at the same time people are willing to take much higher risks in order to solve urgent problems.

On continents still dominate mixed feelings on this project. Some people are enthusiastic to use cargo drones and they are excited and pleased that they have been invited to this opportunity. On the other hand, not everyone shares the enthusiasm for the project. Among people pessimism reigns as a reflection on how the project would work on the continent. A distinctive feature is the lack of confidence. For people it is difficult to imagine how the project would work, if nowhere else in the world, a similar mode of transport has not been implemented yet.

The development of drones on the African continent should participate:

- World-leading researchers, inventors and suppliers of pilotless systems
- Operators of delivery services (post, courier, logistics, e-commerce)
- Representatives of government authorities (legal, regulatory, certification, licensing, data protection & privacy)
- Insurance and safety specialists
- City planners and transport planners
- Designers unmanned products and services
- Supporters and Sponsors
- Media (Flying Donkey, 2014)

African aviation is not in good condition. It seems that Africa is use as a test area because it is less regulated than in the Western world. Testing of drones has bad light on reputation in the Africa. Lack of controls and regulations should not be seen as an advantage. Arguments humanitarian assistance and improved serviceability helps to lobby against air regulations that Africa needs to develop.

7. Case Study

The thesis solves case study of cargo UAVs using the method of QFD (Quality function deployment). The basis of the method QFD is exploring relationships between the demands of potential customers and traffic characteristics. Using the method, it was found that the most important parameters for the customers are an acceptable price for delivery, to ensure high service quality and availability of drones on the required routes. In terms of traffic characteristics is essential degree of automation, information technology, and receiving and shipping in the required time. In another part of the case study was used risk analysis containing a description and assessment of individual risks with subsequent proposals to eliminate or minimize risks. Here it was found that the greatest risk lies in the lack of a qualified workforce and communication errors between the drone and the ground station.

8. Check-in Process

Currently it is implemented project of specially adapted cargo drones for transport. The quickest way for shipping will be select immediate shipping services. That means transporting the shipment immediately after receiving of cargo for transport. Transportation would then be carried out by a drone specially dedicated for this purpose. This service would be designed especially for time-sensitive shipments and delivery of shipments with high priority. For example, when human life is threatened or when heavy loss is probable. The price would be determined individually according to customer requirements and the distance between the places of delivery.

Ground stations are the most important element in shipment. Handling system of shipments will likely consist of two kinds of ground stations. One of them will be terminal, where will be carried out maintenance, repair, handling of consignments and control centre for drones. Most of the operations will be done manually. The second type will be automated ground station where drones will be changing batteries, picking up and delivering packages.

The system will be automated, not only on land but also in the air. Because there will be set fixed places of stations, therefore there will be no requirement for direct piloting of drones. Drones will use GPS and other sensors aboard to navigate along a route. Transportation will take place on specific routes, which will be still repeating. To increase the safety of drones, there will be installed parachutes that will be used in situation of a malfunction or system failure. The aim is to reduce the possible risk for people on the ground or minimize damage to drone and cargo.

9. Conclusion

Environment of unmanned air transport is a complex and dynamic system, which is full of difficulties and problems. Therefore, developers, operators and users of unmanned aerial vehicles have to proceed very carefully to ensure that all rules and regulations are properly understood and followed. Continuous development of rules and standards in UAV flights is the basis for improving drones future. For more orderly development and growth is an important active participation of the user community, which should take care of the necessary support. Technological advancement of unmanned systems has a positive impact on their safety and efficiency flying. The supreme goal for users of remotely piloted drones is to reach rules, regulations and practices that regardless of where and how drones are used, it is easy to understand, comprehensive and rational.

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