A RESEARCH ON THE AVAILABILITY OF UNMANNED AERIAL VEHICHLES IN THE CIVIL AIR CARGO TRANSPORTATION IN TURKEY

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A RESEARCH ON THE AVAILABILITY OF UNMANNED AERIAL VEHICHLES IN THE CIVIL AIR CARGO TRANSPORTATION IN TURKEY

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PLAGIARISM

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

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ABSTRACT

Unmanned aerial vehicles, which were started to be used in the 20th Century and got into a quick development process by the technological data, are used more widely in fields of military and trade, and by individuals for hobby and sports purposes. For the unmanned aerial vehicles supporting nations' military research and development processes, projects are being developed and investment is made. The scope of this research is to understand the preferability of the developed unmanned aerial vehicles by cargo airlines in Turkey. Within the scope of this research interviews, observations and source materials are evaluated by using quantitative research methods. Accordingly, it is seen that companies providing air freight in Turkey are willing to use air cargo vehicles, however, due to reasons such as uncertainties, security concerns, legal regulations and limitations in air space, it is seen that more time is needed to put them in use.

Keywords: Civil aviation sector, unmanned aerial vehicles, unmanned cargo aircraft , UAV, UCA, air logistics, cargo airlines

ÖZET

20. yy'da kullanılmaya başlanan ve 21. yy'da teknolojik verilerden etkilenerek hızlı bir gelişim süreci içerisine giren insansız hava araçları hem askeri ve ticari alanlarda hem de hobi ve sportif amaçlı olarak, bireyler tarafından kullanımı yaygınlaşmıştır. Ülkelerin askeri amaçlarla araştırma ve geliştirme süreçlerini desteklediği insansız hava araçları için ticari amaçlı da projeler geliştirilmekte ve yatırım yapılmaktadır. Bu araştırmanın kapsamını, geliştirilen insansız hava kargo araçlarının Türkiye'de hava yolu kargo firmaları tarafından tercih edilebilirliği oluşturmaktadır. Araştırma kapsamında nitel araştırma yönteminden faydalanılarak firmalarla yapılan görüşmeler, gözlemler ve kaynaklar değerlendirilmiştir. Bu doğrultuda, Türkiye'de hava kargo taşımacılığı yapan firmaların insansız hava kargo araçları kullanmaya istekli oldukları fakat belirsizlik, güvenlik, yasal düzenlemeler ve ticari hava sahası kısıtları gibi sebepler ile uygulamaya geçilebilmesi için henüz zamana ihtiyacın olduğu görülmüştür.

Anahtar Kelimeler: Sivil Havacılık, insansız hava araçları, insansız hava kargo araçları, insansız kargo uçakları , İHA, İKU, hava lojistiği, kargo havayolları

DEDICATION

To my mother Emine Gözeğir

and

my father Hayrullah Gözeğir

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ABBREVIATIONS

AACUS	Autonomous Aerial Cargo/Utility System
AC	Air Conditioning
ACMI	Aircraft, Crew, Maintenance and Insurance
ADMC	Arabian Development & Marketing Co.
ALAADy	Automated Low Altitude Air Delivery
AOG	Aircraft on Ground
AUVSI	Association for Unmanned Vehicle Systems International
BVLOS	Beyond Visual Line of Sight
CAAC	Civil Aviation Administration of China
CAB	Civil Aeronautics Board
CAV	Cargo Air Vehicles
DGR	Dangerous Goods Regulations
ECAC	European Civil Aviation Conference
eVTOL	Electric Vertical Takeoff and Landing
FAA	Federal Aviation Administration
FIATA	International Federation of Freight Forwarders Associations
FTK	Freight-Tonnes-Kilometres
GPS	Global Positioning System
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
LAANC	Low Altitude Authorization Notification Capability
LUCA	Large Unmanned Cargo Aircraft

MTOW Maximum Take off Weight

NAFTA North American Free Trade Agreement

NAS National Airspace System

NASA National Aeronautics and Space Administration

REA Railway Express Agency

RPAS Remotely Piloted Aircraft Systems

SHGM Directorate General of Civil Aviation (Sivil Havacılık Genel Müdürlüğü)

sUAS Small Unmanned Aerial Systems

TIACA The International Air Cargo Association

UAE United Arab Emirates

UAS Unmanned Aerial System

UAV Unmanned Aerial Vehicles

UCA Unmanned Cargo Aircraft

UK United Kingdom

ULD Unit Load Devices

UNICEF United Nations International Children's Emergency Fund

UTM Unmanned Aircraft System Traffic Management

VLOS Visual Line Of Sight

VTOL Vertical Take-Off and Landing

WCS The World Cargo Symposium

WTO The World Trade Organization

YEC Yates Electrospace Corporation

1. INTRODUCTION

Aviation and transportation sector, which has become worth a billion-dollar global system, has improved in spite of all the troubles and challenges through adoptions of improvements in innovations and technologies, and will continue to develop (Sales, 2016, p. 141). Aviation, taking its roots as early as in 1700s has rapidly developed with the impacts of the wars which took place in the 20th Century. Airplanes' ability to observe and carry were utilized during the war period, and, when the wars were over, they got integrated rapidly into civil use. 20th Century aviation sector represents an important period which saw a change of a move from propeller aeroplanes to jet aeroplanes. Improvements in technology in the 21st Century points out to a more rapid development period for the aviation sector.

Increase in global trade, competition resulting from free trade, the natural instinct of companies wanting to make profit force the relevant businesses to be innovative, and, to keep up with the developments. As for the military, developments of airplanes which are an important part of the armed forces, and, their integration to new technologies, have a strategic importance to keep the countries' status quo in power or for them to become more powerful.

Aerial transportation which is developed to provide services in security or attacks during war has become from a luxurious thing in civil use to a basic necessity. Aviation sector, which has reached worth billions of dollars trade volume, has become an inseparable part of the economy by shortening the distances for passenger and freight shipment by the advantages provided in time.

21st Century, the beginning of a new digital era, is predicted to be a period where the improvements in information technologies are going to be applied in every sector. In this sense we can observe the ever-increasing role of the innovations and transformations brought by e-commerce, artificial intelligence and blockchain technologies.

From micro UAVs (unmanned aerial vehicles) used for hobby purposes today, to, UAVs produced with or without guns, take their roots from the idea of flying a mechanical bird 2500 years ago; as for the modern era it started with a helicopter which was prototyped in 1909 but couldn't be flown due to mechanical difficulties. With the research-development investments and integrations of developments in technologies UAVs that become improved and used more widely are used with the purposes of observation, exploration, camera shooting, transportation, agricultural spraying, fire extinguishing and military uses in many countries. UAVs finding their place in the aerial space experienced delays as a result of deficiencies caused by legislations over the years. The necessary steps were taken with the regulations related to the way these vehicles would be used in the national and international aerial domains were made by the relevant authorities and the needed changes were made.

Austin (2010) '*unmanned aircraft will only exist if they offer advantage compared with manned aircraft'* (Austin, 2010, s. 5).

2. AIR CARGO

Glenn Curtiss' transportation of a bag full of parcels from Albany to New York on the 28th of May, 1910, can be taken as the beginning for air cargo transportation. The flight which Glenn Curtis had taken to the Post Office Department to deliver the parcels took two and a half hours for 150 miles (Wensveen, 2007, p. 321). The airplanes manufactured during the First World War had reached a longer travel distance capability and higher capacity. After the war had ended the airplanes that were once used in war were bought by commercial companies to be used in commerce. With that of the Second World War, on top of transportation of military loads, the ever-increasing importance of the transportation of heavy loads contributed greatly in the improvement of aviation technologies (Sales, 2016). While with the increase in interest for civil aviation, international agreements, and, international organizations and establishments the barriers in front of civil aviation were getting removed gradually, civil aviation continued to grow steadily over the years.

Despite majority of people believing the main use of airplanes to be to transport passengers, the volume of cargo transferred is observed to be higher than the volume of passengers transported (Wensveen, 2007, p 321). Aviation and transportation sector, which has become worth a billion-dollar global system, has improved in spite of all the troubles and challenges through adoptions of improvements in innovations and technologies, and will continue to develop (Sales, 2016, p. 141). Transportation of items through air cargo has become a mandatory need rather than a luxurious necessity with the effects of globalization. Air cargo, which is preferred for the time valued items to be transported intercontinentally has

got into a position to be able to compete against other types of transportation methods and time valued items through developments in the industry.

2.1. Definition of Air Cargo

Air cargo covers air freight, mail and smaller parcel services which are, nowadays, used more flexibly, and everything else that goes into the aircraft compartment other than that of passenger luggage on passenger flights. Hand luggage, which is considered to be a part of the passenger, isn't a part of air cargo transportation. On air cargo transportation, not just on cargo flights, a great deal of weight is carried on passenger flights (O'Connor, 2001, p. 153-155). Today, cargo transportation has been started with unmanned aerial vehicles.Therefore we can define 'Air cargo' is cargo and items transported by human and unmanned flights.

2.2. Development of Air Cargo Transportation

Airplanes manufactured earlier for the first time around did not meet the needs of commercial aviation. The airplanes manufactured during the First World War had started to get longer flight-distance and higher carriage capacity. After the war ended, the airplanes used throughout the war were being purchased to carry out commercial operations. However, in spite of their initial purchase prices being low, the yearly maintenance costs being high resulted in demand for new engines and aircraft designs (Sales, 2016, p. 20). The USA, which had joined the war late, provided logistics faster, wider and safer than aviation services by constructing a comprehensive railway network in the early 1920s. However, the war had reflected the potential for both weapon and passenger transportation, and, the U.S came to the conclusion of continuation for the production of airplanes (Cook & Billig, 2017, p 6-7). But, there

being not enough commercial flights and a lack of international rules, the basic needs such as ground and navigation services, connection roads, airports with suitable runways, repair stations, air and flight controls could not be met. As a result of these necessities, various agreements under the name of International Aviation Paris Convention, in 1922, in Paris, were made and the main control areas of national air domains were set. The aviation authority centred in Paris decided to start the legal, technical and meteorological services in 1925. After the agreement which was signed in Paris, Varsaw Convention; which was signed by 152 participants in 1929 and put in action in 1933, and, accepted as the most important agreement in the aviation industry, brought regulations in lots of areas, such as responsibilities and restrictions, flight regulation, judicial authorisation related to international transportation(Sales, 2016, p. 20). The responsibilities of aviation companies and the passenger rights were first discussed at Varsaw Convention and bound to a legality (Cook & Billig, 2017, p. 5). Aviation industry, which covers a wide area and is completed, could only be administered through legislations, rules and controls accepted by an international network (Sales, 2016, p. 175). The impact of the first world war on aviation is very important in the development of aviation history. The benefit obtained by aircraft used for military purposes was the first step in establishing international regulations.

With the Second World War, apart from the military loads, heavy load transportation had also gained importance, and, therefore it had been a period witnessing great developments in aviation technologies. After the war, the airplanes which were used during the war started to be used in civil aviation transportation after certain tests. KLM, Deutsche, Lufthansa and Air France are the leading companies carrying items such as newspapers, banknotes, gold bars, parfum, fashion products, animals such as racing doves, machines and spare parts (Sales, 2016, p. 19-21).

Regular flights started in 1941 after four massive American air operators (United, American, TWA and Eastern) had come together and formed an air operator called Air Cargo INC. With the Second World War, air cargo has become more important. After the war ended, lots of air operators started to provide air cargo services themselves (Sarılgan & Yalçınkaya, 2016, p. 6). Equipped with technological innovations in the second world war, the aircraft began to be used for civilian purposes that followed the war. The first steps of today's air sector were taken after the war and aircraft began to be integrated into civilian uses.

The USA had organised a Civil Aviation Conference in 1944 due to negotiations that were being held for every route before the Second World War, commercial rights issues, worry of legal and economic conflicts that could arise in times of peace. While the representatives of 52 countries showed up and came together, the USSR didn't send a representative to this conference. At the conference agreements upon new custom regulations, application of national traffic rules, etc, and lots of other topics were made. It was requested from the countries to conform to the international applications and standards, and to provide a uniform system which is of the highest standard (Wensveen, 2007, p. 464-465). In 1946, the representatives of the USA and UK came together and signed a mutual more reconciliatorily agreement which included; apart from including the articles of the Chicago Convention, to consult ICAO's opinion as an advisor in case of a disagreement, set the percentage amount[of money] to be taken by air operators and to assign IATA to prepare the procedures for the flight rules. The mutual agreements, exceeding the amount 70, which the US has made since the latter agreement, includes all of the regulations set in Bermuda and Chicago (Wensveen, 2007, p. 471-472). The CAB created a

classification under the name of licenced cargo transporters in 1949. Flying Tiger Line is the first cargo operator which was certified by the Cab; the latter, which was established in 1938 had its operations ceased in 1985 (In 1989, Federal Express bought the full share of Flying Tiger, which was the biggest air cargo operator of the world) (O'Connor, 2001, p. 155). The aviation actors of 1930s and 1940s thought that the most important source of income would be from air cargo. However much the air cargo traffic has a healthy growth rate, other transportation systems provided with more income. Operations done through land, sea or railway vehicles being less costly than the operations done through airplanes, market limitations and deficiencies in aircraft design resulted in air cargo developments to not go in the way of air cargo actors' expectations (Wensveen, 2007, p. 325-326). While the barriers in trade were getting removed one by one with the fixed exchange rate regime which has been in place since 1950s, and, Customs Tariff and Trade General Agreement signed in 1947, economic growth and global trade's development accelerated. EEA (European Economic Area)'s common approach in 1958 sped up this acceleration (Sarılgan & Yalçınkaya, 2016, p. 6). With this acceleration in the air sector necessities for new regulations became prominent. In this regard, to discuss the Varsaw Convention and Lahey Convention's regulations a diplomatic conference was held in 1971 in Guatemala, and a revision of the two agreements' regulations were adopted (Wensveen, 2007, p. 464). With the growth in global trade in 1960s aerial transportation's growth rate reached to double digit numbers and IATA airlines decided to separate passenger and cargo freight types from each other. This era has been an era where the bond between agency and air freight sector has become more professional. The establishment of Airbus in 1970, the beginnings of takes off of

Lufthansa's airplanes in 1972 are significant developments in air cargo industry (Sarılgan & Yalçınkaya, 2016, p. 6-7).

Until the 1980s, the acceleration of the transformation of aircraft transportation and the air industry was a sequential period, when international standards were established, aviation authorities were established and assigned. This period in which globalization gained importance and the destructive effects of war were tried to be reduced, the sensitivity of all countries to developing sectors and their desire to be in the sector are the effects of the rapid development of the air sector.

Studies regarding regulations to support the US aviation policies were started to be made with a reform call from President Ford in 1975. Bermuda II agreement was signed between the US and UK in 1977 (Vensveen, 2007, p. 475). Air cargo transportation's liberalisation accelerated with mutual aviation service agreements being put on discussions again between 1977 and 1985 by the US. Mutual Aviation Agreements Agreement is named so as it is negotiated between two parties; two countries. These agreements cover both passenger and cargo flights, however certain countries have signed mutual agreements only for allcargo flights. The agreement signed between the US and Japan in 1996 can be shown as an example to this. There are articles similar to that of the ones in Bermuda 1 Agreement in majority of agreements. One of these is the principle of having fair and equal opportunities. In the past, this country's frequent violations were witnessed by privileges provided to the national flag carriers and restrictions imposed upon its opponents, and as a result this has been emphasized again and again with mutual agreements (Morrel, 2011, p. 56). Mutual agreements which set forth which networks the air operators can operate

actually shows their will of keeping the air transport in their hands rather than companies. Agreements are comprised of the countries' policies rather than air operators (MEGEP, 2011, p. 3). Air operators which have been negatively effected by the restrictions of access to market, ownership and control started to form alliances in order to increase global interaction, customer advantages and profits as well as to reduce expenditures. Despite many agreements and alliance types they have the tendency for the three categories of trade, strategic and equitable partnerships (Morrel, 2011, s. 117-118).

1980s has been a time period of mutual agreements to increase liberalisation between areas. With these positive improvements in international trade, and, increase in air cargo capacity, as well as, beginnings of the usage of wide-body aircraft and increase for the studies of improvements in the processes, the costs and loading and unloading times were lowered (Sarılgan & Yalçınkaya, 2016, p. 6-7). Restrictions in air cargo has been removed in the US with the Air Liberalisation Agreement accepted in 1978, and with that new operators joined the market. However, majority of those either merged with bigger companies or went bankrupt. Compared to the US, European countries and China preferred a more gradual transfer to the liberalisation (Cook & Billig, 2017, p. 24,32). There are still bilateral agreements between countries. Liberalization can be regarded as a milestone in the air transport sector. Despite the bankruptcies with the abolition of restrictions, the driving force of competition has brought technological and operational innovations. In addition to the flag-carrier airlines, the entry of new airline companies into the market has created a different competitive environment within each country. Passengers and companies

that purchased cargo services were the most benefiting from this competitive environment.

European Union, established in 1993, and NAFTA which was established to enable free trade between the countries within EU in 1994, and, again, the establishment of World Trade Organisation (WTO) with the same purpose in 1995 have been the developments which indirectly effected the air cargo transportation (Sarılgan & Yalçınkaya, 2016, p. 6-7). Members of ICAO had come together and signed a multilateral agreement in 1999, which is called Montreal Agreement (Sales, 2016, p. 20). The clause 'air cargo transport's unlimited responsibility' was accepted for the first time, and, additions and corrections in articles regarding indemnities were made (SHGM, 2008).

John G. Wensveen explains the historical development of air cargo transportation in his book (2007) in this following succession below (Wensveen, 2007, p. 322-325):

- **Air Mail:** Air mail services' continuation were decided to be continued as a result of more than expected profit made through 3-month long test flights from Washington to New York. Regulations were put in place by the American Congress to transfer air mal transport to private sector operators in 1925. The first airplanes were made only for the purposes of mail transportation.

- **Air Carrier:** The first air transportation was done by United Airlines in the US, in 1927. REA (Railway Express Agency)'s dominant presence in the market placed barriers in front of the companies which wanted to carry out air carrier operations.

Every individual air carrier operator started to provide their own services after the bankruptcy of REA in 1975.

- **Overnight Air Express:** Fedex (Federal Express), which has control over more than half of courier network was established in 1974, and started to provide services in 13 fields. In reality, by collecting papers throughout the day and carrying out its operations at night, Fedex set the foundations for the collect and distribute system.

- **Air Cargo:** The first cargo flights took place between New York and Kansas City in 1931 through Transcontinental & Western Air company; unscheduled and only by filling in the space in the aircraft. In 1940, United Airlines provided scheduled air cargo services for the first time. The definition of air cargo authorities having been made by American Civil Aviation Board in 1948, and its inclusion into the official system, and, on top of that, the permission given to three air cargo operators to operate, were important decisions made to develop air cargo transportation.

- **Development of Jumbo Jets:** Wide-body airplanes were being used for passenger flights by Boeing's start of production of B-747 Jumbo jet in 1970 for passenger operations. The first 747 cargo aircraft which had its production completed in November, 1971, was delivered in March, 1972, and started to be used between Frankfurt and New York. B-747, which had the capacity to carry 100 tons at one, was used for the first time in scheduled flights by Sabena World Airways in 1974. Nowadays, the reason why it is still being preferred by carrier operators is because it has a high load capacity.

2.3. International Organisations

2.3.1. ICAO

ICAO, which was founded at Chicago Convention in November, 1944, was founded to create awareness both for military and civil aviation's importance, and, to satisfy the need for international cooperation (Mackenzie, 2010, p. x). ICAO works with 193 member states and industrial groups since May, 2020 is in Quebec (ICAO, 2020).

The assembly constituted by the member states gather once every three years, and every member's vote counts once; decisions are made by a majority of votes (Wensveen, 2007, p. 106). The responsibilities of ICAO are proculaming international aviation standards. ICAO arranges meteorology, aviation charts, telecommunications, air traffic services and noise and emmissions standard and licensing of airmen and aircraft, rules of the air (Cook & Billig, 2017, p. 288). While members are setting standards in their own countries, they arrange according to the rules created by ICAO.

2.3.2. IATA

In 1945, 57 air freight operators came together in Cuba, and established International Air Transport Association (IATA). The duty to set the fares and improve rates was given to IATA through the first mutual agreement signed between the US and UK (IATA, 2005). The members have equal rights to vote and participate in the general assembly meeting held once a year (Wensveen, 2007, p. 107). The most important establishment regulating aviation is IATA. IATA regulates the activities and regulations which are of utmost importance for cargo operations (Sales, 2007, p. 177-178). The quality, pricing and transportation standards of the goods transported

are regulated by this institution and the members are obliged to serve in these standards.

2.3.3 .FIATA

FIATA, which is the biggest non-governmental organization, nowadays, in international logistic transport was established in 1926 in Vienna. FIATA's member states which are distributed in four regions are; Africa/Middle East, America, Asia Pacific and Europe. It represents International Logistic and Freight Shipment Industry at international forums (FIATA, 2019). FIATA represents around 40.000 freight commissioners in 150 countries, and has a non-governmental status (Sarılgan & Yalçınkaya, 2016, p. 15). FIATA is one of the important institutions for air cargo transportation, which is a logistics activity.

2.3.4.TIACA

The International Air Cargo Association (TIACA), aims to develop a modern and united air cargo industry which is effective around the globe, by supporting, informing and connecting with each other every establishment and company that is of any size in air cargo supply chain which it represents. TIACA is a non-profit organisation (TIACA, 2020).

2.3.5.ECAC

It was established in 1955 in order to carry out studies for a safe and effective air system and to provide its continuation in Europe. It currently consists of 44 members (SHGM, 2015, p. 18). ECAC makes regulations covering air transport services carried out in Europe.

2.3.6.WCS

The World Cargo Symposium (WCS) gathers under IATA. It is an important activity, where, by strengthening the cooperation between the organisations, (governments and customs are included) which play a role in cargo logistics, decisions are made that effect the industry (Sales, 2016, p. 178).

2.4. Products Carried Through Air Cargo Transport

Products are separated in two categories which depend on how the products that will be transported through airways are loaded on the airplanes, and, the types of load.

2.4.1. Freights Dependant of Aircraft Loading Types

2.4.1.1. Bulk Cargoes

They are cargoes not placed on igloos, pallets or placed in standard size cargo packages, which, while can be transported on cargo airplanes, can also be transported through the luggage compartment of passenger airplanes (MEGEP, 2011, p. 27). Bulk cargoes can only be entered through the aircraft gate and are accepted by the carrier.

2.4.1.2. ULD Cargoes

They are cargoes placed on igloos, pallets or placed in standard size cargo packages, which are loaded to the aircraft through the use of special systems (conveyers) (MEGEP, 2011, p. 27). In order to facilitate the loading and unloading of the aircraft, the cargoes are put into certain molds and taken to the aircraft.

2.4.2. Cargoes Depending on the Type of Loading

Separated in three main groups.

2.4.2.1. General Cargoes

SHGM (2015) defines general cargo as '*cargoes which do not have incremental and discounted prices applied, and, are not classified as special cargoes*' (SHGM, 2015, p. 25). General cargo does not need to be stored, it should not consist of perishable cargo and dangerous goods.

2.4.2.2. Special Cargoes

Cargoes which require specific handling throughout their transportation and storage, and, have special regulations for acceptance, labelling and loading processes (MEGEP, 2007, p. 3). Special cargoes can be classified as;

- Livestock
- Perishable Foods
- Wet Cargoes
- Heavy Cargoes
- Valuable Cargoes
- Diplomatic Cargoes
- Other Special Cargoes

2.4.2.3. Dangerous Goods

They are cargoes which require services dependent of special regulations; in their transportation and storage carry a risk of causing harm to living beings and the environment, but can be transported within the regulations set in IATA Dangerous

Goods Regulations (DGR) (SHGM, 2015, p. 35). Dangerous goods are taken to the plane after they are subjected to high control standards due to safety risks.

2.5. Air Cargo Carriers

The types of carriers in the air cargo industry are Integrated Carriers, Combination Carriers and Conventional All-cargo carriers (Wensveen, 2007, p. 321).

2.5.1. Integrated Carriers

An individual company carrying out services of taking small parcels from the sender to deliver to the doorstep of the receiver is referred to as an integrated carrier company. The developments of small parcel deliveries in the 1970s, 80s and 90s, led to the improvements in heavy load transportation (O'Connor, 2001, p. 155). Integrated carriers using own aircraft provide sufficient capacity and safety service(Wensveen, 2007, p. 325). Integrated carriers model rests on the main principles of fast and reliable transport, door-to-door transport, guaranteed delivery times and tracking systems (Morrel, 2011, p. 99). We can give DHL, UPS and FedEx as examples of companies that carry out transportation with these features. These companies have a fleet of trucks and courier as well as a scheduled fleet of aircraft.

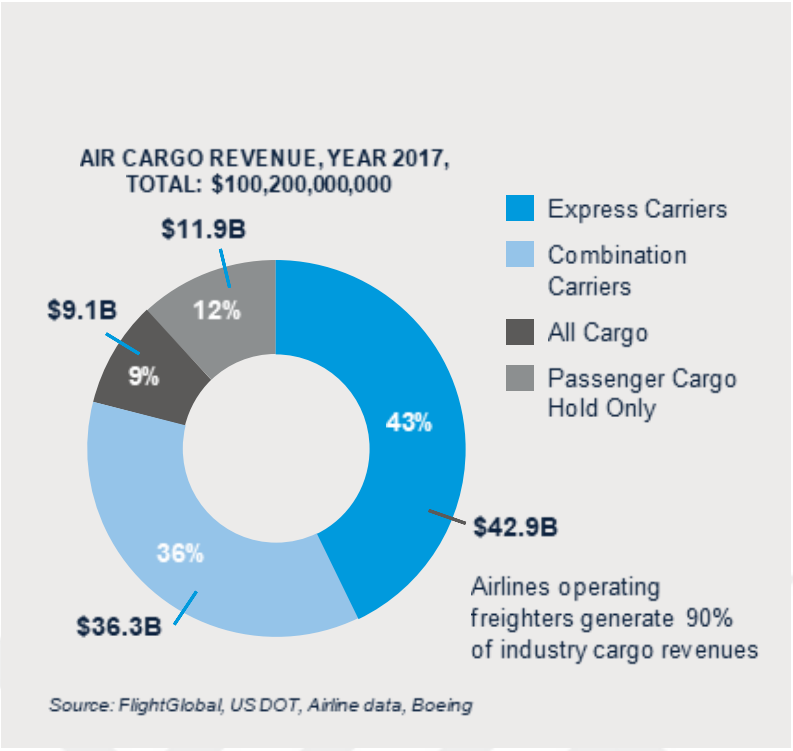
2.5.2. Combination Carriers

Combination carriers carry passengers and cargo Provides point-to-point service for receiving and delivering wire(Wensveen, 2007, p. 325). While an aircraft which does sectional transportation has a set number of seats for the passengers, its body part has appropriately enough space for cargo and passenger luggage. In case of

low passenger count, cargo carried in the section divided by the body provides an extra revenue opportunity (Kasilingam, 1996). While combination carriers differ depending on the airline, the total cargo income in transportation makes up 5 to 10% of the total income (Cook & Billig, 2017, p. 124). When a combined carrier cannot reach enough passengers, it generates an unplanned income by filling its empty capacity with cargo. The place of combined transportation in the cargo industry is too big to underestimate.

2.5.3. All Cargo Airline

Airlines which do not provide passenger services, and, only use cargo airplanes to carry freights are called All Cargo Airlines. One of the first all-cargo service provider airline is Flying Tiger which was bought by Federal Express after the financial crisis it went through (Morrel, 2011, p. 80). Globalization and the increase in international trade have resulted in an increase in the volume of export and import goods carried by aircraft. This volume has increased the need for airline companies providing allcargo service. Cargolux, Evergreen and ULS Airlines are examples of air carriers serving with wide-body cargo aircraft.

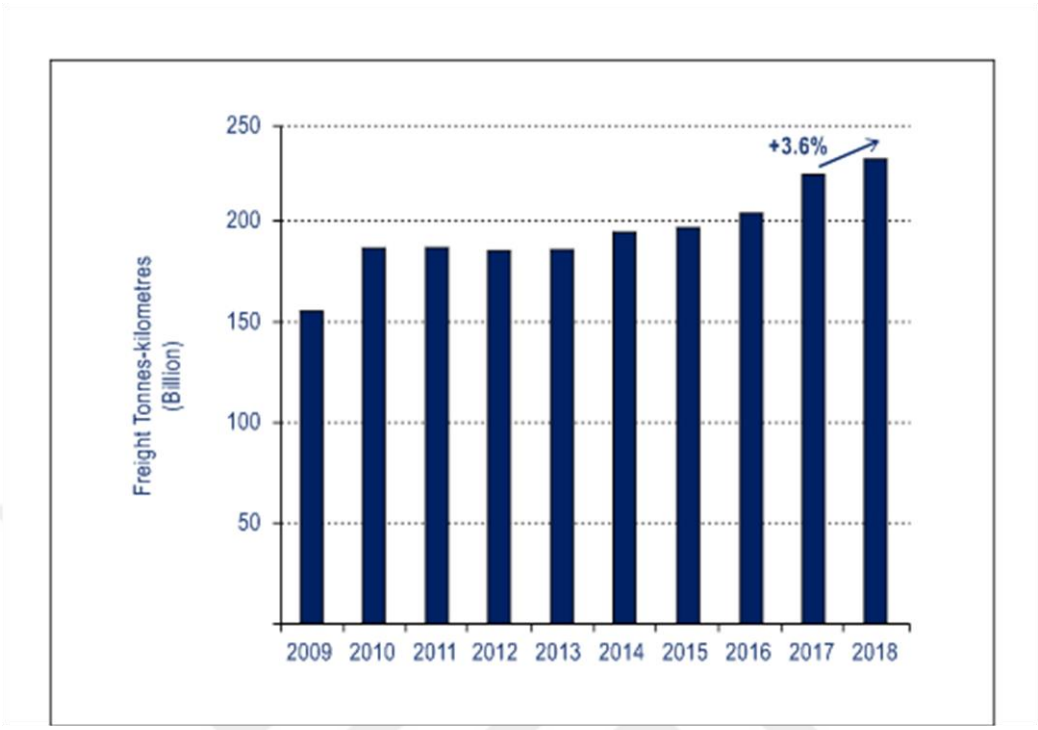


Graph 2.1: Air Cargo Revenue 2017

2.6. The Economic Development of Air Cargo Transport

While the economic goals expected from air cargo transport for years couldn't be met a steady increase in the recent years is observed. Its reflection in the income

percentage in the aviation industry over the years is ever increasing.



Graph 2.2: Scheduled International Freight-Tonnes-Kilometres Capacity (2009-2018)

Source: (ICAO, 2018)

The planned load capacity in 2018 was 363 billion and increased by 3.4 percent compared to the figure in 2017. The scheduled international freight load factor remained at 55 per cent and unchanged.

Air Cargo Carriers-Top 25 (2018)- Scheduled FTK (m)

Top 25 Cargo Carriers 2018 - Scheduled FTK (m)											
Rank	+/-	Airline	2018	Y-o-Y %	2017	Y-o-Y %	2016	Y-o-Y %	2015	Y-o-Y %	2014
1	0	Federal Express	17,499	3.8	16,851	7.2	15,712	-0.6	15,799	-1.4	16,020
2	0	Emirates	12,713	0.0	12,715	3.6	12,270	0.9	12,157	8.2	11,240
3	+1	Qatar Airways	12,695	15.4	10,999	19.3	9,221	20.4	7,660	27.7	5,997
4	-1	United Parcel Service	12,459	4.3	11,940	6.0	11,264	4.2	10,807	-1.2	10,936
5	0	Cathay Pacific Airways	11,284	5.2	10,722	7.8	9,947	0.1	9,935	5.0	9,464
6	0	Korean Air	7,839	-2.2	8,015	4.5	7,666	-1.2	7,761	-3.9	8,079
7	+1	Lufthansa (1)	7,394	1.0	7,322	6.4	6,878	9.0	6,309	9.7	5,753
8	-1	Cargolux	7,322	0.1	7,317	-0.9	7,384	7.2	6,888	-2.4	7,054
9	0	Air China	7,051	5.2	6,701	10.0	6,089	6.5	5,718	16.5	4,910
10	+1	China Southern Airlines (1)	6,597	6.9	6,174	4.0	5,939	10.9	5,355	13.1	4,736
11	-1	Singapore Airlines	6,491	-1.5	6,592	3.9	6,345	4.3	6,083	1.1	6,019
12	+3	Turkish Airlines (1)	5,890	24.6	4,728	29.9	3,640	n/a	n/a	n/a	2,580
13	-1	China Airlines	5,804	1.1	5,741	8.9	5,273	-1.3	5,343	1.5	5,266
14	-1	AirBridgeCargo Airlines	5,511	-0.6	5,543	12.8	4,914	20.8	4,069	25.3	3,248
15	-1	All Nippon Airways (1)	4,587	-4.6	4,810	11.5	4,315	12.4	3,840	-0.2	3,847
16	0	Atlas Air	4,553	0.8	4,515	n/a	n/a	n/a	n/a	n/a	n/a
17	+3	United Airlines	4,455	4.8	4,249	20.2	3,534	10.2	3,206	4.3	3,073
18	0	British Airways (1)	4,276	-2.0	4,364	6.0	4,117	1.5	4,055	-6.3	4,329
19	+2	Asiana Airlines	4,067	1.5	4,008	5.1	3,813	6.1	3,595	-2.7	3,693
20	-3	Polar Air Cargo	4,038	-7.8	4,378	4.0	4,211	0.6	4,186	32.8	3,153
21	+1	American Airlines	3,817	4.6	3,648	n/a	n/a	n/a	3,045	15.0	2,647
22	+1	Air France (1)	3,673	1.7	3,612	5.6	3,419	0.1	3,416	-10.7	3,826
23	+2	KLM (1)	3,604	0.0	3,603	1.1	3,564	-0.1	3,567	-0.7	3,592
24	0	EVA Air	3,580	-0.8	3,609	3.7	3,480	-7.4	3,757	-6.2	4,007
25	-6	Etihad Airways	3,471	-19.3	4,303	4.0	4,481	1.8	4,400	5.8	4,159
		Annual Top 25 total	170,670	2.5	166,459	7.2	155,315	4.1	149,146	4.8	142,279
Source: IATA 2019 World Air Transport Statistics											
Notes: (1) Includes figures from certain partner airlines											

Table 2.1: Air Cargo Carriers-Top 25 (2018)- Scheduled FTK (m)

Source: (Air Cargo News, 2019)

The air cargo companies reflected on the above table are organised considering data from 2018. The data of 5,997 FTK (m) in 2014 which got over 100% of an increase for Qatar Airways and resulted in 12,965 FTK (m), and, the data of 2,580 FTK (m) in 2014 which got to 5,890 in 2018 for Turkish Airlines are remarkable.

Top 25 Air Cargo Carriers 2018 – Scheduled Tonnes

Top 25 Cargo Carriers 2018 - Scheduled tonnes (000)											
Rank	+/-	Airline	2018	Y-o-Y %	2017	Y-o-Y %	2016	Y-o-Y %	2015	Y-o-Y %	2014
1		FedEx	7,565	2.9	7,355	2.9	7,145	0.8	7,087	-0.6	7,127
2		United Parcel Service	4,755	-3.2	4,912	4.9	4,681	4.4	4,482	5.7	4,240
3		Emirates	2,609	-1.4	2,646	4.2	2,538	3.4	2,454	7.3	2,288
4		Qatar Airways	2,262	11.0	2,038	15.5	1,764	20.3	1,466	26.6	1,158
5		Cathay Pacific Airways	1,828	4.8	1,744	9.2	1,597	0.6	1,588	4.0	1,498
6		Korean Air	1,574	-3.1	1,624	7.3	1,514	-1.2	1,533	0.9	1,519
7		China Airlines	1,512	3.4	1,462	10.3	1,326	1.5	1,306	0.8	1,296
8		Air China	1,448	1.3	1,430	7.4	1,331	6.0	1,256	7.3	1,171
9		China Southern Airlines (1)	1,383	3.7	1,334	-12.2	1,519	9.4	1,389	4.2	1,333
10		Turkish Airlines (1)	1,369	26.2	1,085	24	875	38.0	634	0.6	630
11		All Nippon Airways (1)	1,258	-7.7	1,363	7.9	1,263	8.4	1,165	-3.4	1,206
12		Singapore Airlines	1,167	-0.2	1,169	2.6	1,139	5.1	1,084	0.6	1,078
13		Atlas Air	1,115	-5.4	1,179	n/a	n/a	n/a	n/a	n/a	n/a
14		Lufhtansa (1)	977	-1.9	996	4	958	0.8	950	-2.5	974
15		Asiana Airlines	969	0.8	961	4.2	922	7.7	856	-1.4	868
16		Cargolux	850	-1.6	864	6.8	809	6.9	757	4.0	728
17		LATAM group (1)	831	6.5	780	-2.4	799	20.3	664	-13.8	770
18		Kalitta Air (1) (3)	828	10.8	747	n/a	n/a	n/a	n/a	n/a	n/a
19		Polar Air Cargo	826	-14.2	963	3.7	703	2.6	685	33.5	513
20		Japan Airlines	754	3.3	730	10.6	660	0.2	659	5.4	625
21		China Eastern Airlines	730	3.7	704	-41.2	1,197	-4.6	1,255	8.5	1,157
22		AirBridgeCargo Airlines	724	3.3	701	12.9	621	1.0	615	19.0	517
23		Etihad Airways	719	-19.3	891	4.1	929	2.8	904	5.9	854
24		Thai Airways International	669	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
25		EVA Air	648	0.9	642	5.2	610	-2.2	624	-8.8	684
		Annual top 25 total	39,370	1.1	38,946	5.5	36,941	5.4	35,059	3.0	34,019
Source: IATA 2019 World Air Transport Statistics											
Notes: (1) Includes figures from certain partner airlines (2) IATA estimate (3) US DOT Figures											

Table 2.2: Top 25 Air Cargo Carriers 2018 – Scheduled Tonnes

Source: (Air Cargo News, 2019)

When the scheduled tonnes data from 2014 and 2018 are compared Turkish Airlines' growth by a serious rate of over 100% can be seen. Turkish Airlines is followed by Qatar Airways by nearly 100% growth rate. The air cargo market fully recovered in 2017, growing by 10.1 percent. We can attribute this recovery to global economic growth and the increase in world trade volume.

Boeing; *By an increase of an average 4.2% global air cargo traffic in the next 20 years; until the year 2037 Boeing is expected to grow by an average of 2%. With this increase, the number of airplanes within the cargo fleet of the entire world is*

forecast to increase over 70% and reach to around 3.260 aircraft capacity (Boeing, 2018).

REGION	HISTORY 2007–2017 by percentage	FORECAST 2018–2037 by percentage
World	2.6	4.2
East Asia–North America	1.2	4.7
Europe–East Asia	4.2	4.7
Intra–East Asia	3.8	5.8
Europe–North America	0.0	2.5
Intra–North America	2.3	2.3
Domestic China	5.0	6.3
Latin America–Europe	3.0	4.0
Latin America–North America	-0.3	4.1
Africa–Europe	-1.0	3.7
South Asia–Europe	2.4	4.2
Middle East–Europe	3.3	3.2
Intra-Europe	3.1	2.3

Source: IATA, ICAO, ACI, AAPA, US DOT, US Trade, US DOC, TRADE, Eurostat, IHS Markit, CAAC, AAI, India DGCA, FAVT, Airline data, Airport data, Boeing

Figure 2.1: Boeing Forecast

Source: (Boeing, 2018)

3. UNMANNED AERIAL VEHICLES

All vehicles that fly unmanned are commonly referred to as drones. It is seen that they are called drones although they have different features for both UAV, RPAS and UAS. (European Parliament , 2019). Unmanned aerial vehicle systems, which are called drones in common language, are described one by one below.

3.1. Historical Perspective

The idea of a first flying machine takes its roots from a mechanical bird which flew 200 metres in 425 BC. The biggest step in the modern era is an unmanned helicopter prototyped in 1909 which could not be flown due to problems of vibration and insufficient engine power (Valanis & Kontitsis, 2007, p. 15-20). The first usage of UAVs on an air offensive is known to be when Austria sent 200 unmanned airships which had timed fuses implemented in them in 1849. Also, airships were used in 1793 for reconnaissance during the civil war in the USA (Monash University, 2003). When the Wright Brothers were assigned to develop an aircraft in the early 1900s, they conducted their tests without using people. Efforts to improve drone technologies during World War I and II were carried out by military theoreticians. Nikola Tesla's invention of a wireless controlled airship became the source of inspiration for drone development. For this reason, He is accepted as one of the fathers of unmanned aircraft technologies (European Parliament, 2019). In fact, it is seen that developments in unmanned systems coincide with the introduction of aircraft into our lives. Unmanned aerial systems, such as manned aircraft, have primarily been examined in military fields.

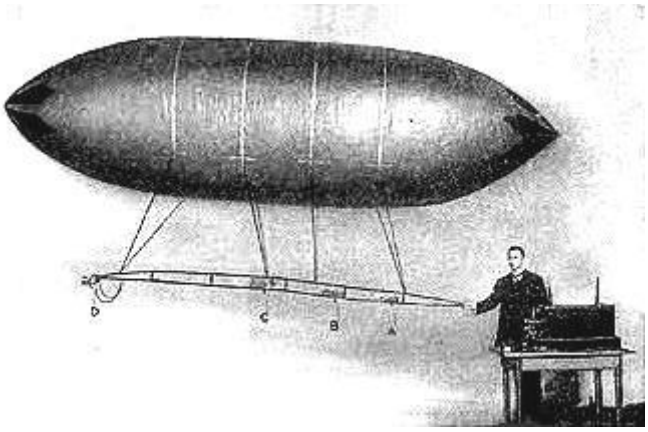


Figure 3. 1: Nikola Tesla with his wireless controlled airship c.1900

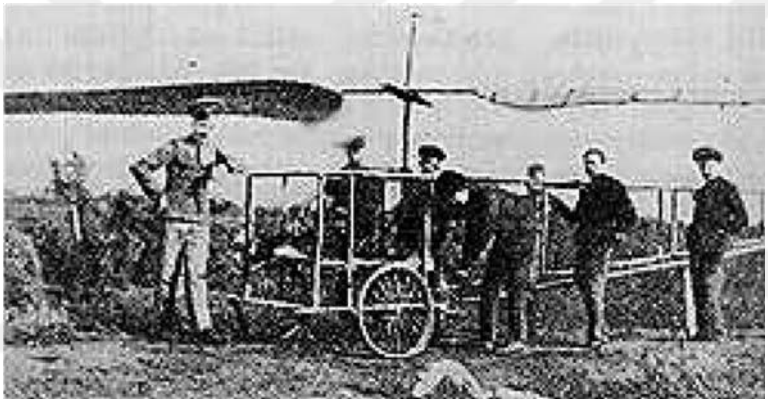


Figure 3. 2: Boris Yur'ev's aircraft Source: (Valavanis & Kontitsis, 2007)

UAVs with over 16-billion-dollar market share were first introduced in the First World War but as they couldn't be seen as reliable vehicles, they were heavily criticised. While the UAVs manufactured with that of the conditions of the era, they were produced in look a lot more different, the airships used in 1917 and 1918 provided a huge advantage on wildfires, intelligence about the enemies, battle damage evaluation and aim gains.

From the early 1920s the strategic usage of aerial power was adopted and reconnaissance airplanes were designed based on this. The basic concepts of UAVs

used in the 2000s came out in the 50s and 60s. The potential the UAVs would create in the future was foreseen by only a few people in that time period. The rapid interest for UAVs started with the usage of UAVs during the Vietnam War, Desert Storm Operation (1991) and the conflicts in the Balkan Peninsula (1990). UAVs were used by the United States in the Vietnam War to obtain signal data and to explore by taking photo and video recordings (Blom, 2010, s. 1-2). It has been observed that technologies related to air systems are primarily used in military fields. This leads us to get the idea that air systems are subject to the process of passing the approval of public authorities before the civil authorities due to the risk and security reasons created by them.

Figure 3. 3: Ryan Firebees Drone used in Vietnam War

Three different technological developments; dramatic improvements in the efficiencies of drone power plants, advancement and availibility of Global Positioning System (GPS) and the remarkable improve ments in lightweight cameras resulted in the development and an increase in the production of drones (Bartsc, Coyne, & Gray, 2017). Tasks carried out through traditional methods being expensive and risky, as well as some tasks requiring repetition, resulted in handing over the task to the UAVs brought by the technology (Chalupníčková, Bahenský, Sýkora, & Heralová, 2014).

The earliest advancements in the history of drones took place in the field of military. Many scientist agree on UAVs, which put together old destructive technological systems such as satellite navigation or autopilot and create new market opportunities, being an innovative aerial technology. China, USA and Israel are leading the drone industry globally (European Parliament , 2019). The success it brought in the military field, the facilities it brought in many areas such as logistics, reconnaissance and similar, resulted in investments and incentives related to unmanned aerial vehicle systems.

However much developments in UAVs don't have a long standing background, the advancements made since 2012 reflect how fast the interest for UAVs has increased.

Table 3.1: Countries that have developed and used civil UAVs (as of January 2019)

Algeria	Croatia	Jordan	Russia	United Kingdom
Argentina	Czech Republic	Latvia	Saudi Arabia	United States
Armenia	Estonia	Malaysia	Serbia	Vietnam
Australia	Finland	Mexico	Singapore	
Austria	France	Netherlands	Slovenia	
Azerbaijan	Georgia	New Zealand	South Africa	
Belarus	Germany	Nigeria	South Korea	
Belgium	Greece	Norway	Spain	
Brazil	Hungary	North Korea	Switzerland	
Bulgaria	India	Pakistan	Sweden	
Canada	Indonesia	Peru	Taiwan	
Chile	Iran	Philippines	Thailand	
China	Israel	Poland	Tunisia	
Colombia	Italy	Portugal	Turkey	
Costa Rica	Japan	Romania	United Arab Emirates	

Countries that have developed and used civil UAVs (as of January 2019):

Source: Sadraey (2020)

While unmanned aerial vehicles were once used only for reconnaissance purposes, today they provide convenience in many different areas. (Sadraey, 2020, s. 5). These examples and their areas of use will be specified in the following sections.

Countries that have developed and used military UAVs (as of January 2018);

Table 3.2: Countries that have developed and used military UAVs (as of January 2018)Source: Sadrey (2020)

Argentina	Germany	Nigeria	Turkey
Australia	Israel	Pakistan	United Kingdom
Brazil	Iran	Russia	the USA
Canada	Iraq	Somalia	
China	India	Spain	
France	Italy	South Africa	

3.2. Remotely-Piloted Aircraft System (RPAS)

RPAS is a system in which command and control connection can be made under the direction of a pilot from any remote controlled aircraft or a remote pilot station while the flight operation is being carried out. (ICAO, 2011, p. 8). RPAS requires a control mechanism and is remotely controlled.

3.3. Unmanned Aerial Systems (UAS)

UAS are all components that enable unmanned aerial vehicles to operate safely in the national airspace. These components are *the ground control system, the datalink, multiple unmanned aerial vehicles, and the terminal that receives data from the vehicle* (Blom, 2010). UAS have 5 main technical elements that air vehicle, payload, control station, maintenance and support system, and launch and recovery system (Sadraey, 2020). Airports will be the easiest choice for the terminal to be used to control the unmanned aerial vehicle in the UAS system. However, unmanned flights cannot be carried out for security reasons yet.

Despite the actions of illegal drone operators, airports see UAS more of an opportunity instead of a threat. Airports should play a role in the development of integration of UAV operations by adopting the UTM system. It should, to reflect a high degree of reliability just like the operations performed by airplanes controlled by people, have an aircraft equipped down to a tee, consist of a qualified team and have an aircraft which is controlled closely. An effective and safe UTM should have the capability of drone detection. Aircraft operators leading the industry of spare part supplies sending a piece directly to AOG via a UA can only be made possible with a unified UTM system (International Airport Review, 2020). The fact that urgently needed equipment can be accessed faster at airports where UAS use is permitted will provide added value and effective use of the time factor.

3.3.1 Ongoing Projects related to UAS

New projects are continuing to be developed every day in order to take advantage of and improve the UAS technology. In this sense, among the below listed

agenda projects, information on National Experimental Test Centre and LAANC is given.

3.3.1.1 National Experimental Test Centre for Unmanned Aircraft Systems

The need for research and tests has increased with the technological developments, legal legislations and regulations related to UAS in order to stop the confusion created. The Systems, which will be established, will be an important step to improve the UAS technology further and, therefore, to contribute in its scientific and economic improvements. DLR, through the national test center aims to realize that;

- Supporting research for unmanned aerial systems,
- Coordinating national and international testing areas,
- Develop new concepts,
- Supporting scientific communities,
- Support processes in technological fields,
- Supporting authorities for legal regulations (DLR, 2020).

It has established this test center to support the steps to be taken towards the development of unmanned air systems. Unmanned aircraft and unmanned systems developed in these centers can be tested by individuals and institutions.

3.3.1.2. LAANC

FAA is working on a system (LAANC (Low Altitude Authorization Notification Capability)) which will integrate UAS into manned air traffic. is called LAANC (Low Altitude Authorization Notification Capability). The authorization processes of UAS which will increase the economic potential of the commercial UAS

operators is aimed to be sped up with LAANC. However much it is a system for UAS it will be an important step on the integration of LUCA (Low Altitude Authorization Notification Capability) to the system. With the use of SWIM and NextGen in the future, the opportunity to send verbal texts electronically will be made possible. A constructed Drone port and the UAS test centres of FAA will be an important step to both allow investors to test UAVs and to integrate these airplanes to NAS (Collins, 2017, p. 17-21). In the USA, authorization requests can be made through LAANC in order to fly unmanned aerial vehicles in controlled airspace. LAANC has authorization capacity, which includes 726 airports and 537 facilities. The drone pilot can fly in controlled airspace by obtaining the LAANC authorization.

3.3.1.3. AACUS

The goal of the AACUS (Autonomous Aerial Cargo Utility System) program, which has the primary functions; The AACUS program aims to develop autonomous capabilities in order to find and land an unprepared landing site without the need for a ground controller at any time of the day in order to make cargo deliveries faster with manned or unmanned aircraft. (van de Ven, NLD AF, & JAPCC, 2014). A 13.5-billion-dollar contract with Lockhees Martin for the AACUS program was made in 2012. On top of the ability to control the prototype with tablets or mobile devices, it can independently determine the landing zones. Experts believe a consciousness for the need of a system like this was the result of the existing risks which were caused by the need for tools for the front-line operations of marine troops in Afghanistan and Iraq. AACUS is designed for basic usage and can be affixed to K-Maxes and unmanned helicopters (NavalDrones, 2020). Developed by Aurora Flight Sciences, AACUS is an easy-to-carry system that includes a software package and

sensor. Compatible with many rotary wing vehicles. It was developed with the motivation to meet military needs and the first test flight took place in a military environment. It can fly in the most difficult landing and take-off conditions.

3.3.1.4 ALAADy

ALAADy (Automated Low Altitude Air Delivery) is a new approach which covers the transportation of goods using only low risk areas (deserted islands, water bodies) with an automatic freight aircraft. This research project is carried out by DLR (DLR, 2019). ALAADy is a civil automatic cargo delivery project that can carry cargo with a capacity of 1 ton under heavy air traffic. Possible scenarios for UCAs are designed by trying to prevent the security risk with flights operated at low altitudes. With these studies, economic and reliability evaluations are made (Dauer, Lorenz, & Dittrich, 2016). This project aims to accelerate the integration of unmanned cargo aircraft into air transport by performing risk and safety tests at low altitudes in unmanned cargo flights. It actually serves as a feasibility study for UCAs, which are intended to be one of the future transportation methods.

3.4.Unmanned Aerial Vehicles (UAV)

It is an aircraft that can carry payloads, can be remotely controlled or fly autonomously, in which the pilot is not physically involved during flight.

UAVs have to meet critical requirements as they fly like aeroplanes and are designed as airplanes. While UAVs are designed their intended use is considered. When designs are made regarding the results of generally made experiments and

research, the main limitation is keeping the production costs low (Sadraey, 2020, p. 3). UAVs', used in 62 countries until January, 2019, load types, carriage capacities, housing places and assignment profiles vary. Therefore, related to this variety, their control and data gathering features also vary greatly. When UAVs are used for military purposes, as they carry the same functionality as manned airplanes, they will create an advantage of lower risk and costs (Sadraey, 2020, p. 4-5). UAVs are different from RPAS. While RPAS are remotely controlled, UAVs can automatically take off and fly with autonomous software.

ICAO (2020) mentions two types of UA procedures;

1. Visual Line of Sight (VLOS): a process where a remote pilot or UA observant maintains a direct, unaided contact with UA.
2. Beyond Visual Line of Sight (BVLOS): operations where a remote pilot or UA observant doesn't use a visual reference to UA during a flight.

3.3.2 The Distinction Between UAV and Model Aircraft

Unmanned airplanes and model airplanes are different than each other. A wirelessly controlled aircraft which is in the visual sight of an operator has zero intelligence, and, is used to carry out basic instructions such as ascending, descending, turning left and right. However, UAVs have an automatic intelligence which can communicate with a control unit; transmit data such as position, speed, direction and altitude to a control unit (Austin, 2010, p. 3). For UAs and many big RPAs the term 'drone' is used widely (Hodgkinson & Johnston, 2018). Although drone is used as a common term, they contain differences in flights according to their automatic flight capability and visual line of sight. These differences can also limit

and expand their usage areas. Since a model aircraft does not have long-range flights or automatic landing and take-off capabilities performed by UAVs, its usage areas are more limited.

3.3.3. UAV Classification

When UAVs are designed, they are categorized using the below technical data.

Table 3.3: UAV Classifications Source: Sadraey (2020)

No	UAV Class	Weight (lb)	Size	Normal Operating Altitude	Range (km)	Endurance
1	Micro	< 0.55	≤ 10 cm	< 100 ft	0.1–0.5	≤ 1 hr
2	Mini	0.55–2	10–30 cm	< 500 ft	0.5–1	≤ 1 hr
3	Very Small	2–5	30–50 cm	< 1000 ft	1–5	1–3 hr
4	Small	5–55	0.5–2 m	1000–5000 ft	10–100	0.5–2 hr
5	Medium	55–1000	5–10 m	10 000–15 000 ft	500–2000	3–10 hr
6	Large	10 000–30 000	20–50 m	20 000–40 000 ft	1000–5000	10–20 hr
7	Tactical/ combat	1000–20 000	10–30 m	10 000–30 000 ft	500–2000	5–12 hr
8	MALE	1000–10 000	1000–20 000	15 000–30 000 ft	20 000–40 000	20–40 hr
9	HALE	> 5000	20–50 m	50 000–70 000 ft	20 000–40 000	30–50 hr
10	Quadcopter	0.5–100	0.1–1 m	< 500 ft	0.1–2	20 min–1 hr
11	Helicopter	0.001–200	13 mm–2 m	< 500 ft	0.2–5	10 min–2 hr

Features that set military and civil UAVs apart

The features setting military and civil drones apart are defined at a Briefing prepared by the European Parliament in 2019 was defined. Civilian and military drones differ from each other in their take-off weight, altitude sea level, endurance, operating range, command control and capacity physical properties (European Parliament, 2019). Sadraey created this technical classification in his textbook for aircraft design. With the research and development studies carried out by the public and civil authorities, these technical features may be developed and the limits of the

restrictions may be changed. The unmanned aerial vehicles sector has a dynamic structure. This feature means that the reader may need to re-search for current values of the data.

3.3.4 UAV Categories

The categories of UAV according to their usage are given below:

- Used for logistical purposes in order to send cargo. Deliveries of small packages such as medicine or envelopes and deliveries of small packages purchased by e-commerce are increasingly common. Project studies are continuing for higher capacity transportation. Project examples are given on the following pages.
- Photo video recordings with UAVs are widely used both for intelligence purposes in military fields and for civilian purposes such as hobby, commercial or advertising shooting.
- UAVs can be used for military and risky missions for attack purposes.
- UAVs can be used to shoot targets designated for military purposes from land and air.
- UAVs can be used in research and development studies.
- UAVs can be used for civilian purposes in hobby, competition, agriculture, tourism, etc.

3.3.5 Applications for UAVs

Unmanned aerial vehicles are used in different application areas today. These application areas differ from each other for civil, commercial and military purposes. These include:

- Civil Applications;
    - Recreation,
    - Archeology,
    - Law enforcement,
    - Conservation of biodiversity and habitat,
    - Disaster relief,
    - Crime,
    - Terrorism
- Commercial Applications;
    - Transmission and distribution,
    - Filmmaking,
    - Scientific research,
    - Journalism,
    - Aerial surveillance,
    - Surveying,
    - Cargo transport,
    - Mining,
    - Forestry,
    - Agriculture
- Military Applications;
    - Demining,

- Attack,
- Reconnaissance,
- Target practice.

3.5. Unmanned Cargo Aircraft (UCA)

Unmanned air cargo vehicles are unmanned aerial vehicles designed for commercial or military purposes only for cargo deliveries, that can be remotely controlled or can perform autonomous flights.

Aircraft can fly in unmanned areas and below a certain altitude. This is because flying involves a risk (Hasan, Sachs, & Dauer, 2018). The use of UAVs in the air cargo industry will be an important step to take the UAV technology one step further over the next ten years (JORDAN, 2020). Unmanned cargo aircraft will serve as a test bed to realize this application. Successful flights with UCAs can be considered as a preliminary task for passenger transportation.

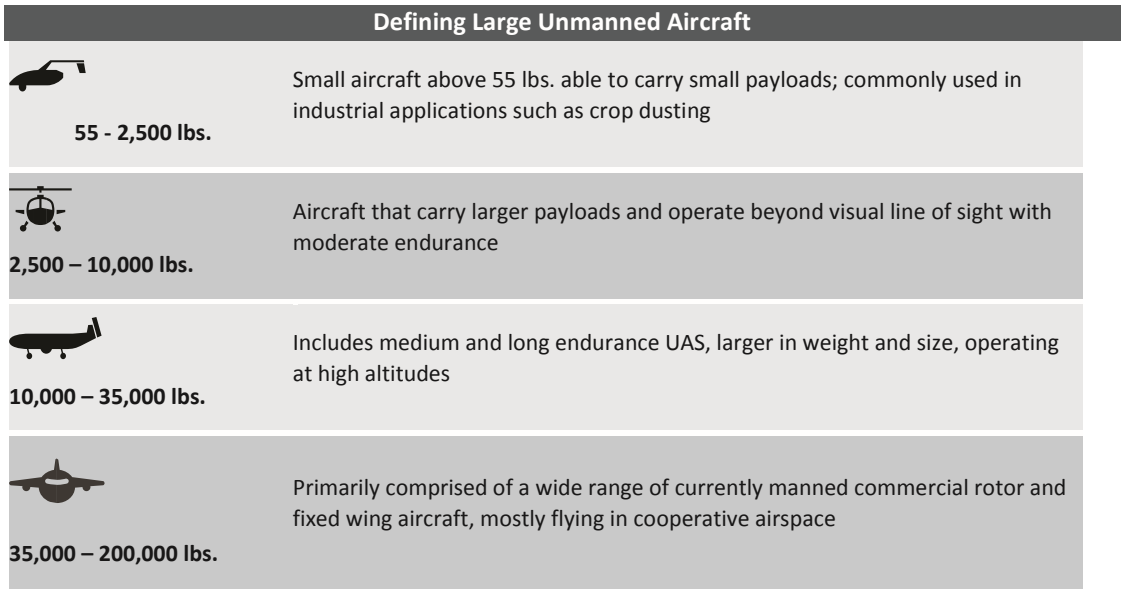


Figure 3. 4: Defining Large Unmanned Aircraft

Source: AIA-Avascent (2018)

Avascent and AIA predicts that R&D efforts for large drones will increase and by 2036 the expenditure for these efforts will reach $ 150 billion (AIA-Avascent, 2018). LAANC, DAIDALUS, SWIM and Nextgen&ADS-B 5 technologies will help the integration of LUCAs to NAS and operate safely. The integration of LUCAs into the national air system is a step to be taken in order to be included in the international air system. International flights can only take place if the security concerns of nations are resolved and the relevant laws are regulated.

3.5.1. Ongoing Projects Related to UCA

Advantages taken from the use of UAVs in the micro level transportation sector has set the ground for motivation to carry out air cargo with higher volume and longer distance capability airplanes and develop LUCA projects. In many countries, projects related to big unmanned cargo vehicles, which are to be used in commercial and military operations, are carried out. As such, examples related to some of these projects are given below.

3.5.1.1. Natilus

Natilus, centred in California, by targeting the transpacific air cargo market, set off with the aim of producing unmanned aerial cargo vehicles, which would cost one tenth of a manned aircraft, and, have half the production cost of traditional air cargoes, and, would be able to fly intercontinentally. They also aim to transport goods which aren’t worthy to be transported through air cargo by savings incurring from production (Wikipedia, 2020).

Natilus is a large scale aircraft drone with a wing-span of 140 ft and a Cargo capacity of 100 tons which flies slower than a traditional freighter aircraft, reducing fuel born by 50% andeliminating the 15% cost of crew. The drone creates a middle solution in the 10x cost gap and 28x time difference between sea and air freight (Angel, 2020). Natilus shared the following example comparing the cost of shipping 200,000lbs of freight from Los Angeles to Shanghai with different cargo types and the cost of NATILUS to show the cost advantage it will realize.

Example;

LA to Shangai with 200.000lbs Cargo

Cargo ship: 204 hours-61.000$

B747 : 11 hours – 260.000$

Natilus: 30 hours – 130.000$

As seen in the example, compared to a Boeing aircraft, the cost is reduced by almost half. But the delivery time is more. Although the cost is high compared to ship transportation, it is seen that the time savings create almost 7 times the advantage.

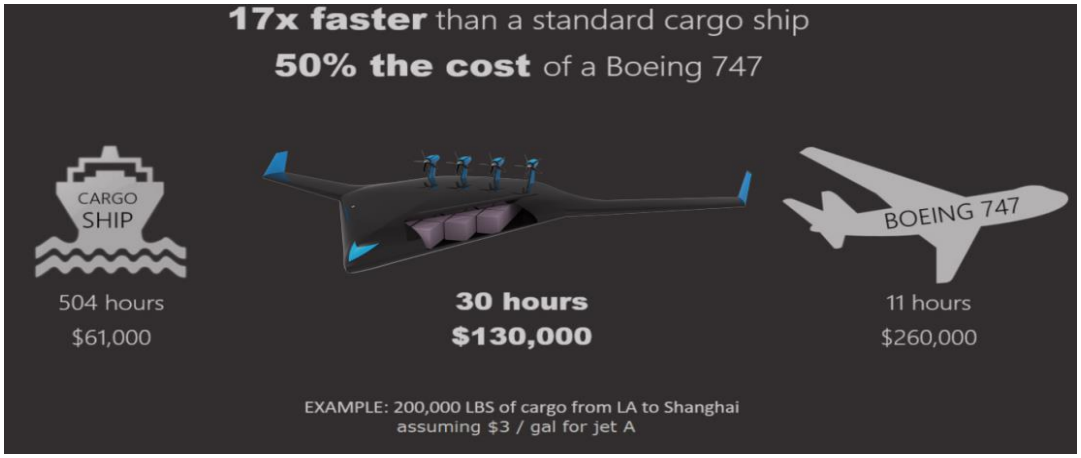


Figure 3. 5: Natilus

Figure 3. 6: Natilus

In 2018, with the 30 feet long prototype developed for a large-scale unmanned cargo aerial vehicle, it successfully completed its test flight over the water (WOODS, 2020). With successful test flights, Natilus is still in the project phase.

Natilus' project developed to construct a 130 tonnes bigger cargo carrier is seen in the image below.

Figure 3. 7: Natilus

3.5.1.2. The Capparal

Initially entering the air taxi market to transport passengers with Vtol electric aircraft, Elroy Air, founded in 2016 in San Fransisco, turned to the autonomous cargo aircraft market to avoid market challenges (Wikipedia, 2020).

Specifications;

- Payload; 250-500lbs (100-225kg)
- Range; 300mi (500km)
- can load and unload cargo autonomously
- Can fly autonomously
- Fuel; electric
- No charging station and airport needed (Elroyair, 2020).

Figure 3. 8: The Chapparal

The platform doesn't require an airport or a specialist electric charging station. The flight, which will take place autonomously, will allow faster loading and unloading, deployment and delivery (MURISON, 2019). The Chapparal, a fuel-type electricity, could be a candidate to become part of the green logistics system. The fact that it can fly autonomously does not require any station or airport, will enable last mile deliveries and delivery to rural areas.

Chapparal, successfully completing its first test flight in 2019, is wished to be used for the transportation of medical equipment, disaster area response and far military assignments. Besides, since it has the potential to satisfy the needs of companies such as FedEx, DHL or Ups, Elroy Air foresees partnership with these companies (HAWKINS, 2019). The Chapparal can be used in emergency missions such as material supply in military operations, medical drug delivery to hard-to-reach areas, and assistance in case of difficulty in reaching areas damaged by the earthquake. Its use in these situations will create a time saving advantage.

Elroy Air signed a partnership agreement, in 2020, with the aircraft manufacturer EmbraerX which is an innovation centred sub-brand of Embraer centred in Brazil.

Figure 3. 9: The Chapparal

3.5.1.3. Boeing CAV

Boeing NeXt started its work with the aim of realizing an ecosystem that will enable it to perform operations in regional and global markets, and Boeing CAV,--developed by Boeing, completed full product test, design, production and flight tests in as short as 3 months of a time period. Performing flight controlled by remote control when it was first designed, CAV later switched to autonomous flight (Boeing, 2019). Boeing has a large share of the global aircraft market. The CAV project is one of the indicators of the importance it has gained in unmanned air cargo transportation. The project was managed by a dedicated team formed in Boeing's research and development unit.

Figure 3. 10: Boeing CAV

Specifications;

- Capacity: 227 kg payload
- Length: 5.33 m
- Wingspan: 26.1 m
- Height: 1.52 m
- Empty weight: 272 kg
- Max takeoff weight: 499 kg
- Powerplant: 6 × Vertical Electric dual propeller
- Maximum speed: 37 km/h

Boeing researchers think CAV prototype to be used as a testbed for autonomous technologies in future applications. The vehicle which began to be tested outdoors in 2019; during a test flight for the CAV prototype an accident happened at Chase Industrial Airport (Texas), on the 21st of June 2019, and the prototype was

damaged (Evtol, 2020). Boeing, which is the developer of CAV, announced that a decision to stop the activities as of September, 2020, was made as a result of heavy financial losses caused by Covid-19 pandemic and Boeing 737 Max airplane crushes (Alcock, 2020). Although the execution of the project has been stopped, we can say that the work done will be the source for future studies.

3.5.1.4. Rhaegal

Sabrewing Aircraft Company, a manufacturer of heavy-duty commercial air cargo aircraft, is the creator of the next generation of unmanned cargo aircraft. It designs UCAs that can fly up to 1500 nautical miles and in harsh weather conditions. Dragonworks lab is located in Slikon valley.

Specifications;

- Speed : 370 km/hr
- Remotely piloted and fully autonomous
- Payload : 2450 kg
- Altitudes : 22,000 feet
- The wings fold on the ground for easy ground handling and in the air during hover for landing in tight spaces,
- The Rhaegal has fold-up” nose
- full pallet-sized cargo access

- Detect and Avoid (D&A) system

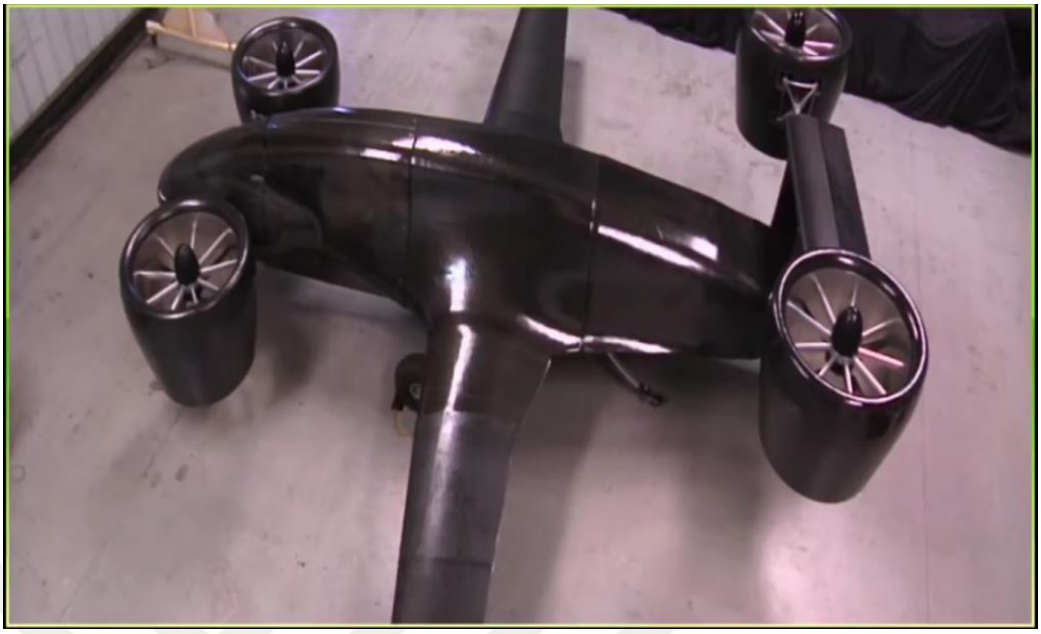


Figure 3. 11: Rhaegal

Sabrewing signed an agreement with Arabian Development and Marketing in 2020. The five-year renewable agreement includes exclusivity for Saudi Arabia, the GCC and the Pan-African region. The deal includes an order for 102 Sabrewing "Rhaegal-B" unmanned, heavy-lift, Vertical Take Off Landing (VTOL), cargo aircraft. ADMC will soon begin taking additional aircraft orders throughout the GCC and Africa. The aircraft was recently unveiled to the public during an US Air Force Agility Prime event. The deal between ADMC and Sabrewing also includes establishing aircraft assembly, maintenance, repair, and overhaul facilities throughout the Kingdom of Saudi Arabia and Africa to service the Rhaegal-B fleet and will provide technology jobs to the region (GlobeNewswire, 2020). Sabrewing, which started to take orders during the project phase, has started to take its place in the Asian and African market. With the facilities to be established and the necessary

maintenance and repairs of a Rheagal fleet in the region where they are located, the user companies will provide time and cost advantage.

Figure 3. 12: Rhaegal

The Rhaegal-B is about twice the size of the -A model. Already in the works is a larger Wyvern model, which will be almost twice the size of the -B. Sabrewing's aircraft promise significantly greater payload and range than other eVTOL designs aimed at the air cargo sector. The Rhaegal-B is designated as the program's production aircraft, and it can carry standard industry Unit Load Devices (ULD) used by existing air freight carriers. It can carry two LD-1 containers or four smaller LD-2 containers or two LD-3 containers (Alcock, 2020). In Sabrewing's projects, it is observed that the load capacity is tried to be kept as high as possible. In case of realization of these projects, overseas cargo transportation will be possible with LUCAs. It will be an exciting development that international transport can be carried out by drones.

3.5.1.5. The Feihong-98

Founded in 1993, SF Express started its unmanned aerial vehicle operations in 2015. The test flight of UCA, which has a carrying capacity of 750 kg, was successful. Test flights of the 1.5 ton capacity vehicle started in 2017. (SF UAS, 2020).

Figure 3. 13: The Feihong-98

The Feihong-98 is converted from a Y-5B, China's first home grown transport aircraft that itself is based on the Russian AN-2.

Specifications;

- Takeoff : 5250 kg,
- Capacity : 1500 kg,
- Speed : 180 km/hr,
- Range : 1,200 km,
- Needs a simple runway to complete takeoffs and landings (KATOCH, 2020).

The Feihong-98 differs from other projects in that the existing Antonov plane has been transformed into a unmanned cargo plane. It is not an unmanned cargo plane design as seen in the picture. The Foeing-98 has little chance of competing with other projects, as not adding human requirements to the design while designing an unmanned cargo plane will create both cost and capacity benefits. However, the ability to transform a manned aircraft into an unmanned cargo plane by integrating systems can contribute to the development of the unmanned air cargo market by allowing the idea of airline companies to transform their existing aircraft into unmanned aircraft.

3.5.1.6. Silent Arrow (Mercy-2000)

Founded in 2012, Yates Electrospace Corporation (YEC) designs the world's fastest manned electric aircraft. Creator of the revolutionary Silent Arrow (Yateselectrospace, 2020). AVIUS Air Delivery is a non-governmental subsidiary of YEC. It was established with the aim of making emergency air response in case of humanitarian aid efforts and natural disasters.

Specifications;

- Empty Weight: 907 kg
- Cargo Capacity : 740 kg
- Length : 2.43 m
- Wingspan: 8.5 m
- Speed : 62 kts @ 1000lbs, 92 kts @ 2000lbs

Figure 3. 14: Mercy-2000

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The Mercy-2000, which is still in the testing phase, is lifted from the ground with the help of a helicopter and released at a certain height and goes into autonomous flight. (BALL, 2020). Electricity of the fuel type serves an environmentally friendly logistics system. The fact that the Mercy-2000 can be lifted with the help of a helicopter creates a disadvantage, while at the same time being able to perform autonomous flight can be shown as the attractive side of the project.

3.5.1.7. Black Swan

Dronamics is one of Bulgarian startups, was founded in 2014. Their product is called Black Swan.

Specifications:

- Cargo Capacity :350 KG over
- Range :2,500 KM
- Autonomously
- Fuel : gasoline engine
- A single propeller
- Takeoff and Landing : no require airports (Dronamics, 2020).

Figure 3. 15: Black Swan

Depending on regulators, operations will begin in 2020 or 2021 with the drone operated by Dronamics and a local partner, using advanced autopilots and remote fleet control systems (Theloadstar, 2019). Designed by a Bulgarian-based company, Blackswan flies autonomously and does not need any airport. Although the carrying capacity is not high, Blackswan's flight range seems to be available nationally and internationally for nearby cities of different countries.

3.5.1.8. Bayraktar Akıncı

Baykar Makine, established in 2014, started its research and development operations related to manned and unmanned aerial systems in 2000. Baykar, which had its first flight test done in 2014, started mini UAV development and production

processs in 2006. Tactic UAVs developed and manufactured for military purposes were used by Turkish Armed Forces in many operations (Baykar Savunma, 2020). Owing to the developed projects success in military operations many countries requested UAVs from Baykar to be used in military operations.

Unmanned Combat Aircraft produced by Turkey is seen as a step that could radically changed traditional methods of warfare. The success obtained with the use of the Turkey's UAV technology in Nagorno-Karabakh, Libya, Syria wars has shown that up front what their competitors. It is envisaged that armed unmanned aerial vehicles will replace conventional aircraft. Bayraktar, a pioneer in the production of unmanned aerial vehicles in Turkey, has signed agreements with Tunisia, Ukraine, Serbia, Qatar and Libya.

'*Bayraktar Akıncı is an unmanned air vehicle system designed to meet rigorous, operational requirements. This aircraft carriers a variety of payloads for reconnaissance, survey, intelligence, electronic warfare, designation and attack missions, and can fly extended hours at high altitudes…With an infrastructure that allows for integration of all nationally developed air to air and air to ground munitions, the system reduces operational necessities and costs relative to manned systems with comparable capability'* (Baykar, 2020). Bayraktar Akıncı's, --which includes 6 AI computers, and, developed to serve for the military purposes--, first fully automatic test took place on the 6th of December, 2019. On the last day of the workshop Selçuk stated '*…Bayrak AKINCI will be able to gather information by the sensors via the artificial intelligence computers incorporated in them, and, by saving the date collected via the cameras on top of the aircraft. This artificial intelligence*

system, which will be able to determine the banking, rotation and direction angles without the need for any external sensor or Global Positioning System (GPS), will provide environmental awareness at the same time, by using geographical information. Improved artificial intelligence system will have the feature to make decisions by processing the data it gathers. This artificial intelligence system, which will be able to identify targets on land which can't be seen with naked eye, will enable the use of Bayraktar AKINCI more efficiently.' (Kökçü, 2020).

Figure 3. 16: Bayraktar Akıncı

Specifications;

- Cruise Speed: 150 knots
- Maximum Speed: 250 knots
- Operational Altitude: 30,000 ft
- Service Selling: 40,000 ft
- Endurance: 20 hours
- Wingspan: 20 m
- Lenght: 12,3 m
- Takeoff and Landing: Runway

- MTOW: 5,500 kg
- Payload Capacity: 1,350 kg (450 kg int + 900 kg ext)
- Fuel: Jet-A1 / JP-B
- Thrust: Turboprop with 5 blade proceller
- Power: 2*450 hp or 2* 750 hp options (Baykar, 2020)

3.6 UCA Potential and Limitations

3.6.1 Market Barriers for Commercial and Civil Application of Drones

Although it is being used effectively for military purposes, there are some barriers to the market for civil and commercial uses. The most important of these are the deficiencies regarding security standards. barriers to the market;lack of operator training and safety standards;

- The training of the operators who will use the drone is not yet at a sufficient level,
- Limited load capacity,
- Airspace constraints,
- Excessive liability arising from civil operations, insufficient regulations,
- The most important is the negative perception of the consumer,
- Safety standards (Erceg, Erceg, & Vasilj, 2017, s. 49)
- Congested airspace,
- Inherent risks,
- Public concern.

Airplanes were opened for civilian use for the first time in history, when their benefits were seen in military operations. There were almost the same limitations in

the first use of aircraft. However, with the benefit provided and developing technology, national and international regulations were made quickly and its use was started for civilian purposes. We anticipate that the same steps may take place for unmanned aerial vehicles. We believe that it will take its place in the air in the coming years with the realization of sufficient R&D studies and successful test flights and the benefit provided especially for military purposes. What should not be overlooked is that it is necessary to contribute to the formation and development of the market by preparing incentive and R&D programs aimed at solving these limitations and the disadvantages of unmanned aerial vehicles.

3.6.2. UCA Advantages-Disadvantages

Unmanned cargo planes will provide a great advantage, considering the safety and reduction of the risk of loss of human life from the advantages, considering the possibility of accidents or terrorist acts. Many people on the plane lost their lives in plane accidents and terrorist acts from past to present. In this respect, UCA would be a good alternative. In addition, the maintenance time and maintenance costs of unmanned aircraft will be less than that of manned aircraft. Requirements needed in manned aircraft such as life support system, windows, AC, pressurized cabin and recreational facilities will reduce the cost as they will not be included in UCAs. Structure and performance requirements to ensure the comfort of passengers require a serious cost for manned aircraft. If the pilot is not on the plane, the requirements such as cabin and instrument panel will be eliminated. The decrease in the number of personnel needed will reduce the personnel expense. As the dimensions of the aircraft decrease, the cargo capacity will increase and flexible body design will be enabled. therefore, it will reduce the cost of the business and increase its profitability. In

addition, restrictions on the transportation of dangerous goods by unmanned cargo aircraft will be reduced. Some UCAs need an airport to land and so creates another cost and time advantage.

Data being able to be saved and measured remotely, lower running costs and easier operation abilities when compared to traditional airplanes and satellites, are the advantages that come out of using drones (Chalupníčková, Bahenský, Sýkora, & Heralová, 2014). Also, when delivery points are far to the HUBs, UCA's direct customer delivery function is so important that it cannot be ignored (van de Ven, NLD AF, & JAPCC, 2014).

Manned airplanes should be equipped in a way to provide safety to passengers and crew as part of flight suitability. However, by lowering this requirement to the minimum needed for UAVs, limitations in a way to reduce their risk of crashes with that of their surroundings can be made. Therefore, it will provide commercial benefits to the design, maintenance and certification stages of vehicles (Hasan, Sachs, & Dauer, 2018).

There are also some disadvantages for UCAs, which have many advantages. The adequacy of ground intervention is questionable in the absence of a pilot in a crisis during the flight. In addition, the number of people to be assigned as drone pilot by taking unmanned aerial vehicle training is not enough yet. The adequacy of the drone pilot training should be tested with the test flights to be made. Life safety and fear of death are the driving forces in the pilot's intervention during a crisis in manned flights. however, an operator on the ground should be able to move with the same

psychology in an unmanned flight. For this, simulations can be created and tests can be applied to pilots investigating their reactions and actions during a crisis. There are limitations in the operations of unmanned aerial vehicles for safety reasons. Even though international organizations try to fill the gaps arising from legal regulations with new regulations, they are still globally insufficient. Although some countries have made regulations on unmanned aerial vehicles, an international common form has not been established. Another disadvantage is that civilian airspace has a more limited area than military airspace. This situation poses an obstacle for businesses engaged in commercial activities. Another obstacle to overcome is the negative perception of unmanned aerial vehicles in the public opinion. because unmanned aerial vehicles create a perception of armed and dangerous by the society. The reason for this situation is the use of unmanned aerial vehicles as an effective war tool in wars and wars. This situation can only be overcome with the successes arising from the use of unmanned aerial vehicles primarily for commercial purposes. The most effective way to do this is UCA.

3.7. Legislative Regulations

As the UAV industry has a complicated and dynamic structure, regulations and standards should be always improved (Chalupníčková, Bahenský, Sýkora, & Heralová, 2014). UAV operations cannot be carried out under current regulations. Flight requirements and standards should be determined with a separate legal regulation. New regulations are made every day, and the information about the current regulations obtained during the research period is given below. The reader may need to check the source again to access up-to-date information.

ICAO aims to support the wireless aerial vehicles' integration to unrestricted air domains, operate safely all around the world, by setting international level standards (ICAO, 2015). Benefits and information attained by the use of UAS in cargo freights is important and necessary for the integration process. UAVs' functionability within the commercial air domain as a safe alternative to manned airplanes should be proven to the public opinion and relevant authorities (Hoeben, 2014). DHL ties the sensibility of the regulations related to UAV to three main reasons, namely, as 'congested airspace,' 'inherent risks' and 'public concern' (DHL, 2014, p. 4). These reasons are among the limitations in the use of UAVs for civil and commercial purposes mentioned earlier. It is observed that these limitations create a barrier not only in the market entrance but also in legal regulations.

FAA tries to include small UAS (lighter than 55kg) operating systems; crop monitoring/inception, research and development, educational and academic uses, powerline/pipeline inspection in hilly or mountainous terrain, antenna inspections, aerial photography and wildlife nesting area evaluations, into the national air space (NAS) since 2018 with the belief of benefitting the society. With the latter aims FAA enacted the Modernization an Reform Act of 2012, in 2012. FAA expressed they won't forbid the carriers wanting to transport through UAS as long as the total weight, including the load of the aircraft they are using, is less than 55 pounds (Federal Register, 2015). AUVSI predicts through the integration process of UAS to NAS in the US, over 100.000 job opportunities will be created (Bartsc, Coyne, & Gray, 2017, p. 4). The potential business opportunities of unmanned aerial vehicles, anticipation of future commercial opportunities and the widespread use of them have been the driving force for the FAA to make legal regulations.

According to FAA's data the amount of registered small hobby airplanes reached to 1,1 million in 2019, as to commercial drones, to around 412.000. At the end of 2019, FAA published a rule related to remote identification which allows the drones to identify and access position information of people and air space users. FAA emphasized the importance of remote identification system as a result of the increasing drone operations give rise to risks in public safety. An adapted insurance coverage for drones and their equipment is formed (Insurance Information Institute, 2020). FAA, the competent aviation authority in the USA, is one of the first international authorities to make legal regulations on unmanned air transport. Technological innovations and improvements made by civil and public authorities in both commercial and military fields, as well as existing commercial opportunities, can be the reason for the rapid realization of these regulations.

At a conference held by the European Union in March 2015, the EU made a proclamation which acts as a guiding document regarding drone advancements. The responsibility to gather, analyse and publish safe information related to drone operations was given to EASA with a revised proclamation in 2018. The European Commission set the determining regulations of technical requirements for the developments of drones on the 12th of March, 2019. On the 24th of March 2019, they set the compulsion for drone companies to enrollment with national authorities as of the 1st of July 2020, and, gave way to UAVs lighter than 25 kg to operate under certain circumstances before obtaining permissions (European Parliament, 2019). One of the important steps is the laying down of the maximum take-off weight to 3175 kg for autonomous VTOL by EASA (EASA, 2019). The European Union sees the opportunities created by UAVs which keep getting technological advancements as a

new era in the aviation history. In this sense, the aviation strategy aims to promote integration of drones into jobs and society (European Parliament, 2019). At the same time as the United States, the European Union has begun to quickly make legal arrangements.

However, it cannot be said that the regulations are sufficient for air cargo transport yet. Because, with the current regulations it is difficult to deploy an automatic cargo fleet. The reason why regulations are delayed is because the regulators try to deal with the challenges caused by small UAVs.

4. AIR CARGO TRANSPORTATION AND UNMANNED AERIAL VEHICLES IN TURKEY

This chapter first will be given information about the air cargo transport took place in Turkey. Information of air cargo carriers will be briefly summarized. Unmanned aerial vehicles in Turkey will be given due to the lack of recent data has a long history and it will be explained what the current legislation.

4.1. The Progress of the Development of Air Cargo Transportation in Turkey

The first air cargo transportation was carried out with a Borel type aircraft which landed on Yeşilköy on the 20th November 1939. Moreover, the first officially recognised air cargo transport was the transportation of envelops, which had 'the first cargo transported by Ottoman airplanes to Bilecik and Eskişehir' written on them, from Lefke (Osmaneli) to Bilecik, by pilots Nuri Bey and Rasıt İsmail Hakkı Bey. On the 7th of April, 1924, a test flight was made with a Spad-46 type aircraft between İstanbul-Ankara, and, afterwards starting from the 13th of September 1924 regular trips, excluding Fridays, were made every day. 1100 kg of post was transported over 92 flights on this route. The authority to make regulations was handed over to the General Directorate of State Airports Authority in 1938. After Turkey became a member of ICAO in 1945, by purchasing airplanes from the US, regular trips to 18 places in Turkey was started to be made. For the purpose of direct transportations of posts to be made after 1947 without the need to change countries or airlines, some countries signed agreements. Post transportation was started to be made by commercial companies when airlines businesses were opened in 1987 (Baykal, 2013). The interest in cargo transportation via airplanes which wasn't sought after at the beginning, showed its influence in Turkey as well, after the upgrowth in global trade.

Air cargo transportation is based heavily on foreign markets in Turkey. However, with the effects of e-commerce and the effort to transfer posts fast, the need to transport posts using air cargo transportation came out. On top of scheduled cargo flights charter services are provided by air cargo companies.

In the civil aviation sector, starting from 2019, the total aircraft capacity of 11 airliners, which provide air cargo transportation services, is 546, and, among them 516 airplanes are passenger, 30 of them are cargo airplanes. The load capacity of the cargo aircraft is totally 2.296.450 kg. Since 2003, the cargo capacity has increased by 659% and the total load traffic in 2019 reached to 3,4 tonnes (SHGM, 2019).

Table 4.1: Air Freight Traffic Source: (SHGM, 2019)

Transported Load (Tonnes)	**2003**	**2018**	**2019**	**2018-2019 Change (%)**
Domestic Routes	188.979	886.025	819.540	-7,50%
International Routes	775.101	2.969.206	2.616.883	-11,90%
Total	964.080	3.855.231	3.436.423	-10,90%

In the table, it is observed that the amount of cargo carried between 2003 and 2019 has increased significantly on domestic routes compared to international routes, but between 2018 and 2019, both domestic and international routes have decreased and the total amount of cargo carried has decreased by 10 percent.

4.2. Air Cargo Airlines in Turkey

This section will provide information regarding air cargo airline that companies operating in Turkey. There are four major airline carriers engaged in air cargo in Turkey according to SHGM data. These; Turkish Cargo, MNG Airlines, ULS Airlines and ACT Airlines.

4.2.1. Turkish Cargo

It was founded in 1933 as a sub-brand of Turkish Airlines (Türk Hava Yolları) under the name Turkish Airlines Cargo and went through a change in brand name to Turkish Cargo in 2000. They provided cargo services by transporting domestic and international posts from 1936 to 1990s in the space leftover from passenger luggage. As a result of demands in increase to air cargo capacity services were started to be provided by converting two passenger airplanes to cargo airplanes, but with the exclusion of airplanes in 2020 a return to combined transportation in the early 2000s was made. In 2000s 4 passenger airplanes were converted to cargo airplanes again, however cargo airplanes were ordered from Airbus due to increase in trade and a lack of the number of airplanes available. They purchased A330-200F, a new generation of cargo airplanes, in 2019 (Wikipedia, 2020).

Nowadays, Turkish Airlines, with 359 aircraft capacity out of which 16 are cargo airplanes, provides air cargo services to 322 destinations out of which 90 are direct destination points. According to World Air Cargo Data cumulative date of December, 2019, while the market share is in air cargo market is reduced by 4,4 percent, globally, Turkish Cargo ranked up 7^{th} on the global air cargo market by having 7,1 percent increase in tonnage (Turkish Cargo, 2020). With Turkish Airlines

entering the cargo market, it has gained a serious competitive power over the years. THY, one of the airlines with the most destination points in the world, has gained an advantage in the cargo market with this power.

4.2.2. MNG Airlines

MNG Airlines was founded in 1996 and started to provide services by making scheduled cargo flights to Germany and the UK in 1997. They make both scheduled and charter trips with the 5 A300 and 1 A330 cargo airplanes they have (Mng Airlines, 2020). In addition to scheduled and charter flights, MNG has a fleet of trucks and courier services, offering door-to-door services.

4.2.3. ACT Airlines

ACT Airlines was stablished in 2004. Air cargo services providing by ACT has extra capacity to major carriers and offers unscheduled flight service and ACMI (Aircraft, Crew, Maintenance and Insurance). Since they received IOSA certificate, they have been providing ACMI and Ad-Hoc Charter services (ACT Airlines, 2020). ACT Airlines is one of the airlines that provide services in international cargo transportation.

4.2.4. ULS Airlines

It is an air cargo company centred in Turkey and established in 2004. They provided services under the brand name of Baron Air Cargo before 2004, then continued under the name of Kuzu Air Cargo, and, after purchasing by ULS in 2008 the new name changed as ULS Airlines Cargo in 2009.They carry out charter, ACMI and scheduled trip services with the 3 A310 airplanes they have in their fleet (Wikipedia, 2020).

4.3. Air Freight Data in Turkey

The change of the number of cargo airplanes, over years, owned by air cargo transportation companies operating in Turkey;

Table 4.2: Number of airplanes owned by air cargo companies in Turkey in accordance with the years

Cargo Aircraft						
	2014	**2015**	**2016**	**2017**	**2018**	**2019**
ACT	4	7	7	5	5	5
MNG	7	7	7	7	6	6
THY	7	8	8	11	15	16
ULS	3	3	3	3	3	3

Source: Edited by the author (SHGM,2014), (SHGM,2015), (SHGM,2016), (SHGM,2017),(SHGM,2018), (SHGM,2019)

Looking at the number of cargo aircraft owned by airlines between 2014 and 2019, it is seen that THY doubled its aircraft capacity. The number of aircraft of ULS Airlines remained constant, ACT Airlines reached a capacity of 7 aircraft by including 3 aircraft in 2015, but continued to serve with 5 aircraft by removing 2 aircraft from its fleet in 2017.

The change of the cargo capacity, over the years, of cargo companies operating in Turkey;

Table 4.3: The change of the cargo capacity, over the years, of cargo companies operating in Turkey

	Load Capacity (kg)					
	2014	**2015**	**2016**	**2017**	**2018**	**2019**
ACT	454.300	795.025	795.025	567.875	567.875	567.875
MNG	353.000	353.000	353.000	353.000	305.000	305.000
THY	421.000	490.000	552.000	825.000	1.200.000	1.302.000
ULS	121.575	121.575	121.575	121.575	121.575	121.575

Source: Edited by the author (SHGM,2014), (SHGM,2015), (SHGM,2016), (SHGM,2017),(SHGM,2018), (SHGM,2019).

Cargo capacities are directly proportional to the number of aircraft. The change in cargo capacity over the years is proportional to the decrease and increase in the number of aircraft.

The number of airplanes and aircraft types owned by air cargo companies since 2019;

Table 4.4: The number of airplanes and aircraft types owned by air cargo companies since 2019 Source: Edited by the author (SHGM,2019).

	Type of Aircraft	**Cargo Capacity (kg)**
THY	A330-F (10)	1.302.000
	B777-F (6)	
MNG	A300 (5)	305.000
	A330-F (1)	
ACT	B747-400 (5)	567.875
ULS	A310-F (3)	121.575

An important issue that should be noted here is that THY data are based only on Turkish Cargo data. Cargo volumes made by THY's passenger aircraft are not included in the given data. Other airlines are companies that only carry cargo and do not contain any other source of information to be inferred.

4.4. Unmanned Aerial Vehicles in Turkey

UAVs which are used widely around the world, have increased in the number they are used in Turkey too, and the obligation for UAVs and pilots to register with SHGM through new legislations is brought. With the new regulations, the number of individuals registered with UAV and possess a UAV license can be tracked since 2006. Accordingly, it can be seen that this percentage has quadrupled over a short period of 4 years. Increase in UAVs, bought for the purposes of hobby, sports or commerce in Turkey, reflects that they go in parallel with developments in the UAV sector.

Table 4.5: The number of registered UAVs and pilots with UAV licences in Turkey (2016-2019)

	NUMBER OF UAVs	**NUMBER OF INDIVIDUALS WITH UAV LICENCES**
2016	8.349	11.839
2017	20.183	22.195
2018	27.439	35.366
2019	34.150	52.120

Source: Edited by the author (SHGM,2016), (SHGM,2017),(SHGM,2018), (SHGM,2019).

In Turkey, due to start by the year 2016 the number of registered UAV and UAV pilot number of legal regulations in this date it is made. As of this date, it is seen in the table that there was a significant increase in the number of registered UAVs in 2017, with the obligation to register as of this date and the notification of penalties for those who do not register. With the acceleration of the development of the sector, the number of people who acquired the pilot certificate increased. It not yet widely used in commercial activities in Turkey, although it is understood from the figures the increasing importance of the sector day by day.

4.5. Regulations

In order to determine the import and registration requirements related to UAVs which will be operated and used in the Turkish air domain, also, to determine the qualifications people, who will use the related systems, need to have, 'Unmanned Aerial Vehicle Systems Guideline' was published by SHGM.

UAVs are categorised depending on the maximum take-off loads as shown below:

UAV0: 500 gr-4kg

UAV1: 4 kg-25 kg

UAV2:25 kg-150 kg

UAV3: More than 150 kg

If UAVs above 25 kg are going to be used for trade operations, it is mandatory for them to be insured. Moreover, for the UAVs to be used in trade, relevant operators must prepare 'Flight Operation Manuals (Uçuş Operasyon El Kitabı)' and present to SHGM.

It is made obligatory, to analyse risks by considering crush risks in the permitted and excepted permitted areas (red) regardless of UAV classification and registration and, to take precautions to eliminate or reduce the determined risks.
In order to obtain a lightweight UAV operator certificate:
Min 20 CAT (Category) UAV0 or
Min 5 CAT UAV1 or
Min 2 CAT UAV2 or
Min 1 CAT UAV3 unmanned aerial vehicle or vehicles need to be owned.

Permissions are given over the UAV registration system about UAVs; for 3 month periods considering the aerial domains specified in the manual, and, under the condition of staying under 400 feet, 2 month periods for excepted permitted areas and above 400 feet. While any sort of training or a piloting license isn't required from people willing to use UAV0 or UAV1s for a hobby or sports, to use them in trade Unmanned Aerial Vehicle Commercial Pilot license is required. To be able to use UAV2 or UAV3s a piloting license is needed. Prospective pilots who are over 18 years old and received their flight and maintenance and communication over radio trainings need to obtain a UAV piloting license to be used for 3 years by applying at the general directorate.

5. RESEARCH

In order for the reader to better understand the research subject, summaries of traditional air cargo transportation and unmanned aerial vehicles are given in the previous sections. In addition, information about the project examples related to unmanned air cargo vehicles is important in terms of analyzing the information obtained after the interview of the research. The opinions of the air cargo transport company in Turkey who think about the projects being developed in the world have been wondering and approaches were asked to evaluate. The same questions in an international shipping company operating in Turkey aimed to reveal the similarities and differences between the perspectives of orienting the company.

5.1. The Importance and Aim of the Research

With this study, investigates the potential and limitations of UCA, the questions asked in the interviews and the approaches of the companies to UCAs were measured and answers to the possibility of transportation to be made by air cargo companies with UCA in Turkey is tried to be given. In this sense, information about air cargo transportation's development in Turkey and around the world was gathered and, with the information given about UAVs, a new perspective for the readers is tried to be provided. In the research done, within the database there being no relevant study around the world or Turkey reflects the importance of the research.

5.2. Research Method

In this research, which was done using qualitative research methods, the companies operating in Turkey researched approach to this project answers to the below research questions were tired to be given in accordance with the information

obtained from primary and secondary sources. Primary sources consist of interviews with air cargo companies. As such, the population is the companies providing air cargo services in Turkey, while the sample group consist of 2 national and 1 international companies. Structured interview questions were given to the companies. As to the secondary resources, a narrative review was made and, books, journals, articles, reports, dissertations and documents on the internet were utilized. The limitation of the research is the disuse of UCA.

Research Question1: What are the potential and limitations of UCA?

Research Question 2: What are the approaches of the airline companies that provide cargo service in Turkey to carry out cargo transportation with UCAs?

5.3. Results Fundings

The first question of the research is answered below. the first question is potential and limitations of UCA. The following results have been achieved by evaluating the information obtained from the literature.

- **Potential of UCA**
  - **Benefits of UCA**
    - **No Needed Crew on Board**; If there is no crew on the plane, the production cost will be reduced, the technical benefit will be provided in the take-off weight of the aircraft, the life safety risk factor for the occupants will be eliminated and the personnel cost will also be reduced.

- **Light Weight Airframe Design**; Since there is no obligation to meet the personnel requirements such as cockpit, instrument panels, safety equipment, etc., which is a mandatory requirement for manned aircraft, in an unmanned cargo aircraft, it will not be attached to the aircraft and a lighter body will be designed.
- **Cheaper Airframe**; a lighter body design will reduce the cost of the body.
- **More Flexible Operations**; Most of the unmanned air cargo aircraft designed do not need any airport. It is expected to provide advantage in terms of space and time to land and take off.
- **Sustainability**; UCA can be developed with technological innovations and improvements, and can take place in the field of green logistics with environmentally friendly turbo engine designs.
- **Design for Cargo Handling**; The design of unmanned aircraft is made according to cargo transportation standards. It has a structure suitable for transportation with bulk or ULDs.
- **Need Little Necessary Infrastructure**; Due to the fact that it can fly at flexible times with flexible operations, it requires less infrastructure.

Costs Savings

- **Labor Costs**; Labor costs in both production and operations are less than manned aircraft.
- **Fuel costs**; Although the fuel types are produced differently, the fuel cost is lower than the manned aircraft. Electric UCA is environmentally friendly while providing a cost advantage.

- **Maintenance**; UCA maintenance and repair costs are lower than traditional cargo aircraft.
- **Efficient Routing and Less Idle Time**; UCA does not have to land for personnel needs. UCA can stay in the air for days. It can take its load from the landing place without waiting and continue its flight for another shipment.
- **Lower Altitudes and Less Fuel**; UCA can fly at lower altitudes and at the same time fly with a low carbon emission rate and less fuel use.
- **Less Damage and Handling Time**; Maintenance and repair times are faster than cargo aircraft.
- **No Airport Charges**; No need to use the airport results in savings in airport fare costs.

Flexibility

- **No Need Home Base**; There is no need home base or airport to return to.
- **Take off and Landing Advantage**; UCA can take off and landing in difficult conditions. There are UCA which can land in mountain areas in rural areas, as well as UCA, which can land on short terrain with short runways, for example flat ground.

Transport time

- Arrival time depends on the distance.
- UCA fly slower than manned cargo aircraft.
- Cargo loading and unloading times are shorter.

- ✈ Time is used more efficiently by performing door to door transfer.

- **Limitations**
  - ☒ **Legal Regulations**; There is a lack of regulations by international aviation authorities. However, studies continue.
  - ☒ **Legislation;** The development of international standards on unmanned aerial vehicles by the air authorities in the countries has not yet been clarified.
  - ☒ **Reluctance to Investments**; It is observed that in an environment of uncertainty, investors do not have a willingness to enter the market.
  - ☒ **Hacking System**; The fact that the flights are managed remotely increases the possibility of hacking the system and suggests the possible risk of hijacking and terrorism.
  - ☒ **Airspace Constraints**; The use of unmanned aerial vehicles is restricted in civil airspace.
  - ☒ **Public Concern**; The public about unmanned vehicles is not informed and biased.
  - ☒ **Congested Airspace**; Even if common use of civil airspace is allowed, insufficiency of airspace can be predicted in common use.
  - ☒ **Inherent Risks**; For UCA, which is in the project phase, the effects of a natural disaster due to weather conditions are uncertain.

Within the scope of the research interviews about the research topic was made with three managers carrying out air cargo transportation services. These companies are ACT Airlines, ULS Airlines and an international company which carries out air

cargo transportation operations in Turkey. With the request made from an international company to keep its name hidden, it is referred to as 'Other firm.' With the prepared questions, how willing and knowledgeable these companies are about transportation with unmanned aerial vehicles wanted to be observed. By putting together all of the answers given to 15 questions in this sense and, by including the answers of the three companies under each individual question, the approach of the answers given to the same questions wanted to be observed.

1. What are your predictions about air cargo transportation sector's development over the next ten years?	
ACT Airlines	Due to the pandemic the entire course in global aviation industry has changed. In air cargo transportation, which isn't expected to achieve huge growth, the demand, especially for cargo airlines, has increased.
ULS Airlines	With the spread of covid-19 virus air cargo transportation has gathered momentum and, it has become the only sector which has been on rise, around the world, in terms of profit and importance.
Other Firm	Air cargo transportation will develop over the next 10 years in the world. Senders meet these demands by making transit transportation to the destinations which the airlines can't directly fly to. During the pandemic and considering the possibility for future pandemics, basic consumption goods such as medicine or food will be transported more and, airliners will put more emphasis on cargo fleets.
2. What are the goals set by your company for the next ten years?	
ACT Airlines	As a cargo airliner we also have the aim to grow by meeting the increasing demand within this period.
ULS Airlines	To spread the number of sectors, countries and agency network we provide services in, and for, all around the world. To spread the logistic services to the public by reaching to individual customers.

Other Firm	Among the most important goals of our company; there is expansion on Istanbul Airport market, get into the cargo market in Europe and Asia and, make agreements with various airliners in Turkey.
3. Increase in global trade volume resulted in increase in air cargo transportation. Can you evaluate these positive advancements with regards to your company?	
ACT Airlines	As, especially the logistic sector is in parallel with increase in trade volume, it increases the demand for us as airliners. Therefore, demand for us has increased and, resulted in increase of the number of our flights.
ULS Airlines	A terrific increase happened in the amount of demands made for our company and, this situation has contributed positively within our opportunities.
Other Firm	Our company provided services namely in the Asian market to India and Pakistan and, set goals to increase destinations and flight traffic in these countries.

4. One of the advantages brought by the digital world is, in terms of customers, the ability to shop online. Companies such as Amazon, UPS and DHL have started to make changes in their delivery methods by using drones as part of one of the innovations brought by technology. What is your view on drone usage for the last mile delivery of small packages?	
ACT Airlines	All of the advantages of technology should be used. As time is extremely valuable for people, as a service which is extremely creative and successful, a service like this is provided.
ULS Airlines	While it seems technologically possible, the costs and amount of people to carry out this operation is, at the moment, insufficient.
Other Firm	Drone delivery is a real innovation project which can be done after the necessary safety and quality requirements are met. If the related countries' Civil Aviation Authorities can make regulations on air traffic, drone delivery can improve drastically in the future.
5. While companies such as Amazon and UPS have started using drones actively in their deliveries, despite PTT Kargo in Turkey tried to carry out studies about this and announced it would be used actively in 2019, drone delivery didn't happen. What are your thoughts on this?	

ACT Airlines	Unfortunately, transitioning from project stage to usage in real life either takes too long or put aside. In order to be not left behind research and development studies should be carried out more often in our country.
ULS Airlines	I don't know how successfully or widely Amazon and UPS use this system but, using drones for e-commerce deliveries won't be efficient.
Other Firm	Civil Aviation General Authority's studies and needed infrastructure provide a basis in this topic in our country. If the prerequisites of the infrastructure in big airports and local deliveries can be provided in our country, drone deliveries can be made.
6. Lots of projects related to unmanned aerial cargo vehicles, designed to make heavy air cargo transportation, are being developed. Do you follow these projects? Are there any special projects you are interested in?	
ACT Airlines	We do follow the mentioned projects, however there isn't a special project which we are interested in.
ULS Airlines	It is normal for this sector to improve. While there isn't a project we are interested in, special studies and research for areas where there are difficulties in terms of security can be conducted.
Other Firm	I do follow these projects. TSK's İHA project and California centred Zipline project interests me.
7. Does your company have research and development units? If yes, are studies regarding unmanned aerial vehicles being carried out?	
ACT Airlines	We don't have an R&D unit and don't carry out any studies regarding unmanned aerial vehicles.
ULS Airlines	No there isn't.
Other Firm	We don't have a research and development unit in our company.
8. Successful studies about unmanned air vehicles in Turkey were made, tested, and started to be used in military. What are your predictions for the integration process to start commercial use?	
ACT Airlines	Not just for our country, but globally as a result of human factors I believe the integration process of UAVs will take some time and a quick changeover won't happen. On top of this, it will cause massive fluctuations in employment data in terms of finance. I think it is a topic which requires in depth evaluation. However, the inevitable result will eventually happen.

ULS Airlines	Trials can be made in areas where transportation is made intensively. If costs are reduced success is guaranteed.
Other Firm	Companies', which are going to use unmanned aerial vehicles, infrastructures and facilities should be made suitable, employees should be trained and necessary promotions for the customers should be made.
9. With the advancements in unmanned aerial vehicles made by international establishments, legal regulations updated every other day. SHGM, too, tries to prevent problems rising from legal regulations in commercial use by publishing guidelines related to unmanned aerial vehicles. How would you evaluate the increasing use of air cargo vehicles around the world and in Turkey?	
ACT Airlines	As known in aviation, in every topic that's been analysed, the prioritised topic is safety. Therefore, I see the regulations made to be a necessity to prevent air vehicles' uncontrolled operations. Of course, legal regulations, too, should support developments rather than put a crimp in these developments. It is also necessary to see, and try to accept, both all of them as investments and technological advancements
ULS Airlines	Making regulations is mandatory both to provide flexibility and in terms of security. While exemptions are brought, providing safety, too, should be the most important condition.
Other Firm	Short distance delivery can be made fast, a new era in cargo sector would begin and job opportunities in the trade market can be created.
10. How would you evaluate using unmanned aerial cargo vehicles overseas or for short distance operations in terms of security?	
ACT Airlines	At first thought it may appear to be surely positive but, what types of problems would be experienced in terms of operations and the infrastructures should be thoroughly evaluated. On top of this the ability to interfere in flights, which may be caused due to safety reasons over long distanced overseas trips, is being removed. However, as I stated earlier, this is the inevitable and will happen sooner or later. Issues rising from employees' work hours will be eliminated and airplanes' staying on hold on ground will be reduced hugely. This will allow the use of airplanes in a more utilised way. Of course, this will all provide positive feedback to the companies as cost saving factors. I don't think this needs to be separated as long or short term.

ULS Airlines	On overseas transportation, systems need to be developed to provide safety for the traded goods. On short term operations both safety of goods and living beings should be pursued. This may be abused.
Other Firm	Using unmanned aerial cargo vehicles on overseas operations appear to be difficult in short term, it may be made possible for them to be used on short distance operations in the short term.
11. When all of the conditions are met, would you consider transportation via unmanned aerial cargo vehicles?	
ACT Airlines	Of course, I would.
ULS Airlines	With the condition of trips being between specified distances and stops, definitely yes.
Other Firm	When all the other conditions are met, I would consider transportation via unmanned aerial vehicles. It could create innovation on intraday deliveries.
12. You provide air freight services for international deliveries. Would you consider getting into the domestic market with the advantages provided by unmanned aerial vehicles?	
ACT Airlines	If it is going to provide financial income and provide advantages in comparison to land transportation a thought can be given.
ULS Airlines	I believe in the necessity to use unmanned aerial vehicles primarily in domestic trade.
Other Firm	I would consider getting into the domestic market by the advantages provided from unmanned aerial vehicles; small and low-volume posts can be delivered in this way.
13. What features (fuel type, transportation capacity, eVTOL, etc) would you expect an unmanned aerial vehicle to have which you would want to include in your fleet?	
ACT Airlines	First of all, these types of airplanes will need to be, software and artificial intelligence wise, well equipped. And, this will affect the acquisition price of airplanes. Therefore, the ability of being able to purchase them in terms of financial costs is the priority. High transportation volume, the ability to fly long distances and the ability to save on fuel are the preferences in succession.
ULS Airlines	It should operate using electricity and have high volume and weight transportation capacity.
Other Firm	I would expect an unmanned aerial vehicle which we would want to include in our fleet to operate using fuel efficiently and have light weight body.
14. With the ongoing projects advantages over employees, fuel, maintenance, insurance, etc costs will be provided by unmanned aerial vehicles. How much of a minimum cost advantage would you expect by including an unmanned aerial vehicle in your fleet?	

ACT Airlines	Roughly calculated, in medium term it should provide 40% more profit when compared to today's costs.
ULS Airlines	
Other Firm	The cost advantage which would be provided by an unmanned aerial vehicle that we would include in our fleet can be calculated after the total costs of posts to be delivered are deducted.

15. In order to fly unmanned aerial vehicles a team with the required licenses is needed. Is there anyone among your current employees who have these licences? Or, are there any projects you are working on to get these licences?	
ACT Airlines	We don't have a team with someone who has a license at the moment.
ULS Airlines	There isn't a practice as such yet.
Other Firm	There isn't anyone who obtains these licences among our employees and, we aren't working on obtaining these licences.

Table 5.1: Interview Results

The answers given to the expectations of air cargo transportation over the next ten years reflect that the sector's development will accelerate. The Covid-19 pandemic which started in 2020 effected air cargo transportation sector's development positively. Air transportation sector, which keeps increasing its market share in global trade, is getting more demand with the effects of the pandemic. Another factor is that this pandemic resulted in questioning whether other pandemics will happen in the future and, in case this kind of a period gets repeated, it is seen that demand for air cargo transportation is going to increase.

When the answers about using drones in last mile transportation of small posts are analysed studies related to using drones in last mile transportation are seen as an

innovation project, however it is concluded that air traffic, legal regulations and lack of employees are issues which need to be resolved. While ULS Airlines thinks using drones in Turkey would not be efficient, ACT Airlines and Other Firm think it could be successful by conducting r&d studies and providing the needed infrastructure.

A question about projects was asked on the 6th question with the purpose to understand how much interest for LUCA projects are shown in our country and, from the answers it is understood that ACT Airlines and Other firm have knowledge of these projects and follow the projects closely, as to ULS Airlines, that they don't yet follow the projects, however, that they are willing to do research to use in areas where there are safety concerns. However, these three companies don't have r&d units and haven't started to conduct any studies related to UAVs.

The need of legal regulations in order to not fall behind advancing technologies is a topic on which all of the companies agree. The need of making sure permitted use of unmanned aerial vehicles through legal regulations don't cause safety threats is especially emphasized by the participants. Other Firm pointed out that the sector will develop through legal regulations and, that advancements may happen in employment with new market opportunities.

Overseas use of UAVs is deemed important in terms of safety concerns and goods safety. Moreover, uncertainty about response to issues rising while on flight is another reason of worry. In short term use, safety of life and property come into prominence. However, as safety concerns are dealt with, moving onto unmanned transportation system is seen as the inevitable by all of the companies and, under the

condition of meeting all of the conditions, the three companies which we interviewed state that they would be willing to transport via unmanned aerial vehicles.

To these companies doing international operations it was asked whether they would want to make domestic transportation via UAVs and, all of the asked companies emphasized the necessity of using them in the domestic market in terms of the advantages it brings rather than using them for international operations.

When asked about their expectations about this aircraft when they would want to purchase an unmanned aerial cargo vehicle to be included in their fleet, it is seen that the prominent preference is fuel type, and, more preferably electrically driven ones. High transportation and volume capacity are common opinions as to the reason for preference of the three companies. ACT Airlines expects an advantage of 40% financial profit. Other Firm did not provide with a clear value in terms of their expectation and, an answer couldn’t be got from ULS Airlines.

6. CONCLUSION

James Jordan, HFW Senior Associate, expressed that ‘logistics supply chain is under pressure and the solution is possibly UAVs and LUCA and, integrating unmanned aerial vehicles into the supply chain is one of the most important developments.’ (JORDAN, 2020). The ability of LUCAs direct, faster and safe, fuel efficient flights to places all around the world which have no infrastructure will provide advantages in terms of competition. The ability to transport highly valuable cargoes, with LUCAs which will provide point to point cargo services, will create added-value in the logistics industry (Collins, 2017, p. 28). Splitting posts which arrive at facilities and sending them out for deliveries via UAVs capable of delivering posts and, providing point to point delivery services, may provide benefits in logistics chain. However, increasing privacy and safety concerns in heavily populated cities are the biggest set backs of this concrete idea. When these setbacks are eliminated, the possibility of providing faster deliveries via UAVs to rural areas, where there is a lack of infrastructure, will improve service quality. As to coming over access problems in developing countries through UAVs, as it will provide an alternative to infrastructure costs, it will accelerate economic development (DHL, 2014, p. 16).

UAVs ability of flight under pressured air space at speeds optimised for environment friendly turboprop engines and, the requirement to fly back to the main base for the purpose of maintenance only, as there isn’t a crew, will reduce the ground stop duration of airplanes. As they don’t require containers constrained by UCA, by providing 10% to 20% of weight reduction on airplanes’ unloaded weight higher fuel efficiency will be made. The best decision will be providing direct flights via medium-size UVAs which have 5-20 tonnes of transportation capacity. Because, both

the production cost of unmanned aerial vehicles which can compete against big airplanes will be high and, they will struggle to compete against UCAs' traditional passenger airplanes at this size transporting on the body weight (van de Ven, NLD AF, & JAPCC, 2014).

When electronic airplanes' flight range and load capacities, developments in BVLOS operations and batteries, help for LUCA's improvement of trade opportunities are considered, LUCAs, which are fuelled with jet fuel in short term, may be a better alternative in terms of trade (JORDAN, 2020).

For use of military operations, projects related to UAVs are carried out by Baykar and, majority of the developed vehicles are used on current operations by Turkish Armed Forces. Cezeri, which is a flying car that has a flight system supported by artificial intelligence, is still under the phase of trials, and, successfully completed its first test flight. However, passenger UAVs create a sense of negativity in terms of public safety. In this sense, LUCA will act as a testbed. Aerial cargo vehicles', which are developed for cargo operations before passenger operations, successful integration to the logistics system and air traffic will be an important step to remove the negative perception on the society. When the aviation history is carefully analysed, it can be seen that airplanes were used in army before commercial activities and, after the wars were over, with their integration to the civilian life the benefits provided can be seen. When it comes the way UAVs are used, it can be seen they were primarily used in military operations. Speedy developments in technology and, faster and easier access to information will make people think that UAVs' use for trade purposes isn't going to take as long as their integration to the commercial life from the time airplanes are

first manufactured. However, the biggest barrier stopping this from happening is, when compared to the areas used in military, it has a smaller area of usage in civil air space. One of the most important enterprises to improve civil operations is the integration of UAS to the unrestricted air space. Turkey's unmanned aircraft systems production and leading position in the development of technology is an important step for the integration into civilian life. Developing UAV sector with the successes achieved in the area of Turkey's military, UCA projects are considered to be in a more advantageous position in the implementation of its competitors.

Financial and regulatory support in drone industry will create opportunities which will widen the use of drone technologies in transportation sector by accelerating its development. However, especially safety and privacy issues need to be solved (Erceg, Erceg, & Vasilj, 2017).

While it looks like it is inevitable through the interview results in scope of the research, observations and information obtained through source materials, for UAVs to get a foothold in the logistics system, it is understood that the companies providing air transportation services in Turkey need more time to get involved in this transportation system. The fact that it isn’t yet started to be used widely around the world, inadequacies in legal regulations, privacy and security concerns result in uncertainty. However, it is observed that when all the developments are evaluated, these firms thanks to the success of the unmanned combat aircraft in Turkey will be as a pioneer in the field UCA use.

REFERENCES

Abeyratne, R. (2018). *Law and Regulation of Air Cargo.* Switzerland: Springer Nature.

ACT Airlines. (2020). *About us*. Retrieved May 25, 2020, from ACT Airlines website: http://www.actairlines.com/

AIA-Avascent. (2018, March). *Large Unmanned Systems and the Next Major Shift in Aviation.* Retrieved May 29, 2020, from https://www.aia-aerospace.org/wp-content/uploads/2018/02/AIA_Think_Bigger_UAS_Paper_02212018_on_screen_viewing-1.pdf

Air Cargo News. (2019). *Air Cargo News*. Retrieved MAY 07, 2020, from Top 25 cargo airlines 2019: https://www.aircargonews.net/data-hub/top-25-cargo-airlines-2019/

Alcock, C. (2020, Sep 17). *Boeing NeXt To Close, Raising Doubts over eVTOL Activities*. Retrieved Oct 10, 2020, from www.evtol.com: https://www.ainonline.com/aviation-news/business-aviation/2020-09-17/boeing-next-close-raising-doubts-over-evtol-activities

Alcock, C. (2020, July 28). *Sabrewing Aims To Start Flight Tests for Rhaegal eVTOLs*. Retrieved Oct 11, 2020, from Ainonline website: https://www.ainonline.com/aviation-news/defense/2020-07-28/sabrewing-aims-start-flight-tests-rhaegal-evtols

Angel. (2020). *Natilus drones*. Retrieved July 06, 2020, from https://angel.co/company/natilus-drones

Austin, R. (2010). *Unmanned Aircraft Systems; UAV Design, Development and Deployment.* Wiltshire: John Wiley & Sons Ltd.

BALL, M. (2020). *Cargo UAV Delivery Service Launched for Humanitarian Relief*. Retrieved Oct 19, 2020, from Unmanned System Technology website: https://www.unmannedsystemstechnology.com/2020/04/cargo-uav-delivery-service-launched-for-humanitarian-relief/

Bartsc, R., Coyne, J., & Gray, K. (2017). *Drones in Society; Exploring the strange new world of unmanned aircraft.* New York: Routledge.

Battal, Ü. (2016). Hava Kargo Pazarının Gelişimini Etkileyen Faktörler. In A. Yalçınkaya, İ. P. Sesliokuyucu, Ö. Altuntaş, Ü. Battal, A. E. Sarılgan, & A. E. Sarılgan (Ed.), *HAVA KARGO VE TEHLİKELİ MADDELER* (pp. 64-80). Eskişehir: Anadolu Üniversitesi.

Baykal, O. (2013). Dünyada ve Türkiye'de Hava Postası Taşımacılığı. www.airkule.com(13 Aug 2020).

Baykar. (2020). *Bayraktar Akıncı.* Retrieved Oct 31, 2020, from Baykar Savunma website: https://www.baykarsavunma.com/upload/ingilizce/akinci_eng_brosur-min.pdf

Baykar Savunma. (2020). *https://www.baykarsavunma.com/tarihce.html*. Retrieved Oct 31, 2020, from Baykar Savunma Website: https://www.baykarsavunma.com/tarihce.html

Blom, J. D. (2010). *Unmanned Aerial Systems: A Historical Perspective (Occasional paper ; 37).* Kansas: Combat Studies Institute Press .

Boeing. (2018). *World Air Cargo Forecast 2017-2037.* Boeing Commercial Airplanes. Seattle: www.boeing.com/commercial/market/cargo-forecast. Retrieved MAY 30, 2020, from Boeing: http://www.boeing.com/resources/boeingdotcom/commercial/about-our-market/cargo-market-detail-wacf/download-report/assets/pdfs/2018_WACF.pdf

Boeing. (2019, May 02). *Watch: Cargo Air Vehicle Completes First Outdoor Flight*. Retrieved Aug 26, 2020, from Boeing website: https://www.boeing.com/features/2019/05/cav-first-flight-05-19.page

Chalupníčková, H., Bahenský, P., Sýkora, V., & Heralová, D. (2014). The Use of Drones in Air Cargo Transportation. *eXclusive e-JOURNAL ECONOMY & SOCIETY & ENVIRONMENT, ISSN: 1339-4509 (Online)*.

Civil and Military Drones;Navigating a disruptive and dynamic. (2019). In E. P. Service. European Parliament.

Collins, M. P. (2017). *The Future Market For Large Unmanned Cargo Aircraft in the National Airpace System.* Lewis University: Master Thesis.

Cook, G. N., & Billig, B. G. (2017). *Airline Operations and Management.* New York: Routledge.

Dauer, J. C., Lorenz, S., & Dittrich, J. C. (2016). *Automated Low Altitude Air Delivery.* Retrieved DEC 1, 2020, from www.dglr.de: https://www.dglr.de/publikationen/2017/420129.pdf

DHL. (2014). *UNMANNED AERIAL VEHICLE IN LOGISTICS A DHL perspective on implications and use cases for the logistics industry.* Troisdorf: DHL .

DLR. (2019, Aug 02). *Vision of a drone - automated low altitude air delivery (ALAADy)*. Retrieved May 19, 2020, from DLR website: https://www.dlr.de/content/en/videos/2019/vision-einer-transportdrohne_automated-low-altitude-air-delivery-ALAADy.html

DLR. (2020). *National experimental test center for unmanned aircraft systems*. Retrieved May 29, 2020, from DLR website: https://www.dlr.de/content/en/institutes/national-experimental-test-center-for-unmanned-aircraft-systems.html

Dronamics. (2020). *About us.* Retrieved Oct 20, 2020, from Dronamics website: https://www.dronamics.com/

EASA. (2019, July 02). *Special Condition for small-category VTOL aircraft*. Retrieved May 18, 2020, from European Informaton Safety Agency website: https://www.easa.europa.eu/sites/default/files/dfu/SC-VTOL-01.pdf

Elroyair. (2020, OCT 10). *About Us*. Retrieved from https://www.elroyair.com/

Erceg, A., Erceg, B. C., & Vasilj, A. (2017). UNMANNED AIRCRAFT SYSTEMS IN LOGISTICS LEGAL REGULATION AND WORLDWIDE EXAMPLES

TOWARD USE IN CROATIA. Osijek, Croatia: 17. international scientifi conference Bussiness Logistics in Modern Management October 12-13, 2017.

European Parliament . (2019). *Briefing.* Civil and military drones. European Parliament Research Service. Retrieved June 08, 2020, from https://www.europarl.europa.eu/RegData/etudes/BRIE/2019/642230/EPRS_BRI(2019)642230_EN.pdf

Evtol. (2020). *Boeing cargo air vehicle accident*. Retrieved Oct 10, 2020, from www.evtol.com: https://evtol.com/news/ntsb-boeing-cargo-air-vehicle-accident/&prev=search&pto=aue

Federal Register. (2015). *DOT, Part III Vol.80 No:35.* www.federalregister.com (11.05.2020).

Feng, B., Li, Y., & Shen, Z.-J. M. (2015). Air cargo operations: Literature review and comparison with practices. *Transportation Research Part C 56*, 263-280.

FIATA. (2019). *The FIATA Reference Handbook.* https://fiata.com/fileadmin/user_upload/documents/Diverses/FIATA_Reference_Handbook_-_November_2019_05.12.2019.pdf (06 May 2020).

GlobeNewswire. (2020). *Sabrewing Aircraft Company Announces an Exclusive Representation Deal and Over $600 Million Dollars In Orders with Arabian Development & Marketing Company In Saudi Arabia*. Retrieved Oct 11, 2020, from GlobeNevswire website: https://www.globenewswire.com/news-release/2020/09/29/2100574/0/en/Sabrewing-Aircraft-Company-Announces-an-Exclusive-Representation-Deal-and-Over-600-Million-Dollars-In-Orders-with-Arabian-Development-Marketing-Company-In-Saudi-Arabia.html

Groningen, R. V. (2017). Cost Benefit Analysis Unmanned Cargo Aircraft: Case Study Stuttgart-Master's Thesis, Erasmus University Rotterdam. Urumqi/Shenzhen: Erasmus University Rotterdam. Retrieved MAY 2020, from https://www.platformuca.org/wp-content/uploads/2017/01/Groningen2017-Business-case-UCA-China-Europe.pdf

HADER, M., & BAUR, S. (2020, Feb 19). *The future of parcel delivery*. Retrieved June 30, 2020, from Rolandberger website: https://www.rolandberger.com/en/Point-of-View/Cargo-drones-The-future-of-parcel-delivery.html

Hasan, Y. J., Sachs, F., & Dauer, J. C. (2018). Preliminary design study for a future unmanned cargo aircraft configuration. *CEAS Aeronautical Journal https://doi.org/10.1007/s13272-018-0309-0*.

HAWKINS, A. J. (2019, Aug 28). *Elroy Air's massive cargo drone completes its first test flight*. Retrieved Aug 25, 2020, from The Verge website: https://www.theverge.com/2019/8/28/20812547/elroy-air-cargo-drone-delivery-test-flight-camp-roberts-san-francisco

Hodgkinson, D., & Johnston, R. (2018). *Aviation Law and Drones; Unmanned Aircraft and the Future of Aviation.* New York: Routledge.

Hoeben, J. (2014). *A Value Analysis of Unmanned Aircraft Operation for the Transport High-Time-Value Cargo (Master Thesis).* the Netherlands: Delf University of Technology.

Hoeben, J. (2014). *A value analysis of unmanned aircraft operations for the transport of high time-value cargo.* Netherlands: Delft University of Technology.

IATA. (2005). *International Air Transport Association Annual Report 2005.* Tokyo: https://www.iata.org/en/publications/annual-review/ (18 May 2020).

ICAO. (2011). *Unmanned Aircraft Systems (UAS)*. Retrieved July 3, 2020, from ICAO website: https://www.icao.int/meetings/uas/documents/circular%20328_en.pdf

ICAO. (2015). *Manual on Remotely Piloted Aircraft System (RPAS).* Retrieved May 15, 2020, from ICAO website: https://www.icao.int/MID/Documents/2015/AFI-MID%20ASBU%20Impl.%20Workshop/4.2-2%20%20RPAS.pdf

ICAO. (2018). *ICAO*. Retrieved MAY 07, 2020, from ICAO website: https://www.icao.int/annual-report-2018/Pages/the-world-of-air-transport-in-2018.aspx

ICAO. (2020, MAY 06). *ICAO*. Retrieved MAY 06, 2020, from ICAO website: https://www.icao.int/about-icao/Pages/default.aspx

Insurance Informaion Institute. (2020). *Facts + Statistics: Aviation and drones*. Retrieved May 18, 2020, from Insurance Informaion Institute website: https://www.iii.org/fact-statistic/facts-statistics-aviation-and-drones

International Airport Review. (2020). *Why we need an unmanned aircraft traffic management system for drones*. Retrieved July 05, 2020, from International Airport Review website: https://www.internationalairportreview.com/whitepaper/111865/why-we-need-an-unmanned-aircraft-traffic-management-system-for-drones/

JORDAN, J. (2020). *Large unmanned cargo aircraft set to take off, despite regulatory challenges*. Retrieved May 29, 2020, from Aircargo News: https://www.aircargonews.net/airlines/freighter-operator/large-unmanned-cargo-aircraft-set-to-take-off-despite-regulatory-challenges/

Kasilingam, R. (1996). Air cargo revenue management: Characteristics and complexities . *European Journal of Operational Research (96)* , 36-44.

KATOCH, P. (2020, Sep 19). *Aircraft Drones*. Retrieved Oct 15, 2020, from http://www.spsmai.com/experts-speak/?id=902&q=Aircraft-Drones

Kökçü, A. A. (2020). *Bayraktar: "AKINCI Taarruzi İnsansız Hava Aracı'nda 6 yapay zeka bilgisayarı bulunacak".* Retrieved Nov 04, 2020, from Defenceturk website: https://www.defenceturk.net/baykar-teknik-muduru-selcuk-bayraktar-akinci-tiha-hakkinda-aciklamalarda-bulundu

Mackenzie, D. (2010). *ICAO; A History of the International Civil Aviation Organization.* Toronto: University of Toronto Press Incorporated .

MEGEP. (2007). *Havayolu Taşımaılığında Kargo Türleri.* Retrieved MAY 08, 2020, from http://havakargoturkiye.com/App_FileUpload/Files/Databank_gt6Km_meb.pdf

MEGEP. (2011). *Ulaştırma Hizmetleri Alanı; Havayolu Taşımacılığı 840UH0122.* Ankara: T.C Milli Eğitim Bakanlığı.

Mng Airlines. (2020). *About us*. Retrieved May 25, 2020, from MNG Airlnes website: https://www.mngairlines.com/tr/kurumsal#tarihce-profil

Monash University. (2003). Remote Piloted Aerial Vehicles : An Anthology. http://www.ctie.monash.edu/hargrave/rpav_home.html#Beginnings (26 AUG 2020).

Morrel, P. S. (2011). *Moving Boxes By Air: The Economics Of International Air Cargo.* Surrey: Ashgate Publishing Limited.

MURISON, M. (2019, Aug 28). *Elroy Air's Chaparral Drone Aims to Fly 250 lbs of Cargo 300 Miles*. Retrieved Aug 05, 2020, from Dronlife website: https://dronelife.com/2019/08/28/elroy-air-chaparral-drone-logistics/

Navaldrones. (2020). *AACUS*. Retrieved May 28, 2020, from Naval Drones website: http://www.navaldrones.com/AACUS.html

O'Connor, W. E. (2001). *An introduction to airline economics.* London: Praeger Publishers.

Sadraey, M. H. (2020). *Design of Unmanned Aerial Systems ISBN 9781119508694 (adobe pdf)*. Hoboken: John Wiley & Sons Ltd.

Sales, M. (2016). *Aviation Logistics: The Dynamic Partnership Of Air Freight And Supply Chain.* London: Kogan Page Limited.

Sarılgan, A. E., & Yalçınkaya, A. (2016). *Hava Kargo ve Tehlikeli Maddeler.* Eskişehir: Anadolu University.

SF UAS. (2020). *Perspectives and Suggestions of UAV in Logistics.* Retrieved Oct 12, 2020, from ICAO website: https://www.icao.int/Meetings/RPAS3/Documents/Presentations/2.2.3%20Li.pdf

SHGM. (2008). *SHGM.* Retrieved MAY 06, 2020, from SHGM Website: http://web.shgm.gov.tr/tr/genel-duyurular/1088-hava-yoluyla-uluslararasi-tasimaciliga-iliskin-belirli-kurallarin-birlestirilmesine-dair-sozlesme-montreal-sozlesmesi-hakkinda

SHGM. (2014). Faaliyet Raporu. Sivil Havacılık Genel Müdürlüğü.

SHGM. (2015). Faaliyet Raporu. Sivil Havacılık Genel Müdürlüğü.

SHGM. (2015). *Harekat.* Retrieved MAY 07, 2020, from http://web.shgm.gov.tr/documents/sivilhavacilik/files/pdf/kurumsal/yayinlar/HAREKAT_Kitabi.pdf

SHGM. (2015). *Kargo Hizmetleri.* Retrieved MAY 07, 2020, from http://web.shgm.gov.tr/documents/sivilhavacilik/files/pdf/kurumsal/yayinlar/Kargo_Hizmetleri.pdf

SHGM. (2016). Faaliyet Raporu. Sivil Havacılık Genel Müdürlüğü.

SHGM. (2017). Faaliyet Raporu. Sivil Havacılık Genel Müdürlüğü.

SHGM. (2018). Faaliyet Raporu. Sivil Havacılık Genel Müdürlüğü.

SHGM. (2019). Faaliyet Raporu. Sivil Havacılık Genel Müdürlüğü.

Theloadstar. (2019, June 19). *Dronamics' Black Swan could be set for take-off next year*. Retrieved Oct 22, 2020, from The Load Star website: https://theloadstar.com/dronamics-black-swan-could-be-set-for-take-off-next-year/

TIACA. (2020, MAY 06). *TIACA*. Retrieved MAY 06, 2020, from TIACA website: https://www.icao.int/about-icao/Pages/default.aspx

Transmetrics. (2020). *The evolution of delivery drones in logistics*. Retrieved June 30, 2020, from Transmetrics website: https://transmetrics.eu/blog/delivery-drones-logistics/

Turkish Cargo. (2020). *About us*. Retrieved May 25, 2020, from Turkish Cargo website: https://www.turkishcargo.com.tr/tr/hakkimizda/turkish-cargo-hakkinda

Valavanis, K. P., & Kontitsis, M. (2007). A Historical Perspective on Unmanned Aerial Vehicles. In K. P. Valavanis, *Advances in Unmanned Aerial Vehicles;State of the Art and the Road to Autonomy* (pp. 15-46). Dordrecht: Springer.

van de Ven, L. C., NLD AF, & JAPCC. (2014). Unmanned Cargo Aircraft;A Paradigm Shift for Theatre and Tactical Level Logistics in Asymmetric Conflicts? In *The Journal of the JAPPC Edition 19, Autumn / Winter 2014* (pp. 73-77). https://www.japcc.org/wp-content/uploads/JAPCC_Journal_Ed-19_web.pdf (17 May 2020).

Wensveen, J. G. (2007). *Air Transportation: A management perspective.* Hampshire: Ashgate Publishing Limited.

Wikipedia. (2020). *Delivery drone*. Retrieved June 30, 2020, from Wikipedia website: https://en.wikipedia.org/wiki/Delivery_drone

Wikipedia. (2020). *Elroy air*. Retrieved July 08, 2020, from Wikipedia website: https://en.wikipedia.org/wiki/Elroy_Air_Chaparral

Wikipedia. (2020). *Natilus*. Retrieved July 05, 2020, from Wikipedia website: https://en.wikipedia.org/wiki/Natilus

Wikipedia. (2020). *Türk Hava Yolları*. Retrieved May 25, 2020, from Wikipedia website: https://tr.wikipedia.org/wiki/T%C3%BCrk_Hava_Yollar%C4%B1#:~:text=Kurulu%C5%9Fu%2020%20May%C4%B1s%201933%20tarihine,u%C3%A7u%C5%9Fu%20olan%20Atina%20hatt%C4%B1nda%20ta%C5%9F%C4%B1d%C4%B1.

Wikipedia. (2020). *ULS Airlines*. Retrieved May 25, 2020, from Wikipedia website: https://tr.wikipedia.org/wiki/ULS_Hava_Yollar%C4%B1

WOODS, R. (2020). *Drone-maker Natilus completes prototype taxi tests, releases images.* Retrieved July 06, 2020, from Aircargo World website:

https://aircargoworld.com/news/equipment/aircraft/drone-maker-natilus-completes-prototype-taxi-tests-releases-images/

Yateselectrospace. (2020). *About us*. Retrieved Oct 15, 2020, from Yates Electrospace Corporation website: https://yateselectrospace.com/about-%2F-contact-us

Zhang, A., & Zhang, Y. (2002). A model of air cargo liberalization: passenger vs. all-cargo carriers. *Transportation Research Part E (38)*, 175-191.