



# Master's degree thesis

**LOG950 Logistics**

**Future Potential Usage of Cargo Airplane the AN 225  
(Mriya) For Logistics Operations**

Viktor Kornienko

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# Preface

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Molde, May 2013

Viktor Kornienko

## Summary

In 1988 Antonov Design Bureau manufactured the world's giant the AN 225 – the largest cargo aircraft. Initially it was meant to carry Buran space ship and the AN 225 was planned to be used in aerospace industry of the USSR. After the collapse of the country, the aircraft remained unused for many years. As logistics was developing very rapidly, Antonov airlines turned their look toward the market economy. The AN 225 was upgraded in 2001 and was ready to operate.

Taking into consideration that the AN 225 is still the largest machine in the world, the purpose of this thesis therefor is to study the future potential of the AN 225 in logistics operation by performing SWOT analyses and conducting interviews with Antonov Company employees. The research describes different modes of transport and emphasizes air cargo industry influence on situation of usage cargo aircrafts, including the AN 225.

Based on interviews and SWOT analyses it is clear that there is a low demand and low level of suitable cargo even for one AN 225. There are not enough suitable infrastructures for accommodating the aircraft. Because of these negative factors the plane isn't attractive for potential customers. From another hand there are a lot of commodities shipped by air, but it is not profitable to use the AN 225 for major part of this range of commodities. To change this situation globally, the machine must be redesigned and modernized. This is impossible due to financial absence as Ukrainian government is not ready to subsidize such projects. For realization of modernization project investors could be involved but there are many factors which hinder to do so. Thus, the future potential usage of the AN 225 in logistics operations is not perspective and in near future the only aircraft will exist and will operate at the same regime.

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# Abbreviations

ACMI	Aircraft, Crew, Maintenance and Insurance
AN	Antonov
CIS	Commonwealth of Independent States
DHL	Dabsey, Hillblom, Lynn (surnames founders of DHL)
FedEx	Federal Express
IAG	International Airlines Group
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
JIT	Just-in-Time
UPS	United Parcel Service
Kg	Kilogram
KLM	Koninklijke Luchtvaart Maatschappij
Km	Kilometer
PC	Personal Computer
RTK	Revenue per Ton Kilometer
SWOT	Strengths, Weaknesses, Opportunities and Threats
TNT	Thomas Nationwide Transport, integrator wholly owned by TNT Post Group
USSR	The Union of Soviet Socialist Republics
USA	The United States of America
V.I.P	Very Important Person

# 1 Introduction

This chapter's aim is to highlight the background of the theme, the area and purpose of the study. In addition, there will be described research design methods and data collection types emphasizing the ones used in the research process. Limitation, terminology and research structure are presented in this chapter as well.

## 1.1 Background

The 21st century is the era of the oil and gas industry. Many countries have discovered new fields each year and all this leads to a huge oil and gas production development. Nowadays, this industry is quite developed and equipment is very important for oil and gas exploration, extraction and development. A familiar situation occurs when a piece of equipment is damaged or cracked, what should the company do when this spare part is very large in size and needed as soon as possible? Without it, the whole production may need to be stopped and financial losses may be counted each minute. Delivering it by sea or train can take from weeks to months. More and more exploration is done in various parts of the world such as the African continent, Arctic and Antarctic as well as oceans which are often very far away from the factories and plants that produce the spare parts. In addition, equipment, pipes and diving complexes need to be transported and people working for such an industry need mobile houses to be delivered to live in while on the project and transport to use on the onshore bases.

Besides the oil and gas industry, there are industries which also demand heavy cargo transportation. Among them is the transport industry which delivers cars, trucks, trains and subway wagons from one part of a continent to another. The aerospace industry transports rocket boosters, space vehicles, and engines from factories and plants to spaceports. The coal mining industry needs mining complexes to be moved to places specific locations where mines are situated. Nuclear power plants in case of emergency need reactors and sarcophaguses to be delivered immediately. The construction industry building massive complexes for such events like the Olympics Games or World Football championships move large components from one country to another. The military

requires the transportation of tanks and other heavy military supplies. Humanitarian aid and relief must organize quick delivery of needed equipment to sort out the ruins in settlements and bring water, medications and food to those who suffered after the earthquake in Haiti, the tsunami in Thailand or tornado storm in the USA to list a few examples. If first aid does not come quickly in these disaster situations, there will be an even more devastating loss of human lives.

Everything listed above gives a big challenge for logistics operators who work with heavy cargo transportation. To fulfill the challenges and tasks described above logistics operators had to use trains and sea around 50 years ago. Nowadays these challenges can be met by cargo airplanes, and one of them is the AN 225.

Among all cargo aircrafts in the world, the AN 225 is the largest freighter despite recent appearance of Airbus 380. This air freighter can lift to the sky cargo weighing of 250 tons and fly long distances (15000 km) without refueling, leaving far behind such well-known aircrafts as Boeing and Airbus. The AN 225 is able to place cargo inside the fuselage 42 meters in length, 6.4 meters in width and 4.4 meters in height. The cargo volume of this unique aircraft is 1,300 m<sup>3</sup>. In order to take on board a heavy single piece of cargo, it has a unique function which is called a kneeling position. In this position the cargo floor is low enough for long goods to be loaded and unloaded safely and quickly. In addition to that this machine has tail and nose hatches, cargo ramp, board cranes and winches which give the opportunity to handle heavy and oversized cargo without ground handling equipment. Moreover the AN 225 can be “safely operated from/to all types of airfields with unpaved, shingle, ice, or other runway surfaces” according to Antonov Design Bureau. ([www.antonov.com](http://www.antonov.com)). Looking at more detailed specifications shown in Table 1.1, we can easily agree that the AN 225 is a unique implement of transportation which can be called as a “king” of cargo planes. ([www.antonov.com](http://www.antonov.com))

Table 1.1: Aircraft Technical Specifications



The image shows an Antonov AN-225 aircraft on a tarmac. The aircraft is white with blue and yellow accents. It has four engines and a high-wing configuration. The tail number 'UR-225' is visible on the fuselage.

<b>External Characteristics</b>	
➤ Overall aircraft length	84m
➤ Wingspan	88m
➤ Max aircraft height	18m
<b>Internal Characteristics</b>	
➤ Cargo compartment length	43m
➤ Cargo compartment width	6.4m
➤ Cargo compartment height	4.4m
<b>Weights</b>	
➤ Maximum take-off weight	650 tonnes
➤ Maximum landing weight	550 tonnes
➤ Aircraft empty weight	285 tonnes
➤ Maximum payload	250 tonnes

Source: Antonov Airlines

## 1.2 Purpose of the Study

The author of this research paper pursues two major purposes. The first one is to give science-based understanding why such a unique giant as the AN 225 is not widely used in logistics operations and to investigate the future external and internal opportunities which can lead to drawing attention of potential users and customers.

The research related to the air transportation industry of post USSR countries made by non-Slovak academics can hardly be found. Thus, the second purpose is to draw the attention of academics for further research in the field which has not been studied outside of Eastern European countries. It is hoped that this master thesis will be able to show that such countries as Ukraine and Russia have huge potential in this industry and many topics for further research.

## 1.3 Study Questions

According to Bryman (2007), for the research process it is essential to put the research questions.

The aim of this research is to investigate the future potential usage of cargo airplane the AN 225 (Mriya) for logistics operations. In order to come to the right conclusion theoretical and practical studies must be conducted. For this purpose the following research questions can be asked under the subject:

- What is the current situation of the AN 225 usage for commercial purposes by Antonov Airlines?
- What hinders the AN 225 to be used on full capacity by Antonov Airlines?
- What can lead to the appearance of the second brand new AN 225?
- Who can be interested in purchasing the AN 225?
- Why has no other carrier ever had the AN 225 in its fleet and are there prerequisites for this?
- What is made and what can be made for the AN 225 to be used more often in commercial activities?

Secondary data is data already gathered, not by the researcher. In the case of this thesis, secondary data is obtained from different sources; such as books, journals, annual forecasts and reports, articles, research papers and official websites of airplane design bureaus and airlines.

#### **1.4 Organization of the Thesis**

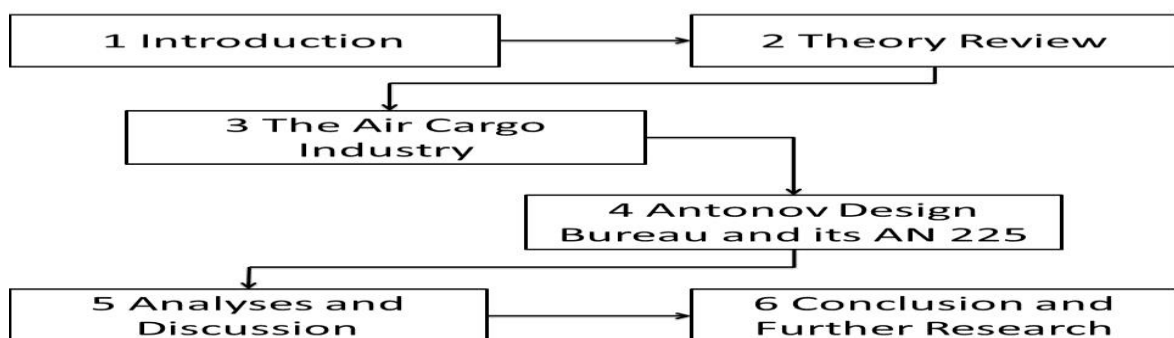
The thesis consists of 6 parts and is structured in the following way:

- Part 1: Introduction  
This part shows the background of the study, defines research questions and methods, data collection approaches.
- Part 2: Theory review  
This part of the research paper highlights theoretical background of development of logistics, its notion. Transport logistics were observed as an important branch and the modes of transport were described.

- **Part 3: The air cargo industry**  
One of the modes described in part 2 was air. Hence, the air cargo industry was taken into consideration. The author looked at historical development of this industry and ended up with freight traffic trends; specified the commodities carried by air and major players in cargo transportation by air. Two forecasts presented by Airbus and Boeing companies were analyzed in order to see the future situation in air cargo business area.
- **Part 4: Antonov Design Bureau**  
Review of part 3 shows the future development of air cargo industry. In part 4 Antonov Design Bureau was examined as it is a big manufacturer with a long history on post-USSR territory. All the main aircrafts produced by Antonov Design Bureau were described in this part and the AN 225 was emphasized as it is the largest cargo aircraft in the world and it is the object of this research.
- **Part 5: Analysis and discussion**  
Analysis of the data obtained during the conducted interviews was done. In addition to that, a SWOT analysis was performed and discussions of the result are included in this part.
- **Part 6: Conclusion**  
Summing up the findings, theory is reviewed in parts 2 and 3, in order to answer the main question of the research. Suggestions, directions and advices regarding further research are presented in part 6 as well.

The whole structure is visually presented in Figure 1.1.

Figure 1.1: The Body of the Thesis



## 1.5 Limitation

There are few limitations to underline. One of the main limits is that the interviews were conducted only with employees of Antonov Company which owns the AN 255. To have a broader picture it would be advisable to conduct the interview with some all-cargo carriers such as Volga Dnepr or Cargolux which are involved in transportation of outsize and heavy freight. The vision of the problem and their point of view on future potential of the AN 225 in commercial operations could give additional material to discuss that could lead to a different conclusion. Additionally it would be needed to get opinions from other aircraft manufacturers in order to understand why their aircraft are used widely but the AN 225 is not. Also it would be beneficial to get in touch with airports and regulators in order to find if there are any 'mouse traps' in future which will make it difficult or impossible for carriers to use the AN 225.

## **2** Theory review

### **2.1 Introduction**

There are several theories which can be applied in this research paper. Since the research of this paper is focused on the usage of the airplane in logistics operation, a logistics theory will be studied in this chapter. Transport logistics will be taken into consideration in order to show the advantages and disadvantages of air shipping among the other modes of transportation. As required, in the main part of the research will be explained some a theory related to the air freight industry.

### **2.2 Logistics, its Definition and Development**

Logistics as a science is considered to be a new study which is in the process of development but it is interesting that a word “logistics” (from Greek *logistike* – counting skills) comes from the Roman Empire times. There were special officers called *Logistikas* who were responsible for food distribution. Logistics gained recognition as a science due to military affairs (Кальченко 2003). During the rule of Byzantine emperor Leo IV logistics were tasked with the supply of military equipment, timely care of the needs of the army and planning of each act of a military campaign. Talented officers always knew that the key role in victory was ammunition, food, fuel at the right time and the right place. Looking at the history it is clear that even the most ambitious war was won or lost depending on the organization of the troops and supplies. Genghis Khan and his sons conquered almost the entire Old World, and the secret of their war strategies was due to the right logistics approach (Түлембаева 2008).

During the Second World War logistics principles were implemented successfully when the United States, the Soviet Union and other countries studied operations related to the management of material flows. During this period, a study dealt with issues of military supply and logistics front, and with mathematical methods and models, which eventually became known as ‘operations research’.

The first author to write a paper on logistics was a French military specialist of the early twentieth century Antoine-Henri Jomini, entitled “Summary of the Art of War” (1838). He defined logistics as "the practical art movement of troops." However, Jomini argued that



logistics is not only for means of transportation, but it also covers a wide range of other areas as planning, management, and delivery, location of the troops' deployment, and the building of bridges and roads, among others (Кальченко 2003).

Tulembaeva (2008) distinguishes several stages of development of logistics in the XX century:

1. 1920s – 1950s, the time when only separate functions of logistics were considered to be important from the viewpoint of cost cutting.

2. 1950s – 1970s, a period of the conceptualization of logistics. The accelerated development of the logistics industry in that period was due to the following factors:

- Oligopolistic markets development
- Progress of computer technologies
- The pressure on production costs
- Influence of military experience
- Energy crises.

3. 1980s – 1990s, a rising period of logistics. The following world economy changes led to such an uplift:

- The spread of logistics concepts and philosophies, such as “Just-in-time”, total quality management and lean thinking
- Market globalization
- The information technology revolution and PC implementation
- Structural changes in business organization
- Growth of international partnership (Түлембаева 2008).

For the last two decades logistics, as a term, has spread all over the world due to mass media sources, such as radio, television, and paper advertisements. Many companies in the transport business known worldwide, such as FedEx, UPS, DHL and dozens of others,

claim they are successful and profitable logistics operators. The term 'logistics' can be heard and seen everywhere, but there is no standard definition of it (Gibson and Novak 2009).

There are many different views, as well as many authors, regarding the term of logistics. Its definition can be in terms of economy, philosophy and military. Referring to logistics in the economic or business sphere, Kasilingam (1998) states that "Logistics represents a collection of activities that ensure the availability of the right products in the right quantity to the right customer at the right time" (Kasilingam 1998, 1).

### **2.3 Logistics and its Three Main Fields**

According to Kalchenko (2003), there are two levels of logistics: macrologistics and micrologistics. The task of macrologistics is consideration of the global problems of information and material processes. Micrologistics examine the local issues of material and information flows at the internal level of a factory (Кальченко 2003). This is divided into 3 kinds: production logistics, distribution logistics and procurement logistics.

Procurement logistics is the activity of managing material flows in the supply of the enterprise by material resources: raw materials, materials, components, products. It organizes all the activities associated with obtaining the material resources and services from suppliers: purchase, delivery, acceptance, temporary storage, and so on. The objective of the procurement logistics is to create a reliable supply of materials to the organization with the maximum possible economic efficiency (Алесинская 2009).

Production logistics is material flow management at the stage of passing of material flow through the production units (Алесинская 2009). Among the main objectives of production logistics are the following:

- developing plans and schedules of work assignments for workshops and other production units;
- planning and dispatching of production based on forecast demand for finished products and customer orders;
- determining the standards of work in progress and monitoring this;
- monitoring the quantity and quality of finished products;

- participating in the development and implementation of production innovation;
- monitoring finished product cost;
- operational management of production and organization of the production targets (Алесинская 2009).

Distribution logistics is a set of interrelated functions realized in the distribution of material flow between the different wholesale customers (Гаджинский 1999). The objectives of distribution logistics are:

- planning the process of goods realization;
- organization of order receiving and processing;
- selection of packing type;
- product shipment organization;
- organization of delivery and transportation control;
- after-sales service organization;
- choice of the scheme of material flow distribution;
- choice of the optimal number and location of warehouses (Алесинская 2009).

Macrologistics includes logistics processes between companies, transportation and warehouse workers (Алесинская 2009). Transport logistics will be described more detailed in the next paragraph of this chapter.

## 2.4 Transport Logistics and Modes

People look at the transport system as one that moves freight from point A to point B. Transport logistics started its development widely in the 1990s and became more important for business structures after serious juridical changes in its sphere (Button 2009). Transport logistics is to choose the vehicle type, and plan the transport process together with warehouse and production sides, to define the rational delivery routes (Миротина 1996). In logistics the transportation accounts for 40-60% of costs and the transportation system is the main unit in the logistics chain (Tseng, Yue and Taylor 2005).

Different ways of moving goods from one point to another is called transportation modes (Farahani, Rezapour and Kardar 2008). There are five main transportation modes: rail, road, water, air and pipe. The preference of mode depends on distance, costs, handling, flexibility and speed (Davidsson, Henesey and Ramstedt 2005).

Rail is considered to be the second main mode in many countries all around the globe, but there are some countries, such as Australia and China, where this mode predominates. Despite the fact that the railroad exists in almost each country, it is not very extensive. Rail cannot offer door-to-door service, and accordingly, deliver any freight to the final destination; using rail will involve road, as well. Rail is assumed to not be a very safe mode of transportation and is comparatively slow. However, it is perfectly suitable for transporting different raw materials and goods of a little value. By its cost, it is cheaper to carry goods by rail than by road or air but more expensive than by water (Farahani, Rezapour and Kardar 2008).

Road as a mode of transport is very important inside of any country as well as it is internationally (Rushton, Croucher and Baker 2012). It is the most important mode of transportation in nearly all countries of the world. It is perfect for logistics because it can deliver goods directly to a customer and doesn't need any other transport to be involved. Road transport is considered to be fast and reliable. One more advantage of the mode is that roads lead to the smallest towns and villages. Economically, it is not a very money consuming way to move goods, although it is tied to the fuel prices in each country. The most suitable freight to move by road would be expensive goods or for short distance deliveries (Farahani, Rezapour and Kardar 2008).

Water transport is the slowest among all modes of transport, but at the same time, it is the cheapest one. It serves mostly for international carryings and it is mostly advantageous for those countries which have access to the water (Janat 2009). There are many countries which can use water transport within the country, using rivers, canals and other water. It started to be used for transporting goods long ago and has an impressive history. Today, water transport is ecologically friendly and not as noisy as the other modes ([www.unesco.org/water](http://www.unesco.org/water)). It is the best transport for heavy goods with no rush in delivery (Farahani, Rezapour and Kardar 2008).

Pipeline is a mode of transport meant to be used for specialized commodities. Most moved products by pipeline are natural gas and petroleum (Janat 2009). It is relatively a new mode of transport and it has its advantages and disadvantages. The advantages are its very high speed of delivery, the most cost-effective way to transport oil and gas.

Among the main disadvantages is narrow specialization, frequent accidents due to violations of pipeline safety, theft of non-ferrous metals and risk of accidents such as fires, explosions, pollution of the environment, and a threat to the population (Ленкина 2006).

Air, as a transport mode, is modern compared to water, rail and road. It is the quickest way in goods delivery but it should be noted that delays happen quite often since it depends on weather conditions. As for the costs, it is the most expensive transport because of fuel consumption, maintenance and crew. It is the best way to move high-value commodities, as well as fragile and perishable products. Of course, it is a priceless mode of transport in emergency situations, especially when used for humanitarian aid. The percentage of damages and losses are very low in air transportation and it is considered to be reliable (Farahani, Rezapour and Kardar 2008).

It is well known fact that many different industries rely on air transportation. This mode of transport is essential for those who must ship or deliver products in a quickest way from one continent to another. Today it is hard to imagine the success of certain businesses without air transportation. Airbus states that "...the air cargo industry carried \$ 2.9 trillion in cargo value in 2011" (Airbus 2012, 127). The main tool in air industry is an aircraft. Now the aircraft manufacturing business is developing and each year mega giant appears which can carry dozens and even hundreds of tonnes of cargo. The largest cargo aircraft in the world is the AN 225 which was meant for aerospace industry. As it was written above logistics reached high level of development for the last years and it dictates the trends for aircraft manufacturers in a way. Hence, AN 225 can be a great tool to meet some logistics challenges.

## **2.5 Summary**

Logistics, as a term, is rooted from the Roman Empire, used to call people who were responsible for food distribution. As a science, logistics owes its term to military structure as during the wars good organized supply was needed because the progress of any war depended on supply on time. Logistics in economics is relatively new science and it is still developing, especially in third world countries. Today logistics, counts in many fields and concepts, such as procurement, production, distribution, warehousing and

transportation. Transportation plays one of the most important roles in logistics chain. Above were described five modes of transport, along with their pros and cons. The air transportation plays an important role in logistics despite the fact that it is a very young industry. The AN 225 presents itself as a beneficial tool for logistics business.

## **3 The Air Cargo Industry**

In this stage the overall aim of this chapter is to look at air cargo business. First it describes briefly historical development of air cargo industry. Then the chapter investigates the air freight traffic trends. It also provides information about commodities which carried by air nowadays. Furthermore the chapter provides the most significant groups of key players in this business. In the end it presents long-term forecasts in order to see to future of the industry.

### **3.1 Introduction**

According to Popescu, Keskinocak and Mutawaly (2010) define air cargo as “anything other than persons or personal baggage traveling by air” (Popescu, Keskinocak and Mutawaly 2010, 209). Due to new developments in the aviation industry, almost anything can be transported by air. Today mostly lightweight and high-value commodities are shipped by air such as aircraft and auto parts, machine tools, perishables, computers and electronics, clothes, military and medical equipment. The air cargo industry is relatively new in the freight sector compared to other freight transport industries which existed before. Never the less, it appears to be an integral part of the world’s global economy (Popescu, Keskinocak and Mutawaly 2010).

### **3.2 Short Historical Overview**

The very first carrier for air cargo was air balloons in the 18th century. They were not as quick and reliable as airplanes. After the invention of the airplane, people started to look at the airplane as a means of cargo transportation. On 7th November, 1910 the first air freight shipment was sent by air. It was a special event in the air freight industry. Two bolts of silk with a total weight of 23 kilograms were shipped from Dayton to Columbus, Ohio within 63 minutes. The freight was delivered faster than it could be done by train.

18th of February, the first airmail flight was completed by French pilot Henri Pequet. This flight delivered 6500 letters and postcards from Allahabad to Naini Junction, India. Since that time there were several official airmail flights completed in different countries such

as Italy, Sweden, Denmark, and Egypt. This lasted until the beginning of the First World War in August, 1914.

It may sound sad but the First World War had a tremendous positive impact on the development of aviation. More aircraft were designed and produced during 4 years of war than during 11 years of peaceful time. The warring countries manufactured almost 200, 000 aircraft and 250, 000 engines from 1914 to 1918. Development of the aviation industry during the First World War showed that large bombing planes can be used not just for military purposes but also for transportation of people and cargo. In addition to that, 1916 can be named as the birth of military airmail.

The First World War brought a lot of human and material losses for warring countries. The cities which were in the epicenters of battles were totally destroyed and inhabitants needed urgent help in the form of bedding, food and medicines. To solve this problem such countries as France and Belgium organized humanitarian operations involving military aircrafts. The first flight with humanitarian freight was shipped on September 1st from Folkestone, to Ghent, using De Havilland DH4 light bombers.

During the 1920s, the amount of cargo transported by air increased significantly. In 1918 approximately 713, 240 letters were shipped across the US using air transportation. By 1927 this number grew to 22,386, 000 letters. In addition to that fact, on 1st July 1924 the first night flight route carrying the post was launched by the US Airmail Service (Camille 2005).

It took eight years, beginning in 1926, for postal administration to be transformed into the post world's lagers network. To fulfill the tasks of this service, there were several private air companies which satisfied the demand. It, in its turn, led to some technical improvements of the planes.

Later on, due to the demand and political situation in the world, such long air cargo operations were opened at London, Brisbane, Amsterdam, and Djakarta, and there were two routes from Penang and Hong Kong to the Great Britain and Australia (Camille 2005).

In 1938 the Second World War began and it brought a huge increase in the need for airmail. European countries as well as the USA and Asia were concerned about mail



delivery. It was very important for all countries that their soldiers could write letters home and get them back from relatives. It was a strategy of the war leaders because to win the war the soldiers had to get support and encouragement to go on. Besides airmail, all countries needed so send provisions and ammunition. It was extremely important to provide mail exchange with the soldiers who were in different countries on the field of battle or held captive. Airmail and cargo need increased significantly. This led to development of air cargo not only among domestic air routes but to international air mail and cargo delivery agreements between all countries taking part in the war (Camille 2005).

After the war, times were not profitable for air cargo business. Most air cargo services depended on passenger flights, because air cargo was transported together with passengers in the cargo compartment. It meant that all cargo mail could be delivered only when possible to do so, not when it was needed (Wansveen 2011).

A revolutionary step in the air cargo industry was the idea of Fred Smith, a FedEx leader, who implemented a new type of service. He wanted to launch a door-to-door delivery service. The main focus was on an overnight delivery system which could allow a sender to send a package today and a receiver to get it the next morning. He was sure that air cargo flights had to operate separately from passenger ones in order to fly at night and deliver the cargo in the morning (Camille 2005).

It must be mentioned that in the 1930s, the air cargo service was developing in Asia, Africa and all over the world together with the USA and Europe. In many cases it was not a profitable industry for other countries or for the USA. But step by step air cargo service was improved and became a profit-making industry. Demand was growing and air cargo service faced the problem of the lack of specially equipped transport airplanes. In many countries passenger planes were modified into cargo ones. They were old and not the best to use for cargo transportation (Camille 2005). This has never been the case with Antonov Design Bureau which initially made cargo aircraft and now possesses a very wide range of cargo aircraft including the biggest cargo aircraft in the world – the AN 225 named Mriya.

### 3.3 Air Freight Traffic Trends

In the last several decades there were a number of trends which can be discussed here, such as growth rate, air freight dominating airlines, and main routes.

In the 1990s the air freight growth rate was around 7.7 per cent annually leaving behind the passenger growth rate. This picture changed greatly in the 2000s when the growth Index decreased to 4 per cent. The reason for it was the economical world crises and the fuel price increase (Doganis 2009). After the last wave of crises in 2008-2009, world air cargo traffic went up to 18.5 per cent in 2010 but already in 2011 this number declined by 1 per cent. Today is only 2013 and to see the rate of the current decade will not be possible for 7 years (Boeing 2012). It must be noted that there are some factors that influence the growth rate of the air freight industry more sensibly than the passenger industry. As it was mentioned above, economic factors in the world would influence on air freighters as well as seasonal periods. On Christmas time and Easter most factories, offices are closed and freight traffic is weaker compared to passenger traffic as people have free days and holidays and are used to fly at these times more often. There are always passenger additional flights at such time. Totally reverse situation can be expected some days before all big holidays. These days are the busiest for air freighters in order to deliver all goods starting from post cards and present packages to special cargo of different size and weight.

Concerning the air freight airlines domination on the market, the situation has dramatically changed in the last decades. North American and European airlines are not taking leading position any more as it was in 1970s in freight transportation. Due to economic situation in these countries, plenty of manufacturers opened their subsidiary companies or built the plants and factories in the countries of Asia and Pacific in order to minimize its operation costs mostly at the expense of low labor costs. Very soon migration of production led to the fact that Asian and Pacific export highly increased. Exports of commodities led to a high demand for air cargo airlines of Asian and Pacific region. Thus, for the last recent years Asian Pacific airlines became predominated on international air freight market and have taken almost a half of the whole market (Doganis 2010). In 2010 Asian Pacific carriers, Emirates and Korean Air, are on the second

and third places of the top 50 cargo carriers internationally being behind only FedEx (<http://www.aircargoworld.com>). According to John McCurry (2012), an editor of Air Cargo World magazine, there were not much changes in 2011 compared to 2010. But the author in his article 'Raise to the top' supposes that 2012 is bringing a new tendency in this sphere. Asian Pacific airlines such as Korean Air, China Airlines, Singapore Airlines and Cathay Pacific which were leaders for so long time will step back because of European airlines spurt. McCurry specifies Lufthansa, IAG and Air France airlines which might be the leaders in 2012 ([www.aircargoworld.com](http://www.aircargoworld.com)).

Rigas Doganis (2010) points six main route groups of the international air freight market. They are Europe-Asia, Trans-Pacific, North and Mid-Atlantic, Intra-Asia (International), Europe-Middle East, Middle East-Asia. The first three groups take most per cent of international freight in terms of tonne-kms – 65.1 per cent while three last groups – 18.7 per cent. The rest takes other routes. Such tendency owes the world economic situation, market relationship and trade lanes. Asia produces for Europe enormous number of consumer goods which must be transported to Europe. In its turn Europe transports different kinds of manufactured goods. The interesting fact that carriers which dominated on the market last years, FedEx and Asian airlines along with predicted dominators in 2012 Lufthansa and Air France are members of the predominated route groups (Doganis 2010).

As we can see world traffic trends in the air freight industry undergo changes all the time due to different reasons and this leads to the constant changes in demand and appearance of new trunk routes.

### **3.4 Commodities Carried by Air**

Air cargo shipment is indispensable for freight transportation of many goods and especially for two groups of commodities such as high-value and time-sensitive products. The products may vary from food and flowers to high-priced equipment, valuable metals and luxury wares (Kaabi and Abdullat 2010).

The book "Flying of course: airline economics and marketing" by Rigas Doganis (2010) presents commodity breakdown of global air freight markets which is shown in Table 3.1.

Table 3.1: Commodity Breakdown of Air Freight Markets

<i>Group of commodities</i>	<i>Share of FEU-kms %</i>
High tech products	27
Capital equipment	19
Apparel, textiles, footwear	17
Consumer products	16
Intermediate products	12
Food: refrigerated/non-refrigerated	6
Primary products	2
All commodities	100

Source: Flying of course: airline economics and marketing (Doganis 2009).

As it can be seen, there is a wide range of products which is carried by air. Out of 100 per cent of all commodities, 27 per cent is high tech products. Capital equipment such as machinery and electrical equipment accounted for 19 per cent of air cargo. 17 per cent of air freight is apparel, textiles and footwear. Such group as consumer products accounts for 16 per cent of all goods that were transported by air. These numbers show that 80 per cent of global air cargo is high tech products, capital equipment, consumer products apparel, textiles and footwear. According to the Boeing analysis (2012) air cargo industry transported 43 million tonnes of different products around the world in 2011.

It should be mention that “commodity mix will vary from route to route” (Doganis 2010, 296). From Europe to North America it can be underlined top five commodities which were exported by air in 2011: capital and specialized equipment, express shipments, chemicals, and transportation-related goods. Also there are some other products which were shipped in fewer amounts such as textiles, plastic goods, vegetables, and animal products.

Capital equipment (machinery and electrical equipment) and express shipments—primarily document and small parcel shipments are top commodities which were exported to Europe from North America. Specialized equipment, chemicals and plastic goods and assemblies can be accounted as large part of products which the North America transported to European countries by air (Boeing 2012). In total there are approximately 2.84 million tonnes of commodities were carried between Europe and North America using air transportation.

Looking at Asia to North America routes, telecommunication equipment and general industrial machinery and equipment are large part of commodities which were carried. Countries such as India and China are the largest exporters of these products in Asian region. In opposite direction the following top products were taken by air: scientific and specialized equipment, general industrial equipment, documents and small packages, chemical materials and electrical machinery (Boeing 2012). Approximately 3.4 million tonnes of different commodities were shipped from Asia to North America.

As for Europe to Asia flow, general industrial machinery, electrical machinery and apparatus are the major groups of commodities which accounted for 45 per cent of the total flow in 2011. Beside this, European region exported to Asia such group of products as automobile parts and accessories, pharmaceutical products, express packages and miscellaneous manufactured articles. The top two commodity groups of Asian air trade to Europe are apparel and express packages. These two groups account for 50 per cent of air cargo traffic. General industrial machinery, electrical machinery, apparatus are also large Asian export market.

Interesting fact is that most of Latin American's exports are perishable products such as flowers, fish, and vegetables compared to other routes.

The main flows were indicated as well as the groups of commodities carried today. It shows us that to carry millions of tonnes of commodities the aircrafts must be involved. We can assume that the AN 225 can be used widely on major trunk routes carried the commodities described above.

### **3.5 The Key Players**

Since the restrictions of air cargo service were weaker than passenger service during last years (Doganis 2010), it can be underlined the key players of air cargo industry that appeared.

The most significant group of key players in international general air cargo services is so-called combination carriers (Shiao and Hwang 2013). The combination carriers are traditionally scheduled airlines that offer service of transportation of passengers and cargo. The second group of players consists of all-cargo carriers. This group tends to

perform only air freight transportation using usually old passenger aircrafts. They don't provide any passenger services since their core business is delivery of goods by air (Popescu, Keskinocak and Mutawali 2010). The next group of key players is integrators that play essential role in air cargo industry. Peculiarity of this group is in delivering cargo from door-to-door (Scholz 2012) which differs from the previously described groups that provide mainly airport-to-airport service. Table 3.2 proves the information written above, showing that the three key groups already mentioned are in the world's ten largest cargo carriers.

Table 3.2: The World's Largest International Freight Carriers in 2010

<i>Scheduled freight tons per mile (millions)</i>			
<i>Rank</i>	<i>Combination</i>	<i>All-cargo airlines</i>	<i>Integrated</i>
1	Cathay Pacific 9,587		
2	Korean Air 9,487		
3	Emirates 7,913		
4	Lufthansa 7,422		
5			FedEx 7,421
6	Singapore Airlines 7,001		
7	China Airlines 6,410		
8			UPS 5,215
9	EVA Air 5,166		
10		Cargolux 4,901	

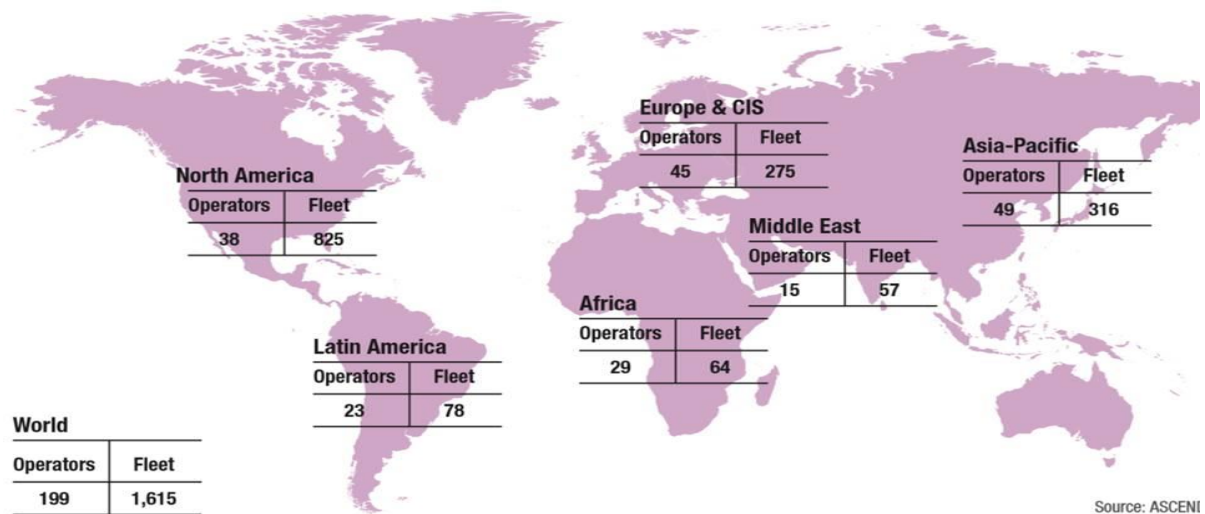
Source: Hong Kong calling (Patrick Burnson 2011)

It can be seen that significant amount of air cargo is carried by conventional scheduled airlines; most of them are from Asian region. There are only one all-cargo and two integrated operators among the top ten largest international freight carriers.

In addition to combination, all-cargo and integrated carriers there are some other top players in international air cargo market such as postal authorities, wet-lease providers and freight forwarders (Doganis 2010). The role of each of these top players in the transportation of international air cargo will be discussed below in this paper.

According to Airbus analyses (2012) in total there are 200 operators offering air cargo services operating 1615 cargo aircrafts around the globe (Figure 3.1). The latest operators' data, from 2012, shows that majority of operators involved in air cargo business are located in Europe&CIS, Asia-Pacific and North America regions. At the same time North America has the largest fleet of freighters which accounted for approximately 825 units.

Figure 3.1: The Number and Location of Air Freight Operators



Source: Airbus 2012

### 3.5.1 Combinational Carriers.

As it was mentioned before, combination carriers are airlines which carry not only passengers but also cargo in the freight holds of their planes. According to Rigas Doganis (2010) there are three types of cargo services offered by combination carriers. The large number of scheduled airlines ship air freight in belly hold of passenger aircraft. The belly is lower deck of aircraft where baggage of passengers, mails and of course air freight can be stored. Usually wide-bodied aircrafts are able to contain approximately 30 tons of air cargo. According to Clancy and Hoppin (2004), 50 per cent of international air freight is carried in the lower deck holds of passenger flights. Most of the typical airlines don't give serious attention to air cargo activities (Bjelicicthe 2001) because they consider air freight business as "a byproduct of their main operation" (Popescu, Keskinocak and Mutawaly 2010, 215).

There are also some passenger airlines which have different cargo aircrafts. These planes are used only for transportation of air freight from one point to another. There can be several reasons for having freighter aircrafts fleet. Morrell (2011) underlines three following causes:

- to supplement capacity on routes operated by passenger aircraft;
- to operate routes that don't justify passenger services;
- to accommodate consignments and loads that cannot be carried in passenger aircraft.

As an example there are several European airlines companies which focus not only on passengers but significantly on air cargo business as well. Such scheduled airlines as British Airways, KLM, Air France and Lufthansa are major combination carriers in European region. Mainly widebody cargo aircrafts are operated by combination carriers around the world. For instance, the fleet of Lufthansa Cargo consists of 18 Boeing MD11 cargo aircrafts (Finlayson 2012). The largest combination carriers in terms of number of aircrafts are Korean Air Cargo and Cathay Pacific Cargo. Each of these companies operates 24 cargo aircrafts (<http://www.worldlistmania.com>).

In addition, there are some airlines that have combi aircrafts as a part of their fleet. Combi aircraft means an airplane where front part of it is for passengers and its tail is meant for cargo. The reason why some airlines use combi aircrafts is because some routes have larger demand for cargo than for passengers (Doganis 2010). One of the scheduled airlines which operate combi aircrafts is Alaska Airlines. The fleet of Alaska Airlines consists of 5 Boeing 737-400 Combi (73Q) planes (<http://www.alaskaair.com>). The tendency of the last years shows that combi aircrafts among other aircrafts are being used less and less due to the new technologies of bigger aircraft construction which are able to carry great amount of cargo in their belly-holds (Doganis 2010).

### *3.5.2 All-Cargo Carriers*

All-cargo carriers also called as cargo-only carriers use the airplanes which were modified from passenger aircrafts into cargo ones. In this case modification stands for the reconstruction of doors, floors, noses and tails in order to load and unload heavy cargo.



This category of carriers has its niche because they transport heavy and large sized cargo which needs to be delivered from one continent to other and it is mostly long-haul flights. Such companies usually own one of the biggest machines such Airbus Beluga, Boeing 777, Boeing 747, Antonov 124. Their system is called airport-to-airport service. (Popescu, Keskinocak and Mutawaly 2010).

In the past there were many all-cargo carriers which operated planned and charter flights. Today there are not so many carriers of this group due to economic situation in the world and some were taken in possession by integrating carriers. Nowadays the biggest all-cargo operators are Luxembourg Company called Cargolux and Nippon Cargo Airlines belonging to Japan, Polar Air Cargo and Kallita Air in the USA and Air Hong Kong in China, Air Bridge Cargo belonging to Volga Dnepr Group in Russian and Antonov Airlines in Ukraine (Doganis 2010).

The last operator has in its fleet many transport aircrafts made by Antonov Company and their pride is to have the largest cargo airplane in the world the AN 225 which operates flights transporting freight which no other plane can carry ( [www.antonov.com](http://www.antonov.com)).

Some giant combination carriers as Lufthansa and Singapore Airlines based on their airlines' fleet set up a branch which deals with all-cargo air transportation. Because of this, it sometimes is not easy to emit the difference all-cargo airlines and combination airlines (Doganis 2010).

### *3.5.3 Integrated Carriers*

Integrated carriers, often called integrators, are the third group of key players. They are called integrators because they combine the transportation ways or integrate them in order to provide the service. (3)

The main peculiarity of this group that differs it from others is door-to-door system. There are four major companies which firmed their positions worldwide: FedEx, UPS, DHL and TNT. Many of them began to deliver parcels having courier service but ended up with express delivery and even transporting heavy cargo. All four main integrated carriers are owners of aircraft fleet but use the service of airfreight airlines as well as passenger airlines. Lufthansa can be a good example to it (Doganis 2010).

All main integrators have hub-and-spoke system. Having hub airport in one country of the continent, they are able to gather all cargo there and send it all together to other continent by one airplane. Providing a door-to-door service, they became very famous and in a high demand. All integrators have tracking system which allows a customer to see where his freight is. They guarantee in time delivery and very often customers pay for it whatever the cost. All these factors made them become profitable organizations but at the same time they are competitors trying to expand its service on all continents. It is interesting that FedEx, UPS and DHL were founded in the USA, but the third one later became European company. TNT was founded in Australia but is very widely consumed in Europe as well as DHL and both are weak in the USA (Morrell 2011).

There are, of course, many other companies, besides the four main integrators, such as La Poste in France, Royal Mail in the United Kingdom, USPS in the USA and some other national post carriers but since these four main integrators hold 80% of the world market industry, it is quite difficult to find its niche in this category for them (Doganis 2010).

Taking as an example one of the four main integrators, FedEx, to see its data information in order to have an understanding how global it is in the sphere of air cargo transportation:

- average daily volume is more than 4 million packages and 12 million pounds of freight;
- service area is more than 220 countries and territories;
- more than 375 airports served worldwide;
- air fleet consists of 660 aircrafts;
- 1173 stations plus 10 air express hubs (<http://www.fedex.com/us/>).

### *3.5.4 Other Key Players*

Other three key players are not playing the major role in the air cargo industry, but still have their place in it.

Such group as postal authorities has been presented in the countries all over the world for many centuries and small packages and letters were delivered by different means of transport depending on the historical period. Today some countries can allow themselves to use air transport for post delivering having its own small airplane fleet belonging to the government or to a private business. Mostly it happens in Europe, such countries as Germany and the Great Britain, and in big countries such as Canada, the USA and Australia. For example, British Royal Mail owns 16 airplanes and Deutsche Post bought 25% of shareholders of DHL and other integrating carriers, expanding the company and made a new name as Deutsche Post World Net. At the same time Dutch postal was bought from the government and became private organization buying TNT, one of the major integrators (Doganis 2010).

A young player of air cargo business is the contract freight operator or so-called ACMI provider. The main point of this service is to lease the aircrafts to the airlines. In other words, ACMI operates the flight for combination carriers using its aircraft, crew, insurance and maintenance but operation is done on behalf of the airlines which order the service of ACMI. There are not many airlines which lease from ACMI. The most well-known wet-lease providers are Atlas Air, Astar Air Cargo and ABX Air and they are more profitable than some combination carriers (Scholtz 2012).

An interesting player, and the last one, is freight forwarders and consolidators. Their business is similar to what travel agencies do for the air passenger airlines. The biggest freight forwarders also offer to their consignors such services as customs clearance, needed paper work, even door-to-door service which means that they can offer supply chain management done by their company without engaging any other company service. This is very beneficial for customer but a trouble for other cargo carriers because freight forwarders can control the customer orders, giving them special price offer such wise displacing small competitors as well as combinational and cargo-only carriers (Doganis 2010).

### **3.6 Air Cargo Forecasting**

It is well-known fact that nowadays each industry makes short-term and long-term forecasts in order to predict the future of the industry in which the business runs. There

are two giant companies, Airbus and Boeing. They prepare annually long-term forecasts regarding the air cargo industry. In this chapter the world air cargo forecast presented by Boeing and Airbus will be analyzed to see the future level of activity in the air cargo business next twenty years.

### 3.6.1 Boeing Company Forecasts

As it can be seen in Figure 3.2, the world air cargo forecast is presented which was done by Boeing analytics. This analysis predicts a long-term growth of world air cargo for the following 20 years.

Figure 3.2: World Air Cargo Traffic over the Next 20 Years by Boeing

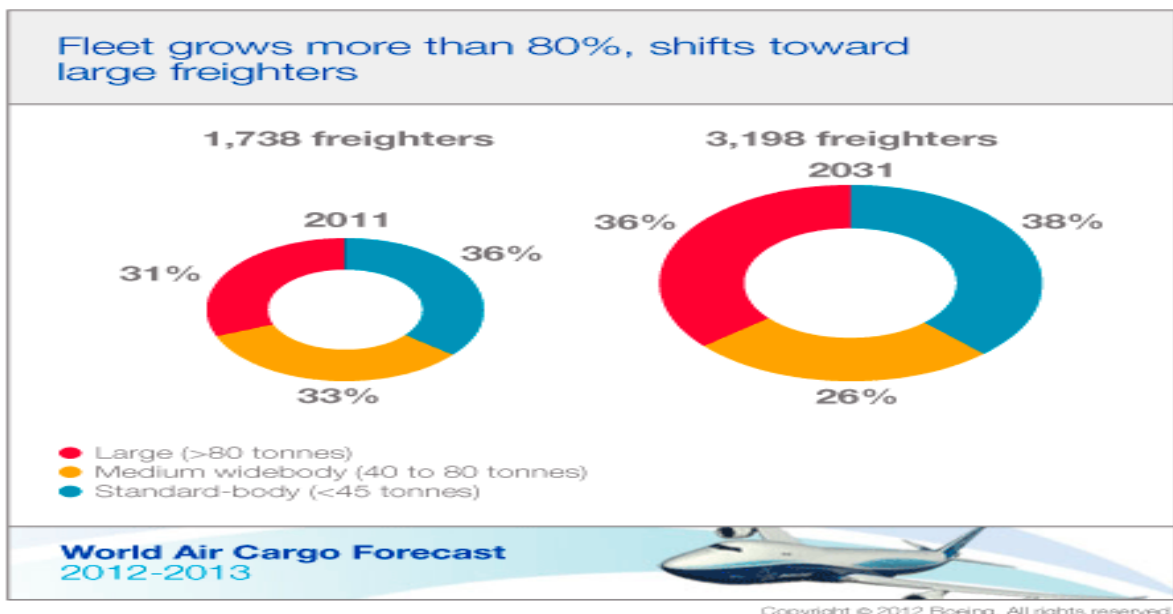


Source: Boeing 2012

It was estimated that world air cargo traffic will be two times more than now growing from 202.4 billion RTKs in 2011 to around 558.3 billion RTKs in 2031. Annual growth of air cargo which includes freight and mail will be approximately 5.2 per cent throughout 2031. The growth of the world air freight will be around 5.3 per cent per year while annual growth of airmail will be much lower, approximately 0.9 per cent over next twenty years. One of reason of slow growth of airmail compared to air freight is that society has been starting significantly rely on Internet communication. Analytics predict that the air cargo industry growth will continue to be led by Asian-Pacific region mainly by such countries as China, India, Japan and Taiwan.

In addition, analytics of Boeing Company suggest that key players in air cargo industry will have to increase their freighter fleet in order to satisfy the demand for the air cargo services in the future. There is a prediction that by the year 2031 the number of freight aircrafts will reach 3198 units which is almost two times more than currently (Figure 3.3). As it can be understood it will lead to the modification of some passenger aircrafts into freighter aircrafts as well as production of brand new ones.

Figure 3.3: Fleet Grows the Next 20 years



Source: Boeing 2012

By the year 2031 scientists suppose that large aircrafts able to carry over 80 tonnes will be increased by 5 per cent in their number which means 926 machines. Out of this number 678 freighters will be produced and 248 will be modified from machines that have been used for passenger transportation service. This category of aircrafts will mainly be used by Asia-Pacific operators for long-haul flights.

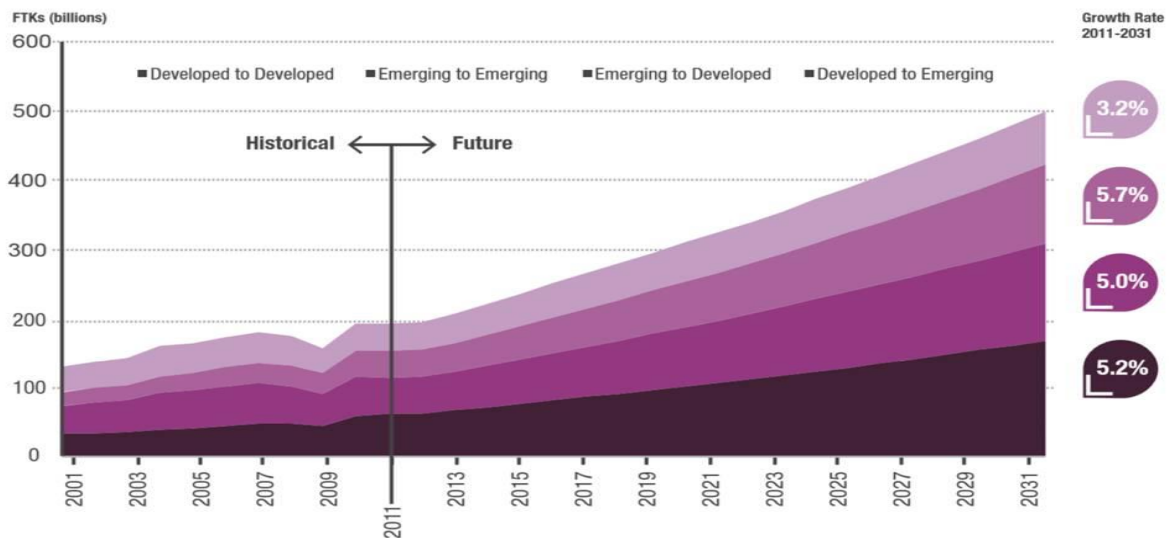
The medium wide-body freighter share of the world's freighter fleet will account for 38 per cent. This number will slightly grow compared to the index of 2011. Calculations show that 257 mid-sized aircrafts will be manufactured throughout 2031. Airlines that support express operations and express operators are going to be the main users of this aircraft category.

Standard body jets generate one third of the world’s freighter fleet. According to the predictions by the period of the year 2031 this group only will be one fourth of air cargo fleet. No constriction of these machines is foreseen in future. Such passenger planes as A320, 737, 757, and A321 will be modified for cargo purposes in order to operate on short-haul distances (Boeing 2012).

### 3. 6. 2 Airbus Company Forecasts

Airbus Company (2012) presented its own long-term forecast of the world air freight traffic and cargo plane demand. The company predicts that air cargo traffic will grow each year and by 2031 will be doubled (Figure 3.4).

Figure 3.4: World Air Cargo Traffic over the Next 20 Years by Airbus



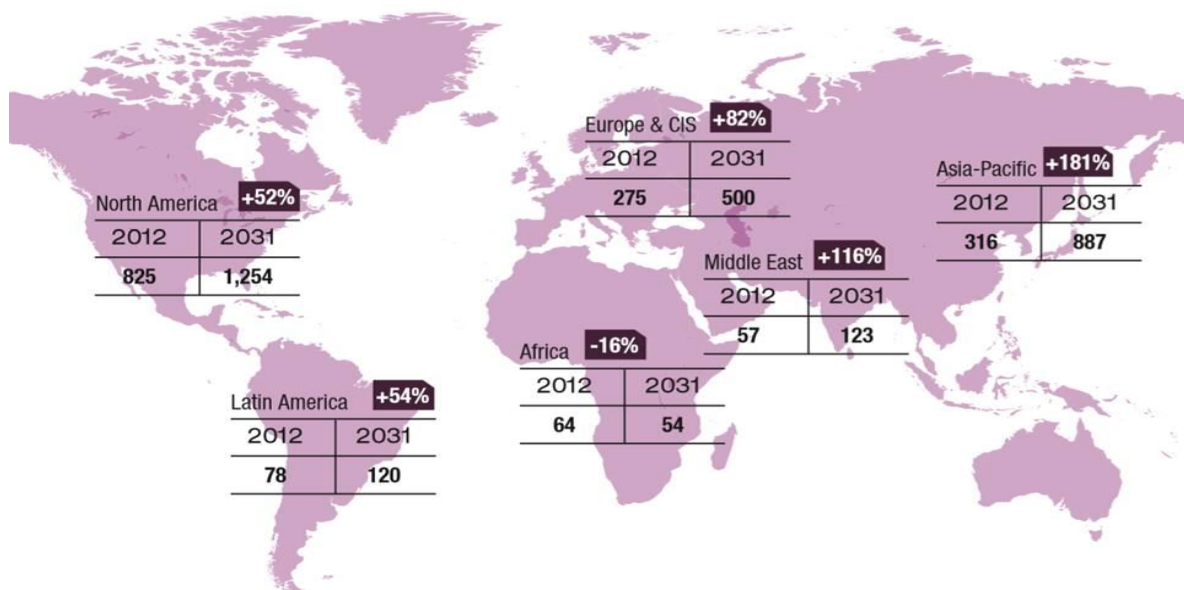
Source: Airbus 2012

Airbus sees average annual air freight growth of 4.9 per cent over the next twenty years. But this growth rate will vary from region to region depending on different factors. For example, the highest growth will be within and between the countries which are developing – 5.7 per cent, while the lowest growth will be within and between mature regions – 3.2 per cent. As well as Boeing, Airbus assumes that the air cargo industry growth will be largely driven by Asian-Pacific region due to such reasons as increase in the distribution of Asian products at Latin American and African markets.

Airbus analytics consider there will be approximately 2938 cargo aircrafts by 2031 in order to accommodate air cargo growth. They say that “over the forecast period, there is

a forecast demand for nearly 1,800 converted aircraft and nearly 900 new aircraft” (Airbus 2012, 137). According to Figure 3.5 presented by Airbus, Asian-Pacific region will operate nearly 887 cargo aircrafts in two decades which is 181 per cent more than now. The largest fleet of freighters will be located in North American region which will consist of around 1254 units. There is only one region, African where there will be no fleet growth in recent years and moreover number of cargo planes will be less compared to what they have now (Airbus 2012).

Figure 3.5: Freighter Fleet Forecast by Airbus to 2031



Source: Airbus 2012

Analytics department of Airbus Company predicts that among 2938 aircrafts, 535 of them will be small jets. There almost will be no production of new small jets because of the weak demand for machines that are able to fulfill short-haul flights. In future most of “new” small cargo planes will be converted from passenger aircrafts. The main reason of the weak demand for this category of aircraft is existence of alternative transportation. Today, generally short-haul distances are served by belly hold of passenger, ships, trains and freight trucks, especially in Europe. Following year’s most small cargo jets will be involved in transportation of goods between different islands or where there are some geographic difficulties.

In terms of mid-sized aircrafts their number will be up to 1375 units in twenty years. It is estimated that 411 of them will be brand new freighters and the rest will be modified

from passenger jets. Also it is expected that major users of medium wide-body aircrafts will be express companies located in countries such as China and India. Operators of the large freighters such as Cargolux and Volga-Dnepr also can be interested in this segment as it will give them the opportunity to have less risk in case of an economic slowdown, as it happened several years ago.

Analytics make prediction that fleet of large freighters will be doubled from 521 units in 2011 to 1028 in 2031. 440 brand new machines will be produced during the following 20 years while 432 machines will be modified from passenger to transport jets. Mainly these types of aircrafts will be used on major intercontinental routes such as Asia-Pacific to/from Europe and North America to/from Asia-Pacific in order to satisfy air cargo demand (Airbus 2012).

### **3.7 Summary**

In this chapter the historical development of air cargo industry was observed. Starting with mail deliveries it grew up to oversized cargo transportation 250 tones in weight. Wide range of commodities carried today was described. To transport the variety of commodities the following types of operators are involved: combination and all-cargo carriers, integrators, postal authorities, wet-lease providers and freight forwarders.

In addition, the future of air cargo business was analyzed according to the forecast made by Airbus and Boeing. These two companies present similar results regarding the future of air freight industry. They state that in twenty years the air cargo traffic will be doubled which will lead to the air cargo fleet growth. These results give reasons to suppose that the AN-225 will be much more often engaged in future transportation of commodities and it can be a need in more machines like this.



## **4 Antonov Design Bureau and its heavy-lift cargo plane AN 225**

This part of the master thesis outlines information related to Antonov Design Bureau and its heavy-lift cargo aircraft the AN 225. In the beginning of this section a brief history of the development of the enterprise is described. The chapter also illustrates a wide range of products which were designed and produced by Antonov Design Bureau in order to see large potential of Ukrainian aviation industry. Furthermore the chapter focuses on largest operating aircraft in the world Antonov 225.

### **4.1 Introduction**

There are several leading manufacturers of commercial and military aircrafts in the world: Boeing in the USA, Airbus in Europe, Embraer in Canada, Tupolev and Sukhoi in Russia and Antonov is Ukraine. Each of these manufacturers is known for some famous aircraft like the Airbus 380 or Boeing 737. In this chapter, Antonov Design Bureau will be looked at as a manufacturer of the largest transport aircraft in the world, Antonov 225.

### **4.2 Antonov History**

The Antonov Design Bureau was named by Antonov Oleg who was born in 1906 in the province of Moscow. He dreamt of aviation from his childhood. He was inspired by his brother's story about the flight through Russia. Oleg was searching for aviation literature for years while in school. In the thirties, Oleg was invited to work for the Yakovlev Design Bureau. During the Second World War, Antonov was constructing the Yak and dreaming of designing his own aircraft to fly when in a peaceful time. After the war, Antonov was a leader of a subsidiary company of the Yakovlev Bureau in Novosebirsk, and in 1946, the USSR government renamed the company the Antonov Design Bureau. Its first produced aircraft was the AN 2. In 1952 the Antonov Design Bureau moved to Kiev, Ukraine, where it still operates today.

In Kiev, the first aircraft constructed by Antonov was the AN 8. The AN 10 and the AN 12 followed in 1955. After the accident with the AN 10, which took place in 1957, Oleg

Antonov's bureau focused on safety and endurance. At that time, the Antonov Design Bureau became one of the leading aircraft manufacturers. He founded his own design school. By that time, there were several aircrafts produced by Antonov and they needed a special place for flight tests. That is how Gostomel base appeared in 1959, in the Kiev region. Now it is a complex which can compete with other world-leading bases. In 1960 Oleg Antonov got his PhD degree in technical sciences, and in 1962, he became a chief designer.

After Antonov Oleg passed away, the Bureau took his name. New chief designer was elected. It was Petr Baluev, who would make Antonov's dream come true – to design and produce the largest aircraft in the world – the AN 225 named Mriya (the Dream) ([www.antonov.com](http://www.antonov.com)).

In 1989, the Antonov Bureau got permission to use the aircrafts for commercial purposes. At that time, Antonov Airlines was founded and currently it is the Ukrainian national cargo carrier.

In 2009, according to the instructions of Ukrainian government, Kiev Aircraft Factory Aviant became a subsidiary company of Antonov Design Bureau.

Since 2006, the Antonov Design Bureau is headed by Dmitry Kiva.

Today, the Antonov Design Bureau, with its two subsidiary companies, Antonov Airlines and Antonov Serial Plant, and Gostomel base still functions, realizing a full range of aircrafts, beginning from design to serial production, and sticking to traditions that Oleg Antonov founded himself. Around 13000 of employees, who represent 198 professions and specialties, work in 35 different areas, among which are "...aerodynamics and strengthen of aircraft, mechanics, hydraulics, heat engineering, avionics, material science"([www.antonov.com](http://www.antonov.com)). The Antonov Design Bureau has designed more than 100 types of aircrafts and has produced 22000 items; they have partners in 76 countries ([www.antonov.com](http://www.antonov.com)).

### **4.3 Antonov Aircrafts**

The Antonov Design Bureau has existed for more than 60 years, despite the USSR collapse, and economic and political instability in Ukraine.

Antonov aircraft range is quite wide. It begins from the AN 2 and ends with the AN 225, still the biggest aircraft in the world. Today model range is represented by 32 aircrafts, shown in Figure 4.1. Bureau designs the aircrafts which can be used for two main purposes: passenger transporting aircrafts and cargo aircrafts. However, some of these were designed for one purpose but later were reconstructed and modifies to be used for other purpose, so they became multipurpose or special purpose aircrafts. The airplanes of these three categories will be described below. There were five gliders, the A 9, the A 11, A 13A, A 13M and A 15, but our focus will be only on aircrafts which were in serial production or were significant achievements ([www.antonov.com](http://www.antonov.com)).

Figure 4.1: Model Range of Antonov Aircrafts



Source: War Cyber. История гражданских самолетов Антонова. [www.warcyb.org.ru](http://www.warcyb.org.ru)

#### 4.3.1 Multi-purpose and Special Purpose Aircrafts

Multi-purpose and special purpose aircrafts designed by The Antonov Design Bureau are the hallmark of this organization, because one of them was the first serial airplane. Beside this, it made the Antonov Design Bureau be competitive in the airplane industry market. More than 80 such machines were produced for many different purposes. We will have a look at only some of them which are the most popular and well-known in post USSR countries and abroad.

The AN 2, a proud of the Antonov Design Bureau, was made after the Second World War, in 1947. When the aircraft went through all test procedures, it started to be

manufactured in Kiev. In the beginning, it was used mainly for agricultural purposes, fertilizer spraying in particular. Later on, it was widely used for aero photography. The designers didn't stop; they modified the AN 2 into aircraft capable for landing on snow, by using ski landing gear instead of usual one, when landing in a Polar area, and since that time, all Arctic expeditions were made with the AN 2. At the same time, the floats were constricted for the AN 2, and it was modified into hydro aircraft, able to land on water. Moreover, it was used also as fire aircraft, because it could carry water inside of the floats. Only seven years later, the AN 2 was modified to be a passenger aircraft, able to carry 10 people on board (Якубович 2009).

The AN 2 is used for many purposes and capable of having many modifications, among which the popular are:

- AN 2Т – transport aircraft (1.5 t of cargo);
- AN 2ТП – transport-passenger (10 folded seats);
- AN 2ТД – transport-landing;
- AN 2П – passenger (10 soft seats);
- AN 2СХ – agricultural (tank on 1.400 l);
- AN 2М – agricultural with increased volume (tank on 2.000 l);
- AN 2 3А(AN-6) – sounder of atmosphere and the high-altitude one (AN-2V);
- AN 2Ф – night reconnaissance and (AN-2НАКВ) – fire spotter aircraft;
- AN 2С – sanitary (to 6 stretchers);
- AN 2В(AN-4) – hydroplane with float-type landing gear;
- AN 2 – with ski landing gear;
- AN 2Л – for forest protection;
- AN 2 – with aviation firefighting sprayer;
- AN-2ЛП – forest fire aircraft (on a basis of AN-2В with filling the floats with water)

([www.antonov.com](http://www.antonov.com)).

Based on data from 2007 around 6000 of AN 2's modifications are used in 40 countries of the world. It is the most popular aircraft of the Antonov Bureau, and it flies on all continents, being produced in the USSR, China and Poland in amount of 15500 units

([www.antonov.com](http://www.antonov.com)).

The AN 3 is an advanced prototype of the AN 2. It didn't gain so much popularity as the AN 2 due to its capability of carrying only 9 passengers, but it was in production and is widely used in post USSR countries.

The AN 6 and the AN 8 are military aircrafts. The AN 6 was based on the AN 2, while the AN 8 was designed specifically for military purpose (Якубович 2009).

The goal of the designer was to invent an aircraft easy in maneuver, with perfect takeoff and landing characteristics. That is how the AN 14 appeared, a light transport and passenger aircraft. It was used for transporting passengers, as well as freight, having several modifications for parachute jumpers, sanitarian and agricultural needs. Oleg Antonov named it "Pchelka" (the Bee) (Якубович 2009). 332 units were produced and some of them were sold to six other countries ([www.antonov.com](http://www.antonov.com)).

The AN 28 is very similar to the AN 14, but with larger dimensions and much more comfortable seats for passengers. Navigation, control and icing systems made it possible to fly in bad weather, day and night. The AN 14 modifications are used for passengers and freight transportation, for geological, fishing and polar exploration, parachute landing, aerial photography, sanitary. It is, indeed, a multi-purpose machine.

The AN 30 was designed to function as an aerial photography machine. It was not a usual for the Antonov Design Bureau to produce a single-purpose or a special purpose plane, but this one was produced in amount of 123 units, and some units were sold to customers in China, Romania, Cuba, Mongolia, Afghanistan, Vietnam, and Bulgaria. Now the AN 30 is reconstructed into passenger plane on demand of some airlines.

India ordered an aircraft from the Antonov Company which would be excellent for hot and humid Indian weather, and for Indian's geographical position. That is how the AN 32 was invented. It was able to flight when it was 40 Celsius above zero and it could easily land in a mountainous area. It was in production for India until 1991. The AN 32 broke 14 world records. It gained good popularity among such customers in Peru, Afghanistan, Nicaragua, Ethiopia, Bangladesh, Columbia and Mexico.

The AN 38 was produced after the USSR collapse, when Ukraine became an independent country and the Antonov Design Bureau could produce what they wanted, not what they

were told to. This machine is good because it can fly when it is very hot and extremely cold. It easily transforms from passenger into cargo aircraft. It is widely used in Russia, Malaysia and Vietnam (Якубович 2009).

Unfortunately not all airplanes, which were designed by the Antonov Design Bureau, are in serial production. Some of them were produced, but they were not attractive to any countries. As example of this is the AN 71. It was intended to serve as radar detection. Two unites were produced and there still is no interest in this aircraft (Якубович 2006).

#### *4.3.2 Passenger Aircrafts*

Antonov passenger airplanes are designed and produced in order to satisfy the demand of the countries which order them. Passenger airplanes are able to fly in different climate conditions and have ability to land in specific areas. Such important things, such as safety, comfort, noise are taken into account. The planes are economic in use and ecologically friendly ([www.antonov.com](http://www.antonov.com)).

The first big Antonov passenger airplane was the AN 10. It was the leader in transporting the passengers in the USSR – 35 million. There were 81 machines in use and it could land on unpaved landing strip. However, after the catastrophe on this plane, more than 100 people died. The cracks were found in nearly every machine, and this led to a very serious decision to stop the exploitation of the AN 10. It was hard to admit the fact that the AN 10 would not be in use any more, as just some years before it got a diploma in Brussels for great construction (Якубович 2009).

Unfortunately, in the USSR times, quite often the Antonov Design Bureau had to design airplane because of the command of the government. Usually the government would give 2 years for them to design and produce a new airplane. It led to many technical problems which were fixing simultaneously with serial production. The government didn't want to hear any excuses. Because of a lack of time for probation, many airplanes crashed. The AN 24's destiny was after such scenario. It was determined to carry 32 passengers and its modification the AN 24Б, 52 passengers, plus cabin crew. It was one of the best sellers overseas among Antonov's passenger planes. It was exported to around 40 countries. Along with its popularity and wide use, there were many accidents in the USSR and

abroad. The USSR government hid this very carefully and this was highlighted only after the USSR collapse. It is hard to calculate how many hundreds of lives were lost, and this disadvantage cannot be compared with dozens of its other advantages (Якубович 2009).

To execute the civil order, Antonov decided to construct the AN 74, taking into account the wishes of both sides: civil and military. This machine can carry 52 people. Later on, it was modified to be capable of flying to the Polar Circle. In addition, the AN 74 was reconstructed into a VIP class airplane with 6 seats (Якубович 2006).

Economic factors were the reason why the AN 74 didn't become popular abroad. Only after the independence of Ukraine and Russia, the AN 74 was bought by some airlines of these two countries. On the one hand, this machine has no analog, but it has competitors. It is necessary to mention that beginning from 1991, the AN 74 drew interest of potential customers from Egypt. Since 1993, it has provided air support to rally "Paris-Dakar". It brought the machine the recognition abroad and nowadays businessmen all around the world look at AN 74 VIP model with great interest.

The AN 140 was born very unexpectedly for many former USSR countries in 1993. The reason for that was the understanding of the economic changes by the Antonov Design Bureau, which gave them the possibility to be market orientated. Local airlines were waiting for something like the AN 140. It has 53 seats and it was intended to replace the AN 24, which was in use more than 40 years in 20 countries by that time. Serial production of the AN 140 was in Ukraine, and later in Iran. Its way to the market is not so smooth. There were several serious crashes of the AN 140 due to technical defects. It spoiled the reputation of the machine. The Antonov Design Bureau staff considers that it is only beginning for the AN 140. They believe if there are no serious damages in future, it will be desired alternative to the AN 24.

Just as the AN 140 was planned to be substitute for the AN 24, the AN 148 was designed to replace the AN 74. It was designed in cooperation with companies from CIS countries as well as from France, the Great Britain, the USA and Germany. The AN 148 was a strategy of Antonov in order to receive recognition from European countries and the USA (Якубович 2009).

Ukrainian and Russian airlines have operated the AN 148 both on domestic and international flights since 2009. Such countries as Georgia, Kazakhstan, Kirgizstan, Russian, Ukraine and Tadzhikistan are interested in the VIP version of the AN 148. The airlines of different countries expressed their intention to acquire 200 units of the AN 148. This fact tells us that the AN 148 was recognized abroad and has its potential buyers.

The newest Antonov passenger airplane is the AN 158 made in 2011. It is based on the AN 148 characteristics, but has 99 seats and is constructed in accordance with safety world standards. It can be used for international flights because this machine can fly at temperature  $-55$   $+45$ , in difficult weather conditions, and in any season ([www.antonov.com](http://www.antonov.com)).

Antonov passenger airplanes, especially the AN 148 and the AN 158, are manufactured to meet the world standard and, by some characteristics, may surpass their analogues produced in Europe or the USA, but it will take long time for the customers to trust in them after the bad reputation of CIS countries' aircrafts that they gain all the time when it is heard that an airplane was made in a post-USSR country has crashed again.

#### *4.3.3 Transport Aircrafts*

Antonov transport aircrafts are the successful ones. The bureau gained the most experience in them. It confirms the fact that many passenger airplanes have their modifications which serve to carry cargo. These machines are known by their possibility of carrying all types of cargo, including the heaviest and most outsized. The peculiarity of all Antonov company cargo planes is they are not depended on ground handling equipment. Besides this, all machines can land not only on paved air strips, but on unpaved, icy and others types. Antonov Company is proud of the facts that its aircrafts were able to operate unique flights, such as picking up people from a drifting platform on the North Pole or carrying maximum weight cargo which could be managed only the AN 225 machine ([www.antonov.com](http://www.antonov.com)).

In 1962, there was a conflict between China and India when Indian troops were surrounded. They had run out of food and ammunition. They were sure they would be captured and killed. Unexpectedly, they got help. Indian pilots landed with provision



carried by the AN 12 – soviet transport aircraft they mastered not long ago. Indeed, the AN 12 was very famous in India and other countries, as the aircraft able to transport up to 90 people and large-size cargo, like cars, military machines and heavy weapons. The aircraft was used in all world events, and because of such a demand, the Antonov Company had to improve the AN 12 many times in many ways. As all other Antonov aircrafts, the AN 12 had quite a few defects, but it led to the AN 12's numerous modifications. Today, the AN 12 has 30 modifications; 1,243 aircrafts were produced in serial production, and 187 units were sold abroad to India, Yugoslavia, Afghanistan, Cuba, Algeria, Egypt, Iraq, Malaysia, Poland, Jordan, Czechoslovakia and China.

The AN 22 was design as a response to American BTC C-141. It is not news that the USSR and the USA had the cold war in the 1960s and these two countries were competing in everything. The competitions led to huge progress in many industries of the USSR, especially in the aircraft design industry. Of course, some aircrafts were designed and produced on demand of the country, but some were just to show that the USSR was the best. That was exactly the reason why the AN 12 appeared. It was intended to carry cargo up to 40 tons for a distance of 3500km. It could carry tanks and other needed equipment for military needs. There was no analogue of such an aircraft in that time, and it was not an easy task for Antonov to design it. Pressurized cargo compartment amazed all, including specialists, when the AN 22 was presented on expo in Paris. All in all, 66 aircrafts were made in serial production. In 1975, the production of the AN 22 was stopped.

For military purposes, especially for the armed forces, the AN-26 was designed and made in the 70s. Only some years later did it start to be used in civil aviation by Aeroflot. Beginning in 1972, the AN 26 was exported abroad and widely used in Poland, Yugoslavia, Hungary, Rumania, Czechoslovakia, Bulgaria, African countries. Altogether, 400 units were sold abroad out of 1400 produced aircrafts. Nowadays they still fly, carrying post and some cargo, operated by Russian, Ukrainian and some EU airlines (Якубович 2009).

The AN 72 was conceived for military purposes, but in the process of engineering, it ended up as the aircraft carrying paratroops and cargo. As it often happens, designing takes time and in two years, Antonov came to the conclusion that the AN 72 had to be for

military, as well as for civil, purposes. This added some extra work for designers, but they reached the goal. There are more than 100 units of the AN 72, and they are operated in many countries all over the world (Якубович 2006).

In 1966 Antonov Design Bureau got a task from the government of the USSR to make a new transport aircraft able to carry 120 tonnes. After such a big event in the Paris expo with the AN 22, America began developing its giant C-5 Galaxy to surpass the AN 22. The USSR could not allow being behind in the giant aircrafts building race. To achieve this goal, all scientists and designers in the aircraft building industry came together. It took a long period to come to the final sketch in 1977. That was the birth of the famous AN 124 named Ruslan (Кушнир 2011).

Ruslan set 30 world records. It flew to 165 countries of the world and landed at 768 airports. It took part in many operations, including the ones leading by the UNO ([www.antonov.com](http://www.antonov.com)).

After the USSR collapse, Ukraine gained its independence and the AN 124 played an important role in economic life of the Antonov Design Bureau. In 2004 Volga Dnepr, Atlant Union, Polet and Antonov airlines were using 26 AN 124s, but Volga Dnepr airlines has been number one in the world in using the AN 124. In its records are transportation of such cargos, such as lorries, weighing 103 tonnes each, a space nuclear reactor, 107 rally cars from London to Sydney, 52 tonnes of gold and so on. The most modern modification of the AN 124 can carry 150 tonnes of cargo. At present, there are 3 aircrafts of AN 124 which have crashed. In 2010, it was planned to begin serial production of the aircraft again, more modern and modified, in order to produce 55 units by 2026 (Якубович 2009).

The AN 225 closes the list of Antonov Design Bureau transport aircrafts. By its specifications, it is the largest aircraft Antonov Company has ever constructed. In some parameters it is not bigger than the AN 124, but according to Table 4.1, the AN 225 is a super-giant, leaving behind all other cargo aircrafts of the Antonov.

Table 4.1: Comparative Data of Antonov Transport Aircrafts.

<i>Parameters</i>	<i>An-12</i>	<i>An-22</i>	<i>An-26</i>	<i>An-72</i>	<i>An-124</i>	<b><i>An-225</i></b>
Maximum take-off weight, t	61	250	24	33	405	<b>600</b>
Maximum payload, t						
- internal	20	80	5,5	10	150	<b>250</b>
- external	-	-	-	-	-	<b>250</b>
Range, km						
- with maximum payload	500	5000	800	1000	4500	<b>2500</b>
- with commercial load	4500	5225	1750	2000	5200	<b>4500</b>
Cruise speed, km / h	570	560	435	550	850	<b>850</b>
Size of cargo cabin						
- height	2,5	4,4	1,91	2,25	4,4	<b>4,4</b>
- width	3,2	4,4	2,78	2,15	6,4	<b>6,4</b>
- length	13,5	29	11,5	10,5	36	<b>43</b>

Source: "АэроХобби" Авиационный научно- популярный журнал.

## 4.4 Antonov 225 as the Largest Operating Aircraft in the World

It was the year 1989, air and space expo in Paris, Le Bourget salon. Two-storied giant landed at Paris airport. It was transport aircraft the AN 225, Mriya (the Dream), with spacecraft Buran on its back. It was a sensation of the year. Nobody has ever seen such a huge aircraft. The USSR was so proud of its new machine which was like a hangar where everything could be placed (Захарченко 2006).

### 4.4.1 Historical Background of Antonov 225

In the seventies, space exploration was rapidly developing. At that time, two competing countries, the USA and the USSR, came to the conclusion that there was a need to make long-term manned space stations. Only disposable boosters had been used until that time, and they had to be made reusable to launch payloads into the orbit economically. Reusable space transportation systems were to be designed. In the USSR, it was a program "Energy-Buran", while in the USA – "Space Shuttle". It is necessary to mention that Soviet program was not completed. The USSR collapsed and financing of the program was terminated (Кушнир 2011).

In the USSR, the space systems “Buran” and “Energy” were determined to be produced in 1976. Since the country was huge, the production of the components of these two systems was in different regions of the USSR, but the final setting up was supposed to be at Baikonur Cosmodrome. To transport the components by train, by road or water was not an option, because it would demand additional roads laying, bridges and tunnel extensions and many other actions. The only way to deliver the components to Baikonur was by air. The Antonov Company was asked to design a special aircraft for space system components transportation. It was decided to construct an aircraft which could serve as a two-step system: the first one was the airplane itself and the second was a small space shuttle on the back of the aircraft to be able to start to the orbit, weighting 170 tonnes. The AN 124 was perfect for both operations: to be special aircraft carrying space cargo and transporting Cosmodrome on its back. After several trials, scientists came to the conclusion that the weight of the shuttle with full fuel tank would be not 170 but 250 tonnes. It was obvious that the AN 124 was not good for this operation, and designers started to think about a new aircraft being able to carry the shuttle weighting 250 tonnes. Design work was led by Petr Baluev, a chief designer of the Antonov Design Bureau because, by that time, Oleg Antonov had passed away (Анисенко 2006).

#### *4.4.2 Technical Specifications of Antonov 225*

The design and production process was made in a comparatively short time. The previous experience in constructing the AN 124 was a big help for designers. The fact that Petr Baluev organized several years before the delivery of a spare part for the AN 124 construction carried by the AN 22 on its back was one more advantages, among others, that Antonov had a great experience in designing transport aircraft (Кушнир 2011).

It took three years to design the new cargo aircraft, the AN 225 named Mriya (the Dream). The first flight date was on the 20<sup>th</sup> of December, 1988 but the weather conditions were not favorable. However, 21<sup>st</sup> of December, 1988, the AN 225 took off. Its first flight took one hour fifteen minutes. The flight showed that the actual characteristics of the AN 225 were consistent with calculations. It was hard to believe that the machine with a take-off weight of 600 tonnes could fly. Length of fuselage was 84 meters; wingspan was 87 meters and wing height – 18.1 meters. There were 6 cabin crew

members and 70 seats. Maximum weight the AN 225 is able to carry is 250 tonnes and it can be placed inside of the cabin with its length of 43 meters, width 6,4 meters and height 4,4 meters as well as outside on its back. The AN 225 is a flying tanker as its fuel tank capacity is 373,618 liters. The practical range, with a load of more than 200 tons is 4000 km. The following items could be carried on its back: space shuttle, power turbines rotors, rigs and so on. Some technical abilities were used till its maximum possibilities, like landing gears consisting of 30 wheels of a man's height (Захарченко 1996).

There is a front cargo hatch and ramp for loading and unloading. Thresholds height adjustment system of cargo cabin provides the best conditions for loading and unloading. All aircraft systems are automatic and require little work of the crew. (<http://lib.rus.ec/b/229995/read>).

In order to take on board a heavy single piece of cargo, it requires a unique function - a kneeling position. In this position the cargo floor is low enough for long goods to be loaded and unloaded safely and quickly. In addition to that, this machine has tail and nose hatches, cargo ramp, board cranes and winches, which give the opportunity to handle heavy and oversized cargo without ground handling equipment. Moreover the AN 225 can be "safely operated from/to all types of airfields with unpaved, shingle, ice, or other runway surfaces" according to Antonov Design Bureau ([www.antonov.com](http://www.antonov.com)).

When the AN 255 was presented on expo in France, there were many people who said that such a huge and unique aircraft could be made in the USA. Until now, the AN 225 is still the largest cargo aircraft. There are several giants that have been made in different countries after Mriya was produced, but their technical characteristics and performance abilities are not higher than the AN 225 (Кушнир 2011).

Table 4.2 shows the most used aircraft for cargo transportation, including the AN 225. According to the specifications presented in Table 4.2, the AN 225 has the highest aircraft specifications. Looking at these specifications, we can easily agree that the Mriya is a unique implement of transportation which can be called the "king" of cargo planes. As it can be seen this air freighter can lift to the sky cargo that weights 250 tonnes and fly long distances (15000 km) without refueling. Although the AN 225's cruise speed index is not

the highest today compared to other machines, it leaves far behind such well-known aircrafts as Boeing and Airbus.

Table 4.2: World’s Biggest Cargo Aircrafts and Their Technical Characteristics

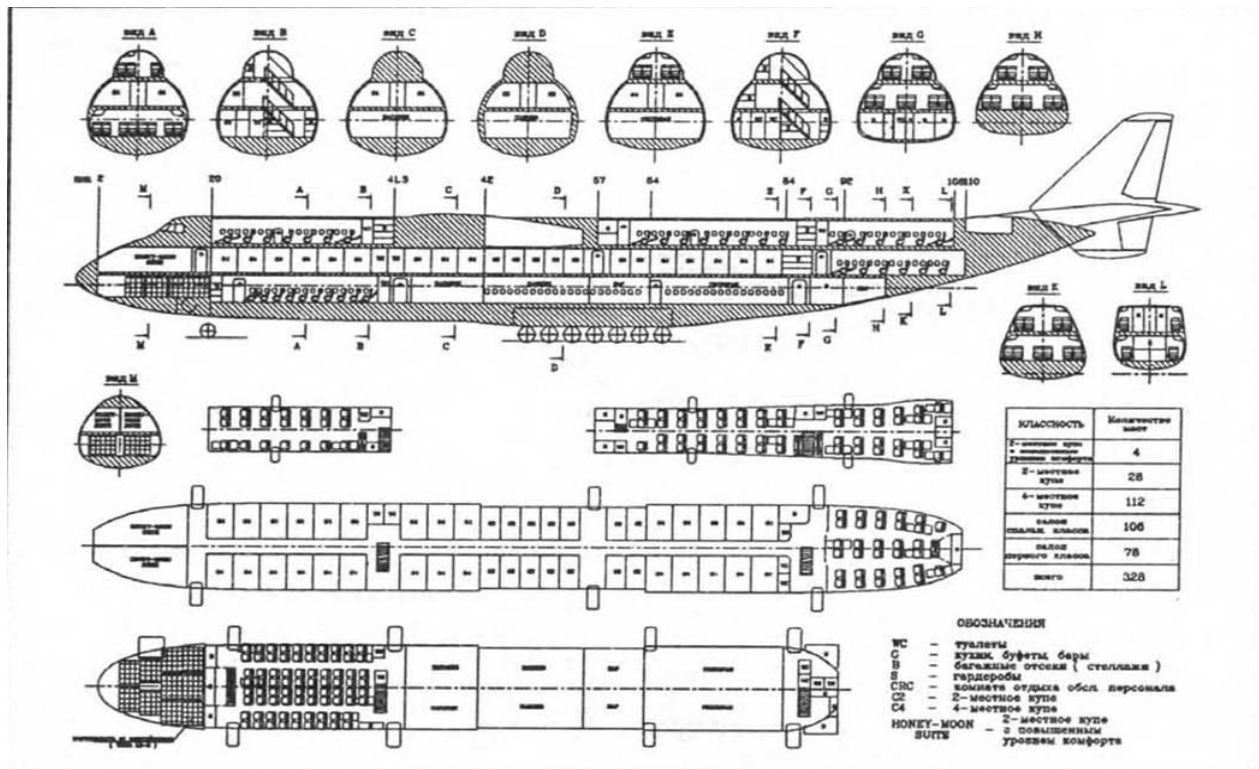
<i>Aircraft</i>	<i>Cargo Volume</i>	<i>Cargo Mass</i>	<i>Cruise Speed</i>	<i>Maximum Range</i>
Airbus 330	475 m <sup>3</sup>	70,000 kg	870 km/h	7,400 km
Airbus 380	1134 m <sup>3</sup>	149800 kg	945km/h	10,400 km
Airbus Beluga	1210 m <sup>3</sup>	47,000 kg	750 km/h	4,632 km
Antonov 124	1050 m <sup>3</sup>	150,000 kg	800 km/h	5,400 km
<b>Antonov 225</b>	<b>1300 m<sup>3</sup></b>	<b>250,000 kg</b>	<b>850 km/h</b>	<b>15,400 km</b>
Boeing 747-8F	854 m <sup>3</sup>	134,200 kg	908 km/h	8,288 km
Boeing 767-300	438.m <sup>3</sup>	52,700 kg	850 km/h	6,025 km
Boeing 777	653 m <sup>3</sup>	103,000 kg	896 km/h	9,070 km
McDonnell Douglas MD-11	440 m <sup>3</sup>	91,670 kg	945 km/h	7,320 km

Source: Compiled using [www.airbus.com](http://www.airbus.com), [www.boeing.com](http://www.boeing.com) and [www.antonov.com](http://www.antonov.com)

It should be mentioned that based on the AN 225 specifications, the designers had a plan to modify the AN 225 into a passenger airplane. They projected the sketch of it and they would give the name the AN 248. They would call it a superliner because, according to the plan, the future AN 248 was supposed to be highly comfortable with a three-deck fuselage. The intention was to include sleeping compartments, a shop, a casino and a restaurant for 328 passengers. The designers hoped to find a buyer who would be interested in huge passenger airplane for V.I.P.s. The sample direction line was London – Abu Dhabi – Singapore – Sydney. It never found its customer. The sketch of passenger version of the AN 225 can be seen on Figure 4.2. (Кушнир 2011).

The AN 225 has 240 world records on its account, 110 of them were set during its first flight. Some of the records can be found in Guinness World Record Book ([www.antonov.com](http://www.antonov.com)).

Figure 4.2: The Passenger Version of the Highly Comfortable Antonov 225



Source: "АэроХобби" *Авиационный научно- популярный журнал*

#### 4.4.3 Antonov 225 Usage in Logistics Operations Since 2001

Despite of all records and rewords the AN 225 gained; it flew not so much as expected. The program of space discovery system Energy-Burann was terminated due to political and economic changes in the country. The USSR stopped its existence and the new country, Ukraine, was not interested in further space programs (Якубович 2009).

For quite a long period of time, the AN 225 was not in use. Market economy took place in post-soviet countries. The demand was in cargo transporting and Antonov Company decided to upgrade the machine in order to have a commercial aircraft able to perform the orders. It was done in 2001 and was presented, as usual, in Paris where the company began the AN 225's promotion company in different countries. It worked out, and clients started to use the machine (Кушнир 2011).

According to commercial executive of Antonov Airlines, in average, the AN 225 fulfills less than 50 orders yearly, carrying various freights. It has flown approximately to 30 different destinations around the globe. Three civilian missions that attracted the attention of many journalists and ordinary people will be described.

In August 2009 the AN 225 carried single cargo item from Frankfurt, Germany to Erevan, Armenia. This flight was set one more record in the list records of the AN 225. This transportation was special in terms of cargo weight and size. It was a power station generator with weight 189 tons, 4.27 meters wide and 16.23 meters long. The client who ordered to carry this load was GS Engineering and Construction, South Korea. Before being loaded to the AN 225, the freight was shipped from Holland and transported to the Frankfurt airport. Mountainous landscape and the absence of a sea port at the final destination were the reasons why it was not possible to deliver the generator by road or by water. The only transportation mode that remained was air. To handle this task was only the largest plane in the world, the AN 225 (<http://www.epravda.com.ua>).

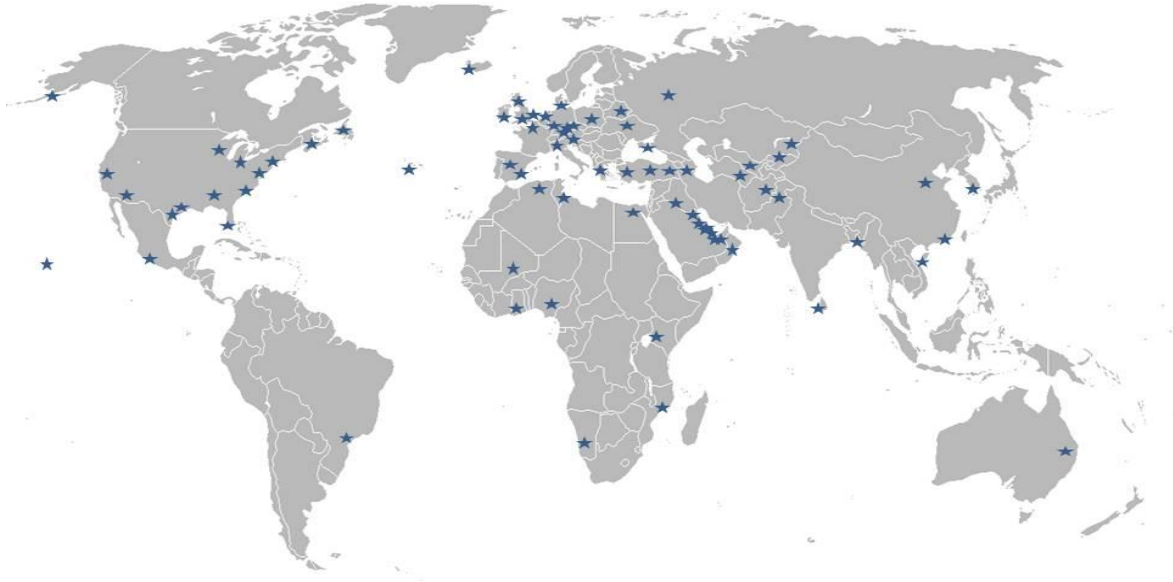
In June 2010, the AN 225 set one more record. This time it was the longest cargo unit ever carried by air. It was two wind turbine blades transported from China to Denmark. The length of each blade was 42.5 meters. Again, only the AN 225 could manage carrying this load because the length the AN 225 cargo cabin is 43 meters as mentioned before. The order was urgent, giving the reason why sea and road transport was not taken into account. It could take one months to ship the blades by sea, while for the AN 225 it took only twelve hours. This order was made by leading logistics company Geodis Wilson AS. (<http://industry.kmu.gov.ua>)

Many times the AN 225 was used in emergency logistics operations and humanitarian aid deliveries. In 2009, this machine operated several flights to deliver generators to Samoa in order to resume the work of the electro station which was destroyed by a tsunami. In 2010, aircraft delivered large-sized construction equipment to Haiti after an earthquake. This delivery was ordered by Japanese government. The AN 225 was chosen considering the need for urgent delivery. In 2011 the government of France contacted Antonov Airlines to make an order of the AN 225 to fly from France to Japan and deliver humanitarian aid. It carried generators, equipment and also small supplies like masks, blankets, protected suites, and essential products like water, food and medications. The total weight of shipment was 145 tonnes. The flight required three technical stops in Minsk, (Belarus) Almaty, (Kazakhstan) and Shijiazhuang (China). Beginning from 2001 all flights operated by the AN-255 until now have beenwe successful (<http://newsland.com>).



Figure 4.3 shows the points on the world map where the AN 225 has operated commercial flights.

Figure 4.3: Airports Accommodated the Antonov 225



Source: Antonov Airlines 2013.

#### 4.5 Summary

To sum up this chapter, it can be concluded that, based on information derived from different sources, the Antonov Bureau Design has its niche among other aircraft manufacturers in the world. With its long history, Antonov produces a large range of aircrafts and works in three main directions, manufacturing transport aircrafts, passenger aircrafts and special purpose aircrafts. Its machines have been used for more than 60 years and dozens of aircrafts are being used widely in different parts of the world. The greatest achievement of Antonov was the AN 225, the world's largest cargo aircraft.

## **5** *Methodology*

This chapter presents the approach used in the thesis, data collection methods and also problems the researcher faced during data finding.

### **5.1 Research Design**

Research design is defined in different ways by many scholars. Stephen Gorard (2013) underlines that research design “... is a way of organizing research project or program from its inception in order to maximize the likelihood of generating evidence that provides a convincing answer to the research question for a given level of sources” (Gorard 2013, 8). Another scholar, Robert Yin defines research design as a “logic that links the data to be collected and the conclusions to be drawn to the initial questions of a study” (Yin 1994, 2). It all comes down to the fact that in other words, research design is an idea of process how from general suppositions come to conclusions based on data analyses (Creswell 2008).

#### **5.1.1 Types of Methods**

Three research methods are differentiated in books. They are qualitative, quantitative and mixed one. The two first approaches are not totally opposites. However quantitative method is mainly used to analyze numerical data. If there is a need to analyze data such as theoretical material, objects or information, for example, then qualitative method predominates. Mixed design combines both qualitative and quantitative approaches (Creswell 2008). Some researchers are mistaken supposing that quantitative research method is better than qualitative. The truth is that they are just different and each researcher is tending to use one or another method depending on which is more appropriate in the research (Dawson 2002).

In this thesis, qualitative method is mostly used to analyze theory, forecast and collected data.

## 5.2 Data Collection

Data can be of two main types: primary and secondary. Primary data is the data which is gathered by researcher. The researcher of this thesis collected data through conducting the interviews. More specifically it will be described below at 5.2.1 paragraph.

Secondary data is data already gathered, not by the researcher. In the case of this thesis, secondary data is obtained from different sources; such as books, journals, annual forecasts and reports, articles, research papers and official websites of airplane design bureaus and airlines.

### 5.2.1 Interviews

According to Lichtman (2009), there are four types of interviews: structured, guided or semistructured, in-depth interview, casual or unplanned interviews.

*Structured interviews* have the same questions prepared for the entire interview. Usual procedure using this type is when interviewer asks the same before prepared questions and ticks the box.

*Guided interviews* are prepared questions beforehand and used for all people but can be changed in the process of interview.

*In-depth interview* is when the interviewer has main questions but the conversation is conducted in free style (Lichtman 2009). According to Dawson it is also called “life history”. This type is used only for qualitative research (Dawson 2002).

*Casual interview* is a dialogue which happened spontaneously on the topic related to the research (Lichtman 2009).

There are four methods of recording: tape recorder, video recorder, note-taking and box-ticking. All of them have advantages and disadvantages and the choice depends on the interview type. Box-ticking goes with structured interview which involving questionnaire. Tape recorder is good while in-depth interview is conducted. Interviews can be conducted face-to-face or over the telephone. (Dawson 2002).

In case of this thesis, the tape recorder was used during the interview process.

The main source of primary data in this research paper is interviews. Out of the four types of interview, in-depth interviews were conducted with the management chain while visiting the Antonov Design Bureau and Antonov airlines. It gave the possibility to get broader information with many small details occurred in a free spoken style and through a face-to-face conversation. There were prepared questioned the author wanted to find answers for, but the interviewer only led the conversation in the direction he needed. Casual interviews were done too, very spontaneously when researcher met different workers at Antonov Company. It gave broader understanding of the problem taking into account different points of view.

Table 5.1 indicates the interviewees and which types of interviews were conducted with them:

Table 5.1 Interviewees list

<b>Interviewee</b>	<b>Type of interview</b>
Senior Manager Antonov Airlines	In-depth interview
Commercial Executive Antonov Airlines	In-depth interview
Employees of Antonov Design Bureau	Casual interview

In-depth interviews require a list of questions or a list of topics the interviewer wants to discuss. In the case of this research, the author made a list of topics which are to discuss in order to obtain needed information for the analyses of the problems and in order to find answers on putted study questions:

1. The operation of the AN 225 nowadays;
2. The reason of using the AN 225 for commercial purposes since 1991;
3. Destinations the AN 225 operated the flights;
4. The main customers of the AN 225;
5. Commodities carried by the AN 225;

6. The group of commodities most profitable to carry by the AN 225;
7. The airports able to accommodate the AN 225;
8. The Challenges Antonov Airlines faces operating the AN 225;
9. Advantages and disadvantages of the AN 225;
10. The expire year of the AN 225;
11. The factors preventing the AN 225 operate more intensively;
12. The condition of the second AN 225;
13. Feasibility of the second machine of the AN 225;
14. Factors which could influence the manufacturing of the second AN 225;
15. Interested parties in ordering the AN 225;
16. How Antonov company sees the AN 225 in future;
17. External factors which can impact positively and negatively the future usage of this aircraft in logistics operations;
18. Operation costs of the AN 225;
19. Plans connected to modernization of the AN 225.

### *5.2.2 Challenges*

The data collection process was hard and the researcher faced several critical problems gathering primary data as well as secondary.

Secondary data collection process was easy in terms of articles from scientific database online. The books related to logistics and the air cargo industry were easy available that is not true of the books about Antonov Design Bureau, the AN 225. To find related books required visiting several different libraries in Kiev, namely National Vernadskiy Library of Ukraine, National Aviation University Library, Kiev National Economic University Library. There were many books on the subject written twenty or even thirty years ago or even of the time of the USSR and the information was not up to date.

Big struggle was to obtain primary data. It took the whole day to go from one office of Antonov Bureau Design in Kiev to another asking to be able to conduct the interview with a person who would be engaged in the AN 225 operation. The first try was on vein. The researcher wrote official application to get the possibility for the interview. Since there was no response, the telephone call was regarded as one of the attempts to get in

contact with the employees of Antonov Design Bureau. Going through the long and difficult process of getting chance to speak to, it came to a good result and eventually the primary data was collected in full.

## 6 Analysis and Discussion

This chapter aims to analyze major findings from interviews which were gained from employees of Antonov Design Bureau. It presents a SWOT analysis of the AN 225 based on information gained from primary and secondary data. Furthermore chapter provides discussion of the findings written in this part and theoretical background of the part 2, 3 and 4.

### 6.1 Interview Reflection

After the interviews with the employees of Antonov's company had been conducted, the summation of the data gathered was reflected in the following logical sections

*Preconditions led the AN 225 to be used commercially.*

In 2001, type certificates were issued to the AN 225 by the State Department of Aviation Transport of Ukraine "Ukraviatrans" and Aviation Register of Interstate Aviation Committee (AR IAC). These certificates give the permission to use the AN 225 for civilian mission flights. All reconstructions were done by Antonov Design Bureau in Kiev, Ukraine. These reconstructions took several years and required large capital investments. This machine started its commercial operations in December 21, 2001. Its first commercial flight was operated from Stuttgart, Germany to Oman, Jordan.

*Current situation related to the AN 225 usage in commercial area*

As a rule of today, the demand for the AN 225 is low since there is not much cargo of such category. Keeping in mind the immense scale of the cargo the AN 225 is able to transport, unfortunately the market for continuous transportation just isn't there. The cost of one flight far exceeds that of the AN 225's competitors and customers are not willing to pay the difference. Typically the amount of orders depends on current situations in the world. The increase of peacekeeping operations, humanitarians and economical activities has a positive impact on the use of aircraft. An average airplane gets less than 50 orders per year. It happens very often that the freighter operates several flights per month and the next two months stands idle. As an example, in February and

March 2013 France started their peacekeeping operation in Mali and the AN-225 performed several flights with French military equipment but on the moment of interview the aircraft has not been used for more than one month.

#### *Operation of the AN 225 starting in 2001*

For some reasons there were not so many orders in the beginning of the aircraft operation for commercial purposes. Several reasons can be underlined:

- Poor advertisement which lead to few orders in the beginning;
- Narrow range of products which can be transported by AN 225;
- Existence of aircraft AN 124 which is able to carry reasonably large range of goods. The freight weighing up to 120 tonnes can be easily transported by AN 124, all more than 120 tonnes automatically goes to AN 225.
- Number of restrictions which created many obstacles for transportation of cargo.

#### *The major reasons for the low demand for AN 225*

The reason why the demand for the AN 225 is not very high today is because there are many different limitations. Basically the machine can take a weight of 250 tonnes but the company often faces the fact that it is very difficult to do and in many cases it is unreal because of the restrictions on the route. One of the main limitations is not a sufficient number of suitable airports.

In some regions where there are a large number of good airports, it is not allowed to take more than 160 tonnes of load, although the technical characteristics allow 250 tonnes. Such restrictions usually are imposed by airports. There are quite a number of cases when an airport has the capability to accept the plane but does not do it as the AN 225 takes a great amount of parking space and needs a lot of attention from the service organization. Therefore, busy airports cannot afford to have such aircraft.

Among other problems, one can name the fire preventive category of an airport as the plane is flying a tank with a great deal of fuel. Therefore, many airports may not provide the desired fire safety class. It should be admitted that some airports have come out of this situation in the following way: the authorities of the airport ask to be informed a few weeks in advance in order for them to rent additional equipment, people, fire engines



and gain the right amount of water in the extra tank. However, it must be emphasized that this is a very rare event because it is not very profitable to upgrade the airport to the needs of the AN 225.

Constant problems occur with countries such as India, China and North America when the load weighing 200 tonnes is carried by the AN 225. As soon as Antonov Airlines try to move the goods somewhere in the region of China, there are always problems. To fly over Russia there are good airports but far enough away. To fly through the south, as India, only two airports give permission to the AN 225 to land, and they are in very bad places. Airports located in regions such as Mumbai, Delhi, Ahmedabad and Calcutta is very often a convenient route but they do not accept such aircraft as the AN 255 due to some reasons. As we all know China is a vast country but there are only two airports that accommodate the plane today. They are Shijiazhuang in Beijing and Hong Kong. In the Shanghai area or close to it there is no airport that accepts the AN 225. There is one airport in South Korea, Incheon and several Japanese airports which allow the plane to land. In North America, a large number of airports are well suited for AN 225 with maximum load but only ten invites the AN 225.

At the same time it is easily possible to transport the cargo from Europe to Saudi Arabia and Emirates because the infrastructure is greatly developed in Arabic countries although there is challenge. Extremely hot temperatures are also a problem for the AN 225 landing at the airport of Arabic countries. That is why the transportation is organized in such a way that the plane can land at night when airstrip is not hot due to the heat of the sun.

Sometimes it happens the airport will agree to have the aircraft but closer to the date, they refuse. As an example, there is Sri Lanka Colombo. Commercial manager of one of the airports in that country once invited Antonov Airlines to bring the AN 225 to visit the airport and even promised good conditions almost at no cost. However, when the plane was about to fly with technical stopover in Colombo they refused. Consequently, Antonov airlines sometimes face instability in terms of using an airport.

Another detail when carrying heavy cargo is it must be specially prepared. For example, if it's a transformer, then it must be the transport safety frame where the transformer is placed into. To design this frame, test, approve and produce; two to three weeks are

required. If it is not far, it is better to ship the load by sea as much time is spent on flight preparations.

#### *Commodities carried by the AN 225*

The most appropriate freight for the AN 225 is goods for industrial use such as mobile power generators, oil and gas exploration machinery, electrical transformers and so on. Everything else can be transported more profitably by the AN 124, especially containers. Cargo cabin of the AN 124 can accommodate twelve 20 feet containers. They are very easy to load due to the internal cranes that can download containers inside and put them into the right place. Regarding the AN 225 carrying containers there are no advantages because the AN 225 is only 5 meters longer than the AN 124. Therefore, basically speaking about types of cargo for the AN 225, it is a very heavy load or those that cannot fit in the AN 124. As for military branch, what makes sense to transport using the AN 225 is tanks only because everything else is designed to be transported by military aircraft. Therefore, almost all the military cargo can be transported by the AN 124, in principle it was designed for this purpose. In order to take humanitarian aid, such aircraft as Boeing 747-400 and the AN 124 can cope with it in most cases. For the last years the AN 225 operated only several flights with humanitarian aid. The experience of Antonov Airlines shows them that for general cargo it is more affordable and better to use other freighters instead of the AN 225.

#### *Average traffic volume per flight in terms of tons*

As it was mentioned before the characteristics of AN-225 allow carrying 250 tons but there are some restrictions that make it possible to carry mainly the cargo weighing only 120 – 180 tons. It means that external limitations don't allow using full capacity of this unique aircraft.

#### *Production of the second AN 225*

First of all, it is very expensive to create another copy of the AN 225. To estimate the current situation, the airplane performs very few flights per year and sometimes can stand idle for several months because the load is not often suitable to be carried by the

AN 225. If the existing model of the AN 225 is not in use at full capacity, there is no sense creating a second one.

Some experts predict that exactly the same situation may be repeated as it was with the AN 124. Although the initial demand for the AN 124 was very small, as soon as the plane started to operate flights, there was a revolution in the market. It appeared just a mass of goods to be transported by it. Manufacturers of equipment began to design the load so that it can later be carried by the AN 124. Perhaps this situation is waiting for the AN 225. But rather narrow range of the aircraft market cannot give such an effect. No one really can make a precise forecast and maybe the second aircraft will stand as the first in the parking place.

Also today there are a lot of technical and financial issues preventing a second aircraft construction. Many professionals (especially engineers) who work at the Antonov Design Bureau do not believe in improving the second plane because they say that there is nothing to finish. All must be done from the beginning. To re-do this requires enormous investments. Antonov Design Bureau has enough capacity for the construction of a new aircraft in terms of people and the right equipment, but big amounts of money are needed and no one will provide it.

#### *Main customers which order the AN 225*

A great deal of orders are made by brokers, as they know about the AN 225 like no one else, but there are cases when firms (producers) call directly and make an order to transport industrial goods for them and ask for the AN 225 to perform the flight. Usually they are manufacturers or repair companies which need to transport from a continent to other transformers or turbines.

#### *Terms of operating the AN 225*

State authorities of Ukraine decide in regards of usage terms for each aircraft produced in the country. When the term is expired it can be extended but it requires routine maintenance and inspection. Only after this procedure, aviation authorities make a decision either to prolong the term or not, and if so, for how long. In usual practice the term is prolonged for ten years. Antonov planes are made with a large margin of safety

and are generally well exploited. Antonov airlines foresee that the AN 225 will fly for quite a long time.

#### *Serial production of AN 225*

As we see today, many airports are being upgraded for Airbus 380 and this leads to great opportunities for the AN 225. Over time, the situation can be changed for the better for the AN 225. The existence of two or three AN 225 is possible only when the amount of oversized cargo will be increased. It must be said that for such companies as FedEx and UPS such aircraft will not be as attractive because they mainly transport parcels. This aircraft can only be attractive to companies that are engaged in transportation of outsize and heavy cargo. So far in the current market situation, many cannot take a risk on such a step because it is economically inefficient to have such an aircraft. Parcels and general cargo is not profitable to be transported by the AN 124. As it was already mentioned the AN 255 is intended for super heavy cargo or monocargo and no other aircraft can transport it.

#### *Future modernization of AN 225 in order to reduce operational costs*

There is a possibility that the AN 225 will be upgraded including powerplant, it will bring the same efficiency as Boeing aircrafts. Antonov management team once evaluated the possibility of installation of foreign engines. In principle, these engines can be replaced on the plane and they are quite reliable and efficient. It is very attractive but to change the type of engine is a very complicated and lengthy procedure that requires a large financial investment. New engines would lead to infrequent technical inspections and less usage of fuel which means the reduction of operational costs. Antonov's engines are quite reliable, but, of course, foreign engine manufacturers' performance is much better. Today Anotnov Design Bureau doesn't have so much money to invest in a project that has a little chance of success. Now the plane spends an average of around 20 thousand liters of fuel per hour of flight. In comparison, the AN 124 consumes an average of 11 thousand liters per hour. In general, it must be said that foreign planes are more beneficial due to more efficient engines and maintenance costs due to universal technique that is scattered all over the world.

## 6.2 SWOT Analysis

Previous parts looked at historical profile and current situation of the AN 225. In addition results were analyzed got from interviews at Antonov company. From this stage SWOT analysis will be developed in order to audit the product and its environment. This SWOT will start from detection of aircraft's internal strengths and weaknesses based on the information gathered from the interviews with Antonov's staff and different literature.

As it was mentioned above the AN 225 has a unique ability to lift up the load in the air weighing 250 tons. This unique ability can be regarded as the major aircraft's strength. Despite the recent introduction of such giant as Airbus A380, the AN 225 still remains only one aircraft in the world which has ability to carry so much weight. "No other name carries more weight" is the slogan which belongs to the company that owns this aircraft.

In 1989 the AN 225 showed the world that it is capable to carry freight on the external store. The aircraft has special vertical tail which gives opportunity to make the transportation of heavy large-sized single piece outside of fuselage. Technical characteristics of flying machine allow taking loads up to 200 tons on the external store. As example it could be such load as distillation columns or something else.

Among other aircraft's strengths can be named ability to load and unload cargo without the use of ground-handling equipment as the AN 225 has onboard complex handling equipment, forward cargo door with ramp and winches which allow to fulfill the loading operations without involving any other external equipment. It has already proven that it is pretty big advantage as it is sometimes needed to land the aircraft in remote locations especially for delivery of military equipment where there is no equipment for discharging operations.

Among weaknesses of the AN 225 can be underlined the following points: large size of aircrafts, high operating cost, the absence of the back cargo door with ramp and in addition to that is less reliable compared to such aircrafts as Boeing and Airbus.

For now large size can be named as one the biggest drawbacks of this machine. Nowadays there are hundreds or maybe thousands of airports around the world but just small portion of them is able to accommodate the AN-225. This plane is too massive for

most of the destinations due to some reasons such as lack of available equipment and human resources for fire protection, short runways, lack of space and others.

High operating cost is considered as another weak point of this giant machine. The installed equipment and different systems on the aircrafts are not efficient any more compare to advanced technologies which exist nowadays. As an example, during the flight, the plane burns in average 18 000 - 20 000 tons of fuel which much more compare to up-to-date aircrafts like A380, AN 124 or B747. Addition to that the AN 225 requires having six crew members: commander, co-pilot, navigator, radio operator, chief flight engineer and flight engineer while the crew of A380 consists commander, co-pilot and sometimes flight engineer who is responsible to monitor pressure gauges.

The AN 225 is less flexible in terms of technical support than modern cargo aircrafts. There are not so many people who are skilled to maintain this type of aircraft around the world. It means that the company owing this plane must send the technician and spare parts to the place where breakdown occurs as there is almost no chance to find needed specialist aside. Such situations lead the company that owns the aircraft to some negative consequences.

The absence of the back cargo door with ramp is one more weakness of this unique aircraft. The existence of a back cargo door would give the possibility significantly to reduce the time of cargo loading processes.

Among environmental opportunities and threats the following points can be named:

Opportunities:

- Technological innovations
- Development of airport infrastructure;
- Government support;
- The growth of oversize and heavy cargo market.

Treats:

- Economic downturn;
- High fuel prices;

- Environmental policy;
- Appearance of new large aircraft as AN 225.

Technological innovations in aero engine direction are a good opportunity for air cargo business as it will help them to reduce fuel consumption. Nowadays fuel for many air cargo operators accounted almost for half of total operation expenses. In addition to that, developments in this field will help partly to overcome efficiency and environment problems.

Development of airport infrastructure is another opportunity which can positively impact on more extensive use of such big monsters as the AN 225. As it was mentioned before there are just several dozen airports which have needed infrastructure and parking space to serve large aircrafts.

The growth of oversize and heavy cargo market turns out to be good for Antonov Company to construct a couple of brand new AN 225. The growth of this market highly depends on development of such industries as oil and gas, aerospace, power engineering, transport, and mining since they mainly generate movement of heavy large-sized freight.

Government support is one more external opportunity which can lead to appearance of new Ukrainian aircrafts such as the AN 225. This support can be provided in the form of soft loans for the development of production, financial investments or tax cuts. Regarding threats, high fuel prices and economic downturn are the most important ones. The history shows that these factors have tremendously adverse impact on air industry. As example the fuel crises of 1970s demolished “well-established names like the US cargo carrier Flying Tigers” (Doganis 2010, 291). Recent events such as financial crises of 2007 - 2008 significantly hit the air cargo business destroying many freight markets and cargo operators around the world.

The environment is one of the hottest issues in aviation industry. There are many different international and local organizations such as IATA and ICAO trying to “develop a range of standards, policies and guidance material” (<http://www.icao.int>) in order to reduce engine emissions. Airlines, air cargo operators, manufacturers of commercial aircrafts and other players will be forced by new regulations and policies to invest a lot of

resources into new environment-friendly technologies. Thus, this issue can be a threat for the AN 225 and for the Ukrainian aviation in general.

Among other threats is the appearance of a new monster like the AN 225 which will be more efficient and environment friendly.

### **6.3 Discussion**

The discussion of the findings provided in this part and theoretical background provided in part 2, 3 and 4 is presented in this chapter.

Studying the commodities carried by air cargo transport it is clear that today the wide range of products is shipped from one region to another. In 2011 according to the Boeing report the volume of carried goods by air accounted for 43 million tonnes. Organizations specialized in air industry forecasting predict that this future will only increase and, in a few decades, eventually double. However, collected information shows that the AN 225 was designed mainly to transport oversized and exceptionally heavy cargo. Among the 43 million tons of cargo transported by air, the cargo that falls into this category is negligible at best. This leads to the AN 225 operating infrequently as the cargo shipped isn't enough to justify the use of the AN 225 in transport on a regular basis and leads to them idling and out of use for months on end

There described many different industries which depend on transportation. At first sight it seems that such aircraft as the AN 225 can be of much use since areas of business as oil and gas, mining, construction, transport and aerospace have necessity to transport huge amounts of load and heavy cargo. Again, based on the opinions of Antonov company, it is clear that different industries would order the AN 225 only in very exclusive cases, otherwise they would use smaller type of aircraft or if it is not urgent, they would prefer any other mode of transport described in part 2.

There are several groups of main key players in air cargo industry: combinational and all-cargo carriers, integrators, ACMA providers and forwarders. According Airbus report, in total there are 200 operators offering air cargo services around the globe using 1615 cargo aircraft. Looking at this picture it can be concluded that the AN 225 is among them and must have been attractive for air cargo operators. But as it was mentioned already



the AN 225 is suitable for special category of cargo and can be interested only for those operators which are involved in transportation of heavy and outsize freight. Today there are few large operators working in this sphere: Volga Dnepr, Antonov Airline and Cargo Lux. Therefore, there can be only numbered companies which can be interested in purchasing or using the AN 255 as Antonov Design Bureau sees that the market for their Mriya is very narrow. They also claim that such giant in cargo transporting as UPS or FedEx having big fleet will not be a potential customers for the AN 225 as these operators are specialized in general cargo and small parcels shipping.

In part 3, chapter 6 of this paper Boeing and Airbus long term forecasts was analyzed. Boeing assumes that operator involved in air cargo business will have to increase their freighter fleet in order to satisfy the demand for air cargo services in future. They predict that by the year of 2031 the number of freighters will reach more than 3000 which is double more than today. The number of large aircrafts will be 926 machines, 678 of them will be new, produced during the future twenty years. Airbus presents positive forecast as well, supposing that there will be 1030 of large freighters and 440 must be produced within two coming decades. In the process of collecting data and conducting interview, Antonov staff members were asked to comment on the forecasts of Boeing and Airbus regarding the AN 225's future. The opinion of Antonov Company is not firm as there are many restrictions and limits which prevent usage of the AN 225 in different countries. Furthermore many customers are interested on aircrafts to be efficient in terms of fuel consumption and environmental friendly. Of course, the AN 225 must be upgraded in order to be competitive. It requires huge investments which Antonov Company doesn't possess.

It was mentioned that the second AN 225 is 70% ready. There are a lot of discussions on it in mass media. It says that Antonov Design Bureau negotiates this matter with the customer and in two-three years it will be ready (<http://www.segodnya.ua>). In reality there are indeed parts made for second AN 225: fuselage, wings and center section plus some other small details. But according to the direct source information obtained by researcher these parts are considered to be outdated as they were made during the USSR time. Engineers of Antonov Company agree in opinion that if to manufacture new AN 225, old details will not be in use and they would have to project the new machine from

the bottom. Many employees don't believe in the fact that new AN 225 will be constructed in recent years.

Air cargo business is a young compared to the other transportation businesses as it was studied in part 2 and 3. But despite of its young age for the last 50 years it reached great development. Now huge number of cargo aircrafts fly each day along with passenger planes; infrastructure is highly developed, technologies allowing airports to accommodate a plane in various conditions as well as at any time. Even so, Antonov Company believes that the world is not ready and prepared for the AN 225 as there are not so many airports can accommodate Mriya today it is desired. It means that is the operator owning such giant is not able to fly where he needs because of some restrictions this aircraft is useless for him.

## **7 Conclusion and Further Research**

The chapter presents the final conclusions the researcher have come to. Also further research suggestions are included in this chapter.

### **7.1 Conclusion**

The purpose of this research was to investigate the future potential usage of the AN 225 in commercial operations. Based on analyses of theoretical material and data findings and reflection the following conclusions are presented by the researcher:

1. Wide range of products is transported by air yearly. The major types of products are machinery and electrical equipment, documents, small packages, apparel, pharmaceutical products and so on. In terms of weight 43 million tonnes were shipped across the globe by air only in 2011. As the research showed it is not advisable to use the AN 225 for small and middle shipments as there are many other analogs which are more efficient for transportation of such products. Today this airplane is used only for outsize and super heavy loads.
2. Based on finding it is clear there is no potential customer for the AN 225.
3. In near future the AN 255 will be used by Antonov Airlines as exclusive aircraft operating the flight on demand carrying only unique cargo types.
4. The completion of the second AN 225 is not possible due to outdated details made for it more than twenty years ago. There is a chance of the appearance of a new machine, and if the customer invests in this project they can have an exclusive product, instead of a machine for making profit. Although, a bad economy shows that the idea is less likely to be brought to life.
5. Looking at the future, based on SWOT analyses, one can conclude that there are mainly two factors that can influence on the AN 225 in positive way: growth of oversize and heavy market, and development of the infrastructure which will allow the AN 225 to fly freely to any destination.
6. To increase its future potential, the AN 225 would need to be upgraded in order to attract some new customers in the next ten years. Through modernization, it's very

easy to manufacture a new plane since this one is constructed in a very specific way and everything is connected.

7. Antonov Airlines has no programs related to modernization of this aircraft due to a lack of funds. From interviews it was clear that the government of Ukraine is not planning to find the funds from the budget in near future. At the same time there are no investors who would be ready to invest in a risky project.
8. There is one factor revealed through the SWOT analyses which casts doubts regarding the future potential of the existing AN 225. This factor is environment policy. Since communities in the world today are trying to reduce the amount of greenhouse emissions, laws have become stricter.
9. Despite the forecasts of the Airbus and the Boeing that in future twenty year air cargo fleet will be multiplied, Antonov Company doesn't believe that there will be a demand on new AN 225.

Summing up the conclusions made above it is clear that there is a low demand and low level of suitable cargo even for one AN 225. There are not enough suitable infrastructures for accommodating the aircraft. Because of these negative factors the plane isn't attractive for potential customers. From another hand there are a lot of commodities shipped by air, but it is not profitable to use the AN 225 for major part of this range of commodities. To change this situation globally, the machine must be redesigned and modernized. This is impossible due to financial absence as Ukrainian government is not ready to subsidize such projects. For realization of modernization project investors could be involved but there are many factors which hinder to do so. Thus, the future potential usage of the AN 225 in logistics operations is not perspective and in near future the only aircraft will exist and will operate at the same regime.

## 7.2 Further Research

Practical part of the research is based on Antonov Company study. It would be interesting to examine one of the biggest freight transport operator as Volga Dnepr as well as conduct interviews with firms who are engaged in air cargo business.

The further research is possible in studying famous cargo aircraft produced by Antonov Design Bureau the AN 124 because today the possibility of renewing the serial production of this type of machine is considered seriously. It would be very beneficial to investigate if

it is advisable to restart production of the AN 124 in terms of huge financial investments and organizational juridical operation.

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