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CONVERSION OF PASSENGER AIRCRAFT TO CARGO VERSIONS

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Abstract

In this presented paper on the topic of conversion of passenger aircrafts to cargo versions, the use of this transformation in the modern history of aviation is analyzed and the current situation is analyzed. For a better introduction to the issue, the introductory part defines the fundamental terms and explains the conversion itself and its various stages. The paper also discusses the companies that provide services for the actual conversion of passenger aircraft and the location where this process takes place. The paper is further supplemented by individual types of aircraft, which are divided according to global manufacturers such as the American Boeing and its European competitor Airbus. The main goal of this paper is to bring closer and clarify this process, which has gained momentum in recent years and has great potential for the future. This paper is very significant in case of COVID-19 pandemic and its huge influence on general aviation when there is enormous demand of conversion passenger aircrafts to cargo versions. The most common causes of conversion, advantages and disadvantages are also included. The conversion process itself is described in more detail and the paper focuses on the various technical phases of the aircraft conversion itself.

Keywords

Conversion of aircraft, Transport, Freighter, Company, Boeing, Airbus

1. INTRODUCTION

Since its inception, air transport has been a permanent part of everyday life, in the form of the transport of passengers and their luggage, otherwise it can provide the transport of various goods of everyday needs. Freight transport accounts for a significant share of the aviation market and accounts for a significant proportion of the flights that take place during the day at world airports.

For companies that have specialized mainly in freight transport since its inception, the option was to purchase a new cargo aircraft or convert a passenger transport aircraft that would meet all requirements and provide technical parameters as a full-fledged original cargo version. The use of aircraft for purposes other than those originally manufactured and specialized dates back to the war period, where mainly military aircraft later performed tasks in civil aviation for the transport of passengers or goods. The conversion or process of conversion of the aircraft from the original destination, in this case freight, to freight has long been associated with aviation associated with its application has found many carriers who have used this option to extend the life of their aircraft or the entire fleet.

The last period of 2 years has significantly increased the intensity of cargo flights and has benefited more from companies that have focused exclusively or largely on cargo flights. While passenger companies had no one to transport, as travel between countries was banned due to the measures, this was a significant burden for freight companies. For many passenger airlines, focusing on freight was the only way to avoid losses during the COVID-19 pandemic, and their origins included the transfer of medical supplies, respirators, drapes and gloves. Companies with their transport versions could only use the lower cargo area of aircraft, which is often called belly cargo hold. In this way, however, the flights were not financially advantageous and the maximum payload of the aircraft was in many cases less than half. For this reason, too, the first steps consisted of storing the goods directly in the unmodified cabin in the passenger seats, where everything was secured with drawstrings, or still secured with safety nets if the goods were released. This solution was not financially sustainable in the long run, so they decided to dismantle the seats, resulting in lightening while maximizing space exclusively for the goods. As a result, it was again possible to load the aircraft more to make the flight itself even more financially profitable.

However, the situation did not improve and the vision of freight transport drew even more attention to the possibility of conversion and forced companies to use this solution to modify their current aircraft, or most of their fleets.

2. METHODOLOGY AND SELECTION

The main goal is to describe and present the individual phases of the process of conversion of passenger transport aircraft to cargo versions. Specify the technical steps during the conversion. For easier introduction to the issue, the individual basics of the issue will be described and listed as basic concepts to better clarify the topic.

The main method we will use will be the analysis, as the given topic will be divided into individual parts as a whole, which we will discuss in more detail and explain in more depth.

We will primarily deal with the current state, but we will also look at the history, as long as it will be necessary and necessary in the individual parts for the smooth continuity of the whole issue.

Subsequently, the individual types of aircraft and companies that provide the possibility of conversion will be listed and we will describe them in more detail. Next, the reasons and causes of the conversion, which most often occur in individual operators, are discussed.

3. CURRENT SITUATION OF THE ISSUE HISTORY AND THE BEGINNING OF CONVERSION IN AVIATION

Air transport saw a significant increase in the post-war period, when it slowly but surely integrated into the daily lives of the citizens of almost every country in the world. During these times, the number of built aircraft, which no longer had a way to be used in their original purpose, also increased significantly. If they were not to be decommissioned, they had to find an alternative role that would extend their life, especially from an economic point of view [5].

As it was no longer necessary to carry soldiers, weapons, bombs, ammunition and other military equipment, the civil aviation offered options such as transporting passengers or goods. As air tickets were an extremely expensive item for the average citizen, the vision after the transport of goods was more attractive. It should also be noted that the conversion of former military aircraft to freight was a relatively easier route, as providing sufficient equipment and comfort for passengers was a much more extensive modification, which of course took longer and cost more [5].

Over time, aircraft manufacturers began to produce new aircraft, in this case primarily aimed at transporting passengers and cargo. Meanwhile, freight traffic began to grow and gain strength, with a sufficient number of aircraft and demand coverage itself to be ensured thanks to a combination of newly manufactured and converted aircraft [5].

Among the first aircraft to be converted for freight were piston models such as the DC-3 / C-47 or DC-4 / C-54, which were produced in large numbers and were the most proven aircraft at the time. pilots. From the piston to the turboprop, where we can mention representatives such as Convair 580, Vickers Viscount, Lockheed L-188 Electra or Fokker F27 Friendship [5].

The current era in the late 1960s brought aircraft such as the Boeing 707 or Douglas DC-8. These were four-engine narrow-body aircraft, also known in the Air Force as narrow-body, with one aisle for passengers. As there were not enough jets at the beginning, the manufacturers did not manage to produce a sufficient number of aircraft to cover the transport of passengers and cargo. Therefore, some were converted to costly versions to complement the costly fleets of the companies. Other aircraft from The Boeing Company that went through the process of conversion to expensive versions were the Boeing 727 and 737. The legendary Boeing 747 also joined these representatives and was later supplemented by models 757, 767 and 777. Douglas designed another model. DC-10 and later after the merger with McDonnell in 1967 it was a larger version of the MD-11. These two models currently fly mainly as expensive versions, and very often they are rebuilt aircraft. As for the European jet models that started the conversion process, it was mainly the Airbus A300 and its smaller model A310 [5].

Newer types such as the Boeing 757 and 767 and the Airbus A330 were added to these models in the 1980s. Models 757 and 767 were later added by Boeing. Today's conversion providers offer services primarily for these aircraft, with models such as Boeing 777, Airbus A320 and A321 or Boeing 737 from the NG series gradually being added [5].

3.1. CONVERSION AND ITS INDIVIDUAL STAGES

A conversion is a physical transformation that changes an aircraft from the original to the new destination. In this case, it is a conversion from a passenger transport aircraft to a cargo version, also known in the aviation as a freighter, which will be able to compete with the original cargo versions on the aviation market. It will find its application with potential aircraft operators mainly due to financial advantages, more current availability of several types of aircraft, but also a shorter process of inclusion in their fleet [5].

The interior will be stripped of parts and unnecessary equipment will be installed, such as interior fittings and equipment in the form of seats, kitchens, passenger toilets, storage and storage areas, side and ceiling hand luggage consoles, oxygen equipment and a passenger entertainment system that includes touch screens or other control devices. During this phase, the intention will be to keep the interior of the aircraft as clean as possible to provide space for subsequent modifications and to maximize space for cargo containers (ULDs) [5].

Exterior parts of the fuselage such as windows will be completely covered with the help of special aluminum panels and light window bolts. There will be more interventions in the structure, while the most visible and characteristic part of this process is the installation of cargo doors (MDCD), which will be located on the left side of the fuselage, which will be sufficiently reinforced and reinforced. The door will be opened by a hydraulic or electric mechanism. The main deck will also be strong enough to withstand the new forces and pressures created by air containers, pallets and other goods. A new ceiling lighting, drainage system and cladding inserts will come into the cargo interior along with the new main deck to protect the cargo interior walls from damage. As containers, pallets and other goods will need to be moved across the main deck, a loading system (CLS) is required to allow easy movement without significant friction or damage to the deck or container surface. Older conversions have a non-powered floor, while newer converted aircraft will have electric rollers and ball bearings installed to move the container without the need for physical pushing by airport personnel [5].

A particular aircraft may go through the conversion process at several companies, which have their own designation for their programs, and the aircraft itself may then be designated as P2F, BCF, BDSF or PCF. Originally manufactured cargo versions of aircraft are marked with the letter F, while conversions have SF. This is actually the designation of the process itself, which has been described above. The P2F conversion may traditionally be performed by the original equipment manufacturer (OEM) or it may be a contracted third party or an independent company that is able to enter into a cooperation agreement with the original equipment manufacturer. The latter case of a provider of such conversion services is a third party who has the means for its own conversion solutions. Typical representatives of OEM manufacturers are already mentioned Boeing or Airbus. Third-party companies are, for example, EFW, which together with ST Aero provides conversion services for Airbus. Aeronavali or the

Israeli company IAI is cooperating with the American giant Boeing [6].

3.2. REASONS AND CAUSES OF CONVERSION

For companies and operators, this is a way to extend the life of an aircraft by 20 years, and for some aircraft it can double their current age in active operation. This process is primarily provided to older aircraft, which, as transport versions, would no longer meet sufficient comfort for passengers but still technically meet the criteria for operation in the countries concerned. For older transport aircraft, this is an ideal way to avoid their permanent grounding at airports or larger areas such as the Mojave Desert, or subsequent scrapping [6].

Financial reasons will be among the most crucial ones, which are often very burdensome for operators. When buying a new and original version of a cargo aircraft from Boeing or Airbus, the future owner will pay an average of four times the price of the conversion. The conversion prices for the smaller aircraft range from $ 10 million to $ 12 million. The price for a medium-sized category of narrow-body aircraft is between 15 and 20 million dollars, and for wide-body aircraft it can reach up to 20 or 30 million dollars. The largest categories range in price from $ 55 million to $ 65 million. By comparison, the price of a new medium-sized wide-body cargo plane is $ 70 million, and for even larger types, we get up to a whopping $ 150 million. These prices are a frequent reason that companies prefer to invest 25% to 30% of the price of a newly manufactured aircraft. [5].

Maximizing the cargo space and / or increasing the dimensions at the loading and unloading points are other reasons that will convince companies to choose this option. The conversion adjustment will also significantly increase the maximum weight of the goods and the maximum payload, which is also called payload in aviation. [5].

For these reasons, it is possible to point out the advantage of the conversion and the associated new functions and capabilities of the aircraft are associated with it. However, it should be emphasized that compared to a completely new aircraft, the price is significantly lower, but still not negligible. This step is a technically demanding solution and will pay off for companies over a longer period of time [5].

3.3. ADVISABILITY AND CHOICE OF AIRCRAFT TYPE

At present, companies can choose from several types of aircraft that can then be converted to expensive versions, and they can also choose a company or provider to provide the conversion process itself. With the right choice of aircraft, technical parameters such as fuselage cross section, payload, range, maximum speed, weight or sufficient center of gravity are often influencing for companies. On the other hand, low investment costs, compatibility with the infrastructure of the airports where they primarily operate, or compatibility with other types of aircraft can be decisive for the potential customer and the future operator. If a given type of aircraft also has an expensive version, then this may also be one of the more significant reasons that leads to the selection of a suitable model [5].

The age of the aircraft is also a very important factor and the ideal aircraft for conversion usually reaches a minimum age of 10 to 20 years. This is also associated with information on the number of hours flown and the service life of individual parts of the airframe, but especially the power unit. For this data, it is necessary to know and have records of the overall history of the aircraft during its operation [5].

The number of pieces produced and the overall expansion of a given model can also weigh on the choice of a given operator, as this can have a significant impact on the number of spare parts and their availability. If the aircraft in a particular fleet is more widespread with the operator, then for this reason it may be more successful in the selection [5].

3.4. COVID-19 PANDEMIA AND THE IMPACT ON AIR TRANSPORT

Over the last 2 years, the Air Force has received a severe blow in the form of a significant decline, especially during transport flights. With more thought, one could also find the benefits of this sharp drop in flights, in the form of reducing emissions, saving on operating costs or significantly reducing the workload of air transport workers. However, the operators did not find it positive even in the slightest point of view. It should be noted that the problem is still felt today and it will take years for it to return to its original state, which would correspond at least to the figures from 2018, or the period from 2019 [10].

As the need to transport goods continued to grow due to online orders, it was the only way for airlines to start filling their aircraft with these goods. The paradox is that with the decrease in passenger flights with passengers, the capacity to carry goods also began to fall, as in passenger versions of aircraft they could carry cargo in the cargo space itself, which was also designed for this together with passengers' luggage [10].

Prior to the COVID-19 pandemic, up to 45% of the world's air cargo was carried in the hold along with passenger baggage during civil flights. Simply put, with the decline in passenger traffic, cargo also suffered significantly, as approximately 50% of the required aircraft cargo space was lost [11].

4. CONVERSION PROCESS PROVIDERS THE BOEING COMPANY

Boeing is one of the world's two largest and leading aerospace manufacturers in the world. The multinational American company, which is interested in designing, manufacturing and selling, has annual revenues of approximately $ 85 billion. It is a global manufacturer striving for countless innovations in various technical fields. The company is currently headquartered in Chicago, Illinois. The company achieves significant commercial success with a large number of aircraft types, and also provides business services [4, 15].

With 40 years of experience in this field, Boeing currently offers Freighter models, expensive versions of the 747-800, 767-300, 777 transport aircraft, as well as the latest version 777-8. The conversion models are 767-300 and 737-800. These models are part of the Boeing Converted Freighter program, and therefore bear the BCF design [6].

Among the representatives of the Next Generation (NG) series, which has achieved considerable success with airlines, is the Boeing 737-800. At present, it forms a significant part of the fleet in companies such as Ryanair, Southwest Airlines, but also in leading ones such as United and American Airlines. It should

be replaced by the latest fourth-generation MAX series over the coming years. This model is an ideal platform for the cargo version on short and medium routes, with a range of 3,750 km alone. The design payload is 23,950 kg and the total volume of the main deck reaches 141.5 m2. ULD Type 88´´x 125´´x 79´´ with a weight of 127 kg can be placed on the main deck in the number of 11 pieces and another ULD Type 60.4´´x 61.5´´ with a weight of 91.7 kg. The load volume of the lower part is 43.7 m³. At the ends of the wings there is a characteristic end in the form of winglets, which will ensure partial fuel savings. In terms of equipment, a fully digital cockpit with the Honeywell CDS system is installed for the two-member crew, which integrates up to 6 large liquid crystal LCD displays. There is also the option of being equipped with a state-of-the-art head-up (HUD) display, global navigation landing system (GNSS) or dual system for more efficient flight control [3, 18].

Figure 1: A view of the main deck of a Boeing 737-800BCF. [Aviation Week: ASL Aviation Orders Boeing 737-800BCF, 2019 https://aviationweek.com/mro/asl-aviation-orders-boeing-737-800bcfs]

Another converted model is the Boeing 767, which can also be considered a long-established transport aircraft. This medium-sized wide-body aircraft is mainly made up of version 300, which is again in this case converted from Boeing to a suitable expensive version for increased demand for goods, as well as a replacement for older types such as DC -10, Airbus A300 and A310, or its shorter version 767-200. It is a versatile and reliable type that is 18% per tonne of cargo more economical than the already mentioned Airbus A300 and produces lower noise emissions. Emphasis is placed on the quality of the process, which guarantees excellent flight characteristics and fuel savings. This is due to the fact that Boeing is the only one on the market to offer additional installation of winglets, which will ensure fuel savings of 3% to 5% on medium-haul routes. In recent years, we can see this model in the fleets of companies such as Air Transport Services Group (ATSG), Amazon Prime Air, UPS, FedEx and DHL, which are showing even greater interest. It should be noted that the first Boeing 767-300BCF was delivered to All Nippon Airways in 2008 [3, 20].

The cargo volume of the main deck is 336.5 m³, while it is possible to place 22 pieces of ULD Type 88´´x 125´´x 96´´ with a weight of 127 kg and 2 pieces of ULD Type 88´´x 125´´x 79´´ . The volume of the lower part is then 108.7 m³ and 4 ULD Type 88´´x 125´´x 96´´ containers weighing 131 kg and 14 ULD Type LD-2 Containers weighing 91 kg can be stored here. . With a range of 6,195 km and a maximum design payload of 52,980 kg, this aircraft is capable of transporting sufficient goods on medium or longer routes [21].

4.1. ISRAEL AEROSPACE INDUSTRIES

It is the largest manufacturer of military and civil aircraft in Israel. . The company was founded in 1953 and in 1959 they focused on their own design and aviation systems. From airspace, through land to the navy, the company is able to provide modern drones, weapons systems, radars, special mission aircraft, navigation and communication systems. [23].

IAI and Bedek Aviation provide IAI under one roof, while 3 divisions of Bedek Aviation Group have services focused on the maintenance of aircraft, power units and other components, respectively. parts. This provider, with more than 40 years of experience in the field of passenger aircraft conversion, is one of the world's best. With a total of up to 250 aircraft delivered, he has gained considerable knowledge of conversion procedures, and now offers this process for the Boeing 737-300 / 400 Classic Series and the 700 and 800 Next Generation Series. Especially in the past, it also provided a conversion for the Boeing 747, specifically its older versions 100 and 200, while nowadays it is only a newer version 400. The last representatives from Boeing are models 757-200 and 767-200 / 300. A great rarity is the offer for the MD-11, which already belongs to the very rare aircraft. They also plan with the Boeing 777-300 and Airbus A330-300 in the future [24].

The Boeing 747 is a long-range, four-engine long-haul aircraft. The first flight took place in 1969, where it was a version 100. Although the 747 model is a large-capacity aircraft, a total of 1569 pieces were produced. Such an adjustment is currently one of the last solutions to keep this type in its fleet, as four-engine aircraft are gradually disappearing from traffic. During the conversion, parts of the main deck such as the girders will be reinforced and additional inserts, new lighting and a loading system will be installed. Door no. 1 and no. 5 will remain fully functional and the rest of the door will be deactivated. There will also be one toilet, a kitchen, a rest area for staff and the part between the front of the cargo area and the cockpit will be separated by a partition. The design payload is 114,759 kg and the load of the main deck is 590 m³, while it is possible to place 23 pieces of ULD Type 96´´x 125´´x 118´´ with a weight of 370 kg and 7 pieces of ULD Type 96´´x 125 ´´x 96´´ with a weight of 350 kg. The load volume of the lower part is 152 m³ and up to 9 pieces of ULD Type 96´´x 125´´x 64´´ with a weight of 120 kg and 2 pieces of ULD Type 60´´x 92´´x 64´´ can be stored in this space. also weighing 120 kg. For companies, this aircraft is able to carry a considerable load up to a distance of 8250 km. Compared to the originally produced expensive version of the Boeing 747-400F, there is a difference that the BDSF version does not have a front nose opening door. With the help of these doors it is possible to load the goods along the entire length of the hull 56.4 meters. In the case of conversion, it will be a traditional location on the left side of the fuselage, as it is a technically and financially demanding procedure [2, 25].

4.2. ELBE FLUGZEUGWERKE EFW

EFW is currently a joint venture between the multinational airline Airbus, which accounts for 45%, and Singapore's ST Aerospace, with the remaining 55%. The company was founded in 1955 and today its headquarters are located at Dresden International Airport [27].

During the conversion of aircraft, the company focuses mainly on Airbus A320 / A321, A300 / A310 and A330 aircraft, which are

subject to the P2F conversion process. The conversion is handled by experienced teams, which handle each aircraft independently and then provide logistics support for the customer [29].

5. DETAILED DESCRIPTION OF THE A330 P2F AIRCRAFT CONVERSION

At the beginning of the conversion, the Airbus A330-300 is taken over by technicians who perform preliminary operations in front of the hangar. Subsequently, the protrusions on the fuselage such as sensors, pitot tube, antennas, or other external parts are covered. Subsequently, hydraulic fluid and fuel samples will be taken as they need to be sent for quality testing. This process will take about one hour [31].

In the next part, the aircraft is stripped of its interior in the form of 400 seats, toilets and a kitchen. Then comes the group for removing the trim, ventilation grilles, side and ceiling panels in the cabin. Hand luggage storage is also selected and the last part is the carpets on the floor. All parts of the interior are dismantled to provide access for technicians during the conversion, maximizing future cargo space, and the equipment is either scrapped or sent back to the aircraft owner. It will take about 20 days for the workers to this point [31].

As far as power units are concerned, there is a possibility that a case of sale will occur. The original owner may decide to keep the engines, in which case the side trim and intake manifold inlet ring will be removed. The side covers are folded down. The technicians get to the auxiliary gearbox or drive housing and disconnect the engine and aircraft units. The motor remains suspended on 8 screws, which can only be unscrewed after attaching the orange support arms, which will help lift the mobile cradle to the motor. At the end of the process, these mobile cradles, which serve as a towing truck, will be taken to a hangar for storage and subsequent transport. [31].

The most noticeable change is the modification of the fuselage at the place where the cargo door (MDCD) is installed. The hull is stripped of the basic white color and only the green anti-corrosion spray will be visible. Subsequently, they will plan to install the door in place of the newly cut hole. In order to proceed safely during the individual stages, it is necessary to strengthen the torso in these places, proceeding in two stages to avoid possible deformation of the upper part of the fuselage [31].

As the windows for passengers will no longer be necessary, their subsequent covering with the help of milled aluminum plates will ensure a sufficient seal, while the fuselage will be partially strengthened. The more holes there are in the hull, the more it takes away from the overall fortress, which must be avoided. Once the aluminum sealing plate is in place, the technician attaches a black plastic frame from the inside [31].

Isolation is an important part, as outdoor temperatures are often below -50 degrees Celsius, so sufficient insulation is required. Cold and warmer air inside the aircraft will be prevented from colliding, which would result in excessive condensation and increased humidity. Insulating mats are ideal for balancing temperatures [31].

To sufficiently strengthen the main deck, a massive aluminum base frame is used, which must withstand loads of up to 62 tons of cargo. Subsequently, the loading system (CLS) will be installed. It also separates the main deck or upper cargo area from the lower one. This is the most significant modification in terms of the amount of material and the extent of the modifications. Floor, inter-rib beams and floor panels will be replaced or reinforced. The Airbus A330-300 gets the installation of a powered loading system that meets the highest criteria in this area and allows you to unload the entire space in 30 minutes. Container weighing sensors will also be built into the floor, with colored markings and numbering inside the cargo area to ensure that each container is precisely positioned for the best balance of the aircraft itself before departure. The container will be fixed to the floor with a locking system [30, 31].

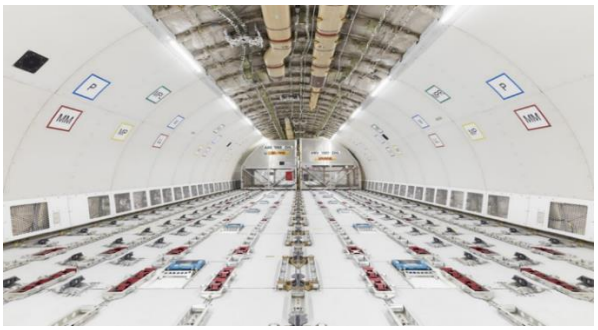

Figure 2: A view of the CLS system of the Airbus A330. [Asfaar by Airbus: First A330-300P2F enters service with DHL, 2017 https://asfaarbyairbus.com/asfaar/december-2017/first-a330-300p2f-enters-service-dhl/

In the event of a fire in any material, or the entire container or pallet, there will be a smoke screen in the front, which will protect the crew from the subsequent smoke directed to the front of the cargo area and especially the cockpit of the pilots. The front part of the cargo space is equipped with a safety net or a rigid barrier to prevent the possible release of containers, pallets and other goods, which will retain any released container and absorb the impact of up to 9G. Between the cockpit and the safety net there is a section for crew members or personnel who will be on the given flight. In case of release, a part of the crew could sit or stand against this part, so the protection is primarily for them and consequently also against damage to the aircraft itself [30, 31].

The last final phase will present the finished aircraft after a 4-month conversion, while only minor modifications in the form of cabling and insulation of the smallest cables are being completed. The Airbus A330 will then be weighed, using a total of 10 scales under each wheel. The price of the conversion will reach $ 18 million, but for comparison the price of the new Airbus A330 is about $ 230 million. These are the last steps before handing them over to the original or future customer [31].

Figure 3: Airbus A330-300 after conversion. [Mark Dwyer: First Passenger-to-Freighter A330 delivered to ASL Airlines, 2017 https://flyinginireland.com/2017/12/first-passenger-to-freighter-a330-delivered-to-asl-airlines/]

6. CONCLUSION

In this article, we approached and evaluated the conversion of passenger airliners to expensive versions. The amount of information on the topic was quite extensive, and the same is true of the sources themselves.

The conversion found its application in the earlier history of the Air Force, when the post-war period condemned military aircraft to the civilian field. The companies provided services for passengers and, of course, for various goods. The time has progressed further from piston aircraft, through turboprops, to modern jet aircraft, where even more attention has begun to be paid to the conversion process.

The reasons and causes have not changed significantly since the beginning of the current era until today. It was and still is possible for the airline to convert the aircraft more financially advantageous, without finding any differences in equipment and overall quality of workmanship compared to the original expensive version. It should be emphasized that the significantly lower price is mainly due to the age of the aircraft and its total time spent in active operation, which is in the range of 10 to 20 years. Another reason is to extend the life of the aircraft, especially from an economic and financial point of view.

It is even planned to convert even younger aircraft under the age of 10 in the near future. In the chapter on providers, we listed the main and most prominent representatives in today's market, and we also listed their own models, for which they currently provide a conversion program. The last chapter of the main text part belonged to a detailed description of the conversion, where we described the individual steps on the Airbus A330 aircraft.

Converting passenger airliners to cargo versions is a technically demanding process required by a company with an experienced team of mechanics. At present and in the near future, it will certainly not lose its application in aviation, on the contrary, it will strengthen it even more.

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