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EVOLUTION OF AIR TRANSPORTATION. STAGES OF DEVELOPMENT AND FORMATION OF AIR CARGO TRANSPORTATION

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The evolution of air transportation has played a crucial role in shaping global logistics and trade. Throughout its formative years, air cargo transportation has transitioned from its experimental beginnings to becoming an essential component of the global supply chain. Air transport, as one of the key elements of the global logistics system, has undergone significant changes over the past century. Its evolution is connected with technical achievements, the growing needs of world trade and the globalization of the economy. The development of air cargo transportation went through several key stages that led to the creation of a modern aviation logistics system.

The first flying machine mentioned in connection with Leonardo da Vinci is the ornithopter. Now this word is popular thanks to Denis Villeneuve's film Dune, but it is not a fantasy, but a very real concept that was the basis for the idea of how a person

could learn to fly in a few weeks. The idea of the ornithopter came to Leonardo da Vinci while observing birds. The device of the brilliant Italian inventor remained on the drawing board. Subsequently, people repeatedly tried to implement it, but even the best models could not fly more than a few hundred meters.

In particular, among his drawings you can find a hang glider, although in fact similar ideas were expressed even earlier. The prototype of an ultralight glider in the form of a frame covered with fabric was first tested by the German inventor Otto Lilienthal at the end of the 19th century. In addition, already in the 1950s the modern design we are familiar with appeared [1].

Balloons were the earliest form of air transport. They are sometimes called "free balloons" because having no engines they are forced to drift by the wind flow. This fact makes balloons not reliable enough for carrying people.

In 1709, the first hot air balloon was launched. However, the balloons were uncontrollable. By the end of the 19th century, huge airships began to dominate the air - airships, which are much slower than airplanes. In the 30s they operated regular passenger flights, including intercontinental ones.

It so happened that the end of the 19th century was also an important turning point in the history of aviation. The main goal of those who were directly involved in the formation and development of aviation was to fly heavier-than-air machines. At that time, this occupation was perceived as a pastime of individual enthusiasts. Later, aviation turned from some curiosity into the extremely important technical and social phenomenon that it soon became [2].

The range of the first manned flight on the Flyer 1 motor airplane, carried out on December 17, 1903 by the brothers Orville and Wilbur Wright, was 37 meters, and it lasted 12 seconds, but this short flight opened a new era in the history of mankind.

At the beginning of the 20th century, the development of air cargo transportation was in its infancy. The first airplanes that appeared at the beginning of the 20th century were mainly designed to transport mail and passengers. However, over time, it became obvious that with the development of technology and the increase in the size of aircraft, it became possible to transport larger loads.

The First World War was an unprecedented impetus for the development of military technologies, in particular aviation. At the beginning of the conflict, aviation was primitive, carried out reconnaissance missions, and the only weapon on board the aircraft was the pilot's personal weapon.

During the First World War (1914–1918), aircrafts were used to transport supplies such as ammunition and medical supplies. This period was marked by the realization of the potential of aviation in the field of logistics, although the technology of the time limited the possibilities of transportation.

In 1915, reconnaissance aircraft gradually began to be equipped with fixed machine gun mounts on the wings, which were directed "by the entire aircraft," and on two-seater aircraft, a machine gun appeared on a hinge in the rear cockpit.

By 1917, combat aviation, its main types and weapons were almost fully formed. Electric bomb release systems began to be actively used, and release from cassettes could be carried out either in one gulp or one bomb at a time.

At the end of the First World War, dozens of airplanes took part in air battles at the same time. The war in the air was now no less intense than the battles on land and at sea.

After the First World War, aviation began to actively develop in the civilian sphere. In the 1920s, the first commercial airlines appeared, focused on transporting passengers and cargo. An example is KLM, an airline founded in 1919 that began transporting mail and small cargo. Moreover, due to the fact that they are the only company that has kept its name and has not gone through thousands of mergers and acquisitions, today they call themselves the oldest airline in operation today.

Over time, aviation technology developed, and aircraft became more capable of carrying loads and were adapted to transport various types of cargo. New models of aircraft appeared, specially designed for cargo transportation. The 1920s also saw the beginning of the construction of the first airports with the necessary infrastructure to service cargo aircraft [4].

Aviation in the 1920s was known as The Golden Age of Aviation. This is because airplanes were becoming more widely used commercially. The first passenger

flight took place. Aviators were creating larger and faster airplanes. As airplanes became larger and faster and flying for longer without stopping, famous aviators began to attempt to set records. For example, Charles Lindbergh was credited with being the first aviator to successfully fly across the Atlantic Ocean. At that time air transport was very valuable for emergency medical work. The most important use of air transport besides carrying passengers is carrying mail.

During the first two decades of commercial air travel, improvements in aircraft design and developments in industry infrastructure gradually made air travel more comfortable for passengers. In 1936, the American Douglas DC-3 took off - the first airliner that began to generate income by transporting only passengers (from 20 to 30 people).

Passenger planes of that time flew much lower than 4500 m, which is why they often encountered harsh weather conditions. Sealing the cabin and interior while maintaining constant pressure in them made it possible to fly much higher.

The war became a powerful catalyst for the development of military aviation, including for the transportation of goods for the needs of the front. The transportation of troops, weapons, ammunition and other goods by air is of strategic importance. Many transport aircraft were mobilized for the needs of the army, and the production of new aircraft was focused on military orders.

The Second World War relegated civil aviation to the background, but contributed to the development of military aircraft, which delivered cargo and carried bombs on board. New technologies developed during the war, such as powerful engines and improved aircraft designs, were used in commercial aviation. During this period, large cargo aircraft began to appear en masse, capable of transporting much larger volumes of cargo [3].

The active development of air cargo transportation began in the 1950s. At this time, new types of aircraft appeared that were capable of transporting large volumes of cargo over long distances. This has been driven by economic development, the expansion of international trade, and the increasing demand for fast delivery of goods over long distances.

Fast and reliable delivery of goods contributed to the development of international trade, allowed companies to quickly respond to market changes and reduced logistics costs. In the 1950s, many airlines began offering door-to-door cargo delivery services, which greatly increased convenience for customers. Also, the development of communication and information technologies allowed for better coordination and management of cargo transportation.

In the 1950s, the first airlines specializing in cargo transportation emerged. Some passenger airlines began to allocate separate divisions for handling cargo. For instance: Flying Tiger Line (founded in 1945) - the first American cargo airline, actively operating in the 1950s; Seaboard & Western Airlines - carried out international cargo transportation.

Cargo aviation began to use actively transcontinental and international routes. Aircraft began to transport mail and correspondence (especially important in the business world); industrial goods such as spare parts, cars, electronics; perishable goods (flowers, meat, dairy products).

Helicopters occupy a special place in the air transport system due to their versatility, maneuverability, and ability to fly in difficult conditions. Unlike airplanes, helicopters can take off and land vertically, which makes them indispensable for solving problems in hard-to-reach areas, emergency rescue, and specialized transportation. They are indispensable in the fields of rescue operations, medicine, cargo transportation, military and police activities, and are also becoming increasingly popular in passenger transportation and tourism.

In any case, air transport has its advantages and disadvantages. The main advantages include speed of transportation and safety. Air freight allows for the fastest possible delivery of goods, which is especially important for perishable goods, urgent orders, or situations where time is of the essence. Airlines provide a high level of safety and security for goods, making them the best choice for valuable or fragile items. Although, with modern tracking systems, companies and customers can monitor their cargo at every stage of its journey. This increases transparency and allows for quick responses to potential problems. Air freight is also very flexible, allowing for a wide

range of cargo to be transported, from delicate electronics to large industrial equipment. But there is still a considerable list of such disadvantages as: high cost of crew training, limited list of cargo that can be transported, dependence on weather conditions, low carrying capacity, high cost of transportation and other conditions. Not all communities have airports, which can create additional difficulties when delivering goods to remote areas. In addition, aviation is one of the sources of greenhouse gas emissions, which contributes to global warming, and airports and flying planes can create noise pollution, which negatively affects residents of nearby areas.

There are a number of factors that influence the development of air cargo transportation, including: economic growth, technological developments and globalization. Global economic growth leads to increased trade volumes and, as a result, demand for air cargo transportation. Advances in aircraft manufacturing and information technology allow for the creation of more efficient and cost-effective cargo aircraft. Increased globalization leads to increased international trade volumes and demand for international air cargo transportation.

Air transport provides fast and efficient passenger and cargo transportation, connecting countries and continents. Thanks to its high speed and reliability, aviation contributes to the development of tourism, business, scientific exchanges and cultural ties. Aviation enables companies to develop supply chains. Air travel also contributes to the development of remote regions and island states by providing vital supplies (medicines, food, and equipment), access to medical services and attracting investors and tourists.

The future of air cargo is expected to be shaped by factors such as warehouse automation, integration of different modes of transport, and blockchain-based smart contracts. The development of technologies such as autonomous forklifts and robotic warehouse management systems can dramatically improve the efficiency of cargo handling and storage. The growing need for multimodal transport is prompting airlines to work more closely with land and sea logistics operators, creating a unified supply chain. Using blockchain technology to manage contracts and ensure transparency can minimize delays and costs associated with international cargo shipments [5].

Air transportation plays a key role in global trade and logistics. Speed, safety and flexibility make it the best option for many companies operating in the international market.

With each passing decade, aviation become more accessible. Despite high costs and environmental impact, air transport remains an indispensable element of global international transport, playing a strategic role in the development of the world economy. Taking into account modern trends and innovations, aviation continues to develop, becoming even safer, more efficient and more environmentally friendly.

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DRONE DELIVERY: WHEN WILL AUTONOMOUS TRANSPORTATION BECOME WIDESPREAD?

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Drone delivery is one of the most promising innovations in the field of logistics, which can significantly change ways of goods transportation. Thanks to use unmanned aircraft devices (UAVs) for cargo delivery, this method promises decrease of expenses, increase of delivery speeds and reduction emissions carbon dioxide. Successful test runs have already occurred in many countries, however large-scale implementation of drone delivery remains complicated tasks through legal , technical and infrastructural barriers .

The development of drone delivery is a part of global digital transformation, which encompasses automation and the use of artificial intelligence to improve efficiency of transport logistics. In addition to commercial advantages, drones can play