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Determinants of Air Transport Development

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Abstract:

Purpose: *The study aims to systematize the most important events and processes that determined the progress in the development of air transport. It serves to clarify the research methodology, the importance of globalization and competition, relationships, stimulators and alliances in the process of gaining advantages on the passenger air transport market.*
Design/Methodology/Approach: *The configuration and scope of the research process were based on the available literature, statistical data, empirical calculations, interviews, opinions, experiences of scientists and representatives of airlines and airports. The methodology of the effectiveness of the impact of market rules in the conditions of liberalization and globalization was also used, as well as gaining a leading position in the conditions of competition and the search for economic efficiency.*
Findings: *The need to supply high-quality expected services, maintain permanent ties with former and current customers (loyalty programmes), apply incentives, promotions, discounts and awards, determining the dimensions of passenger movement between traditional and low-cost carriers, has been demonstrated.*
Practical Implications: *Reliability, comprehensiveness and universality of research become an absolute requirement for the effectiveness of analyzes and assessments. The universal research methodology presented in the study can be used in any field and in relation to any entity of transport activity.*
Originality/Value*: The research methodology adopted allows for comprehensive research, both theoretical and pragmatic. It also extends the effective search for the desired solutions. In order to gain a competitive advantage in air transport, it is necessary to improve the quality of services and service in all phases of the transport process, as well as to expand and tighten loyalty relations with customers*

Keywords: *Air transport, globalization, alliances,ancillary revenues*.

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1. Introduction

The history of the development of air transport is several hundred years old, although the first airplane was constructed just over 100 years ago. From the beginning of the development of air transport, the process of building a competitive advantage in the conditions of market globalization has gained particular importance. The changes that took place in air transport, in general, in an evolutionary way, included sequentially demonopolisation, deregulation and liberalization.

However, soon the pace and directions of changes in the sector were determined by the influence of two dynamically developing processes: competition and globalization. The development of airlines and partnerships shows that crises and periods of economic slowdown accelerate the process of deregulation and liberalization, as well as integration of airline companies.

The best way to survive the crisis is to participate in alliances that allow to increase the share in the global passenger transport market and intensify the generation of revenues, also from non-ticket sources. Participation in loyalty programs is also of great importance, as they increase the attachment of passengers to a particular airline

2. History of Air Transport

2.1 Achievements of Leonardo da Vinci

The history of aircraft construction began very early, because already in 1505 Leonardo da Vinci formulated the principles of flight in the "Bird Flight Code". When Leonardo da Vinci's notes saw the light of day, aeronautics took on a different meaning. He was the first scientist to make a scientific and rational analysis of flight. His notes contained about 150 designs for flying machines or parts of them, including the prototype of the parachute, helicopter (air screw) and propeller. The only drawback of these investigations was the modest calculations that Leonardo made to keep the machine in the air, without the use of human muscles.

At the end of his life, he verified his considerations in the direction of using a fixed wing. Among his many interests, he was fascinated by the phenomenon of flights. On the occasion of his research on the air and the anatomy of flying birds, he came to the conclusion that a bird or bat flies according to the principles of mechanics, enabling the construction of a machine that could fly on a similar basis.

Leonardo da Vinci, like many people of the Renaissance, was fascinated by nature, from which he drew inspiration and ideas for his research. Hence his sketches of wings and designs of flying machines, e.g., hang glider and helicopter (Calvert, 2002).

2.2 English Experiences

In England, Sir George Cayley was considered the father of aviation. In 1799 he presented for the first time in history the idea of a modern airplane. He identified the drag vector (parallel to the flow direction) and the lift vector (perpendicular to the flow direction) (Sproule, 1974). It was this concept that the Wright brothers used in the first airplane and successful flight more than a century later.

In 1804, he designed a propeller-driven airship and continued his research in the field of aerodynamics, and even postulated the use of an internal combustion engine. He proposed abandoning the idea of an rnithopter and adopting the concept of a heavier-than-air aircraft. He also put forward the hypothesis that: the whole problem boils down to counteracting the constraints that force bearing surfaces to support a given weight, mainly the force that balances air resistance and the force of gravity.

2.3 The Era of Wright Brothers

The Wright brothers were the first to build a steerable airplane by combining an airframe with an internal combustion engine. They received a toy helicopter from their father, powered by a rubber band. Having already owned a workshop and a bicycle factory, they returned to their childhood interests. They built a wind tunnel to explore the science of flying, which expanded the research that led to the construction of a glider with satisfactory flight characteristics (Kelly, 2021).

Their friend Charles Taylor helped them build a 12 hp four-cylinder engine that alternately rotated the pusher propellers using a dual drive train. The Wright Brothers' plane was a "duck" biplane and was called the "Flyer". It had wings with a width of 12.29 m, a total length of 6.43 m and a bearing surface of 47.38 m. The first flight was made on December 14, 1903, but after a few seconds the plane fell to the ground. The plane, repaired 3 days later using skids, flew 36.5 meters in 12 seconds, taking off into the wind. This first flight was captured on film.

The next attempts made it possible to overcome even 260 m. Their success quickly went around the world, resulting in an offer to organize demonstration flights for 500,000 francs. At the end of 1909, they founded the Wright Company and began manufacturing aircraft in Europe. The US Army also purchased the Flyer A model, making it the first military aircraft (Marvin, 1953). Their paths parted, Orville took up research for the US Army, and Willbur came to France, where he founded the first flight school in Pau.

2.4 Civil Aviation after World War I

After the war, air transport developed, as experienced pilots returned from the front, and hundreds of war surplus aircraft began to fall into private hands. This caused civil aviation in Europe to develop more by necessity than by chance, as dilapidated

rail links and other ground infrastructure made it difficult to use other means of transport (Czerkowski, 2021). For example, America, paradoxically, could still use the land infrastructure intact, where the railroad was the dominant mode of transport. In France, Great Britain and Germany there were already operating airlines whose flights were served by, among others:

- Zeppelin airships on the Berlin - Weimar route,
- planes on the route Paris - Brussels and Paris - London.

In Great Britain, Imperial Airways was founded in 1924, Lufthansa was founded in Germany in 1926, and Air France in France, Sabena in Belgium and Linee Aeree d'Italia in Italy in 1933. Some companies have started to merge.

2.5 Civil Aviation after World War II

With the end of World War II, the end of seaplanes came to an end, but their concept survived, because they were and are still used in difficult areas around the world, such as: Canada, Alaska, Pacific, and to perform special tasks, e.g., Canadair CL-215 as firefighting equipment big fires. The Second World War slowed down the development of aviation, but did not stop it, there was an ongoing competition between the aforementioned flying boats and airplanes (Dierikx, 1997)

Many airports began to be built, and the development of technology resulted in the appearance of larger planes that flew faster and farther. After the war, in 1945, the first transatlantic airline from Great Britain to the USA was opened, which was also the beginning of regular transatlantic air transport. In the following years, newer and better aircraft were built, which soared to great heights and reached supersonic speeds - 6,693 km /h.

2.6 Development of Wide-Body Aircraft

In the 60s of the last century, two different models of aircraft appeared, permanently enrolling in the history of aviation. Europe was trying to build a supersonic plane, and America was trying to build a model that could take as many passengers as possible. Combining the works of France and Great Britain, the supersonic Concorde was created (62 m long, 25 m wide - wingspan 25 m, with a movable nose), the permissible cruising speed at the ceiling of 15,000 thousand. m was 2.04 Ma (2179 km/h). He took maximum of 136 people, but the operating costs were huge, and the noise was a nuisance (Calvert, 2002).

In the USSR, the idea was copied and the Tu-144 competed. In the USA, work on a huge plane 70 m long, 20 m high, weighing 300 t was finishing. The plane had a characteristic hump. The Boeing 747 (jumbo jet) entered service. Concorde did not survive the competition and catastrophe. Thus, this type of aircraft was abandoned.

The era of wide-body aircraft had begun. DC-10, Lockheed L-1011 and DC-10/MD-11 were commissioned. Airbus Industrie is established in Europe (merger of Daimler Chrysler Aerospace and British Aerospace). Their first large plane was the Airbus 380 (Liwiński, 2009b) (Table 1).

Table 1. *Number of Airbus and Boeing aircraft in individual airlines in 2021*

Airline	**Number of planes [pcs]**	**Plane model**
Emirates	149	A 380
Singapur Airlines	24	A 380
Quantas	20	A 380
Etihad	10	A 380
Air France	12	A 380
Emirates	142	Boeing 777
Singapur Airlines	59	Boeing 777
Quatar	28	Boeing 777
Unitted Airlines	75	Boeing 777

Source: *Own study.*

The increase in passenger traffic resulted in the development of regional connections, the so-called "third level". They were served by light, propeller-driven aircraft, taking 10 - 40 passengers, generating low operating costs. Thanks to them, passengers could reach the most important cities in the region or country faster. Currently, there is a war between Airbus and Boeing for the customer and market dominance (Liwiński, 2009a). Airbus's flagship models are wide-body aircraft: A300, A310, A340, A380, and Boeing's Boeing 777.

3. Contemporary Trends in the Development of Air Transport in a Competitive Environment

3.1 Globalization in the Air Services Market

The strongest regional and global supranational organizations and rich countries with great economic potential participate in the mainstream of market transformations. Globalization should be understood as: a world market enabling the production, supply and distribution of goods and services on a large scale along with their specialization (Marciszewska, 2001).

Many authors, including A.G. McGrew and P. Lewis, tend to accept globalization based on multi-criteria connections and couplings between entities creating the system (McGrew and Lewis, 1992). According to A. Ruciński, "[…] globalization is a socio-economic process and concerns national economies, cultural, social and even criminal phenomena, including terrorism (Ruciński, 2009).

The possibility of operating on the global market is becoming more and more available to air carriers of all countries, but there are still some limitations that prevent all domestic entities from having free access to it (Piasecki, 2003). The global socio-economic development means that more and more companies operate on this scale.

According to J. E. Stiglitz, "[…] globalization has reduced the feeling of isolation existing in many developing countries and provides many of its inhabitants with access to knowledge unavailable even in the richest countries a century ago (Sriglitz, 2005). The general development of civilization means that enterprises now have the means, knowledge and skills that allow them to manage on a global scale (Gwiazda, 2000).

According to G.S. Yipa, wanting to join the global market, must obtain an answer to two basic questions: "[...] how global is the field of their activity and how global should their company's strategy be" (Yip, 2004). Globalization is therefore defined as an internal and external process in which entities, striving to take over an increasing size of the market, undergo changes. External conditions are of decisive importance, in which the company, deciding to choose an appropriate development strategy, changes its environment from domestic to international (Hawlena, 2012).

3.2 Strategic Alliances and Codeshare Agreements

Experience in the field of partnership cooperation shows that cyclical periods of economic recession accelerate the process of deregulation and liberalization, as well as the integration of airlines. The best way to survive the crisis is to participate in alliances that allow you to increase your share in the global passenger transport market. The cooperation allows to increase profits thanks to the optimal coordination of the route network, planning a flexible pricing policy, the use of shared service facilities, financing system and frequent flyer programs, as well as code-share agreements.

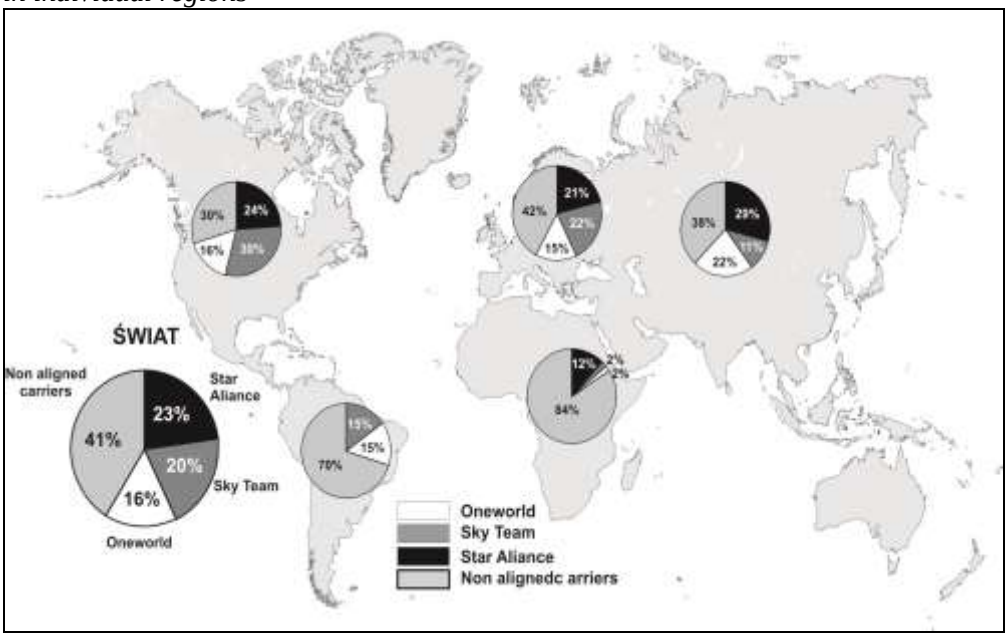
Alliances in air transport are constantly gaining new carriers. E. Marciszewska believes that "[...] a strategic alliance is a long-term operation of two or more air carriers that are participants in the market game of international competition, which aims to strengthen their competitive position in the sector both against other competitors, as well as suppliers and customers, while maintaining their organizational and legal separateness" (Marciszewska, 2001).

According to M. Romanowska, the form of cooperation prevails in contemporary partnership relations, meaning a tendency to enter into alliances or an agreement concerning mainly the division of markets into spheres of influence and the way they are used. It also assumes gaining a competitive advantage by coordinating partnership projects. Such a system of relations shows that an alliance is a

relationship between enterprises that intend to pursue a common goal (Romanowska, 1997).

Partnership agreements always include voluntary undertakings of various scope - from the simplest to the very complex. The choice of the form of the agreement depends on the goal that its participants want to achieve in a specific market (Cheng-Jui, 2002). The strength of the new alliances can be demonstrated by the forecast of strategic analysts, according to which, ultimately, three groups of carriers related to British Airwais (One Word alliance), Lufthansa (Star Alliance alliance) and Air France - KLM Group (Sky Team alliance) will probably remain on the European market (Figure 1).

Figure 1. *Share of passenger transport of airlines associated in strategic alliances in individual regions*



Source: *Own study.*

Within individual alliances, there is a phenomenon of cooperation which is a combination of competition and cooperation. The most common instrument of cooperation is the use of code-sharing. According to M. Żylicz, code share is "[…] a split designation of flights, which takes place when on an aircraft operating flights in the air service of one carrier, some seats are used, possibly reserved for use by another carrier for an agreed fee, for the transport of its passengers and freight for its own account. Each of the air carriers organizes transport performed on its own account and with its own flight designation (Żylicz, 2011).

As a result of observations of the global aviation market, it can be seen that alliances and code-share agreements are developing as substitutes for capital links. Code share is a form of cooperation used both within and outside of them. It is an activity coordinating the functioning of the branch transport chain, carried out by several carriers (Ruciński, 2009).

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4. Pricing Policy Using the Yield Management System and the Benefits of Using the Frequent Flayer Procedure

4.1 Possibilities of Using the Yield Management System

The use of Yield Management techniques has become a necessity for airlines not only to increase their profits but also to survive in an environment of increasing competition. This has become particularly important in the era of air transport deregulation. To honor passengers who prioritize comfort over price, airlines have established three basic service classes, although not all companies use them and not on all flights. These are:

- Economy class, the most common and cheapest, with the largest package of tariffs and discounts.
- Business class largely caters to business travelers and wealthier non-business travelers.
- First class - the most expensive, operated only by reputable airlines on intercontinental routes (Hawlena, 2004).

Due to the popularity of individual classes and the importance of passengers, the division of seats on board the Boeing 747 (jumbo jet) aircraft is as follows: 326 - economy class, 51 - business class, 8 - first class. It is worth mentioning the additional offer of carriers, which is the Premium economy class. Its quality and attractiveness is between economy class and business class.

Of the interesting offers that have already gone out of service, the Concorde supersonic aircraft should be mentioned (British Airways had 7 such aircraft and Air France had 5). On the other hand, low-cost carriers appeared, offering their customers a tourist class, which is characterized, among others, by a smaller seat spacing, or landing at peripheral airports, i.e. the offer is of the lowest quality, but it is compensated by the price.

There are often special price promotions where you can buy a ticket for as little as PLN 70, and last year (2022) a Ukrainian student studying at the University of Life Sciences in Lublin, in the Department of Tourism and Recreation, managed to buy a ticket for PLN 1 on the Vilnius - Lublin route. Several such tickets low-cost airlines present for sale to prove the existence of such offers in the advertisement.

However, every entrepreneur strives to maximize profit from his activity. The peak load pricing system can be used for this purpose, which loosely translates as peak load pricing.

Yield management is a tool for optimizing income. It promises hopes for a particularly high increase in revenues under the following conditions:

- inflexible generation capacity with high fixed costs,
- forfeiture of services in the absence of sales,
- reservation (booking) of the service in advance,
- high demand uncertainty,
- customer segmentation.

A comprehensive database is essential to achieve YM goals. These are:

- historical data relating to the structure of demand,
- historical data relating to the course of booking,
- price elasticities, aggregated by time and segments,
- data on events (e.g. conferences) that generate demand,
- data on competitors (offers, capacity, prices, etc.) (Hawlena, 2004).

The use of Yield Management techniques is a necessity for airlines not only to increase their profits, but also to survive in an environment of increasing competition. This has become particularly important in the era of air transport deregulation and open sky policy.

4.2 Frequent Flyer as a Process Supporting the System of Revenues and Profits

Simple loyalty programs introduced in the initial period of their application included only the accrual of bonus points for flights made, but even this narrow scope allowed the principals to characterize the client and his aspirations (Berman, 2006).

Increasing the attractiveness of the service results in the attachment of regular customers to the carrier by rewarding it for frequent use of the offer of a given airline. This process was pioneered by American Airlines, which offered free and discounted benefits to loyal customers in the early 1980s. A passenger who frequently used the carrier's services could receive various privileges, such as:

- reduced or free tickets,
- seats in a higher travel class (so-called upgrade),
- the possibility of transporting additional luggage.

The increase in the popularity of these incentives among airline customers has led to the interest of companies providing other services. The Mariott hotel chain has created the Honored Guests Program, and the Hyatt - the Golden Passports Program. Regular guests, after obtaining a certain amount of points, received discounts and free accommodation. Credit card issuing companies also benefited from their experience, awarding points based on the frequency of card use and the amount spent, as well as the car rental company.

In Poland, at the next stages, PLL LOT implemented an independent Lot Voyager program, then it was a member of the Qualiflyer Group alliance with Swiss airlines, and now (after the bankruptcy of Swiss Air), our national carrier has become involved with the Miles and More alliance, led by Lufthansa (Hawlena, 1998). Experiences from the implementation of these programs and contemporary challenges make it necessary to make changes in the way they operate.

A favorable revaluation of incentives was made in the current Miles and More loyalty program. Its participants can earn and use miles on all destinations of Star Alliance member airlines and on flights from 19 other carriers outside the alliance. The attractiveness of the program is influenced by the presence of many non-aviation partners, including Avis, Hertz and Hilton. Co-branded credit cards, combined with large programs, are also important, thanks to which revenues are generated based on everyday consumer spending (this ensures revenues in periods when passenger traffic is lower).

According to a report published by IdeaWorks Company, the largest income in this category was generated in 2021 by American Airlines. At $4.33 billion, that meant revenue of $26.15. per passenger and $37.68. per program member. United's American airlines ranked second. With revenues of $3.32 billion, the carrier increased its revenues by $31.96 thanks to the loyalty program. Per customer and $31.38. per program member (Gola, 2022).

5. Impact of Non-Ticket Revenues on the Financial Result of an Airline

The term “additional revenues” is the Polish version of the English term “ancillary revenues”. The term "ancillary" means "providing help or support, additional". In the

operations of airlines, non-ticket revenues were treated until recently as a secondary element of generating profits (e.g., duty free), but since the establishment of low-cost carriers, they have become increasingly important in the process of increasing the efficiency of air services. An analysis by the American company IdeaWorks shows that airlines obtained almost $30 per passenger from the sale of ancillary services in 2021. That is over $8 more than before the pandemic. The non-air offer as a source of revenue is becoming more and more important for carriers.

In addition, the share of the sale of ancillary services in the total revenues of carriers is increasingly important, regardless of the basic business model. While in the segment of the largest American airlines last year it accounted for 22.2 % (16.1 % in 2019), in the major low-cost airlines it was already 36.3 % (27 % in 2019) (Table 2). For other low-cost carriers, it accounted for 10.5 %. (9 %) of proceeds, and 7.4 % in other lines. (6.7%) (Gola, 2022).

Table 2. *Increase in sales of non-ticket airlines in 2021*

Airline	**Country of origin**	**Growth in sales of non-ticket services in total revenue [%]**
Brazil	GOL	16
USA	Frontier	11,3
Hungary	Wizz Air	10,6

Source: *Study based on (Gola, 2022).*

The authors of the report claim that the pandemic has forced airlines to better manage their revenues. This applies equally to American, European or Asian carriers. The best sales of non-ticket services are managed by the Hungarian carrier Wizz Air, followed by airlines from the United States, Mexico and Ireland (Table 3).

Table 3. *Share of non-ticket revenues in total revenues of airlines in 2021*

Airline	**Country of origin**	**Share of non-ticket revenues in total revenues. [%]**
Hungary	Wizz Air	56
USA	Frontier	54,9
USA	Spirit	54,3
USA	Allegiant	51,3
Mexico	Viva Aerobus	44,8
Ireland	Ryanair	44,7

Source: *Study based on Gola, 2022.*

Carriers, looking for new sources of revenue, expanded their offer, e.g. for the introduction of fees for large hand luggage or extra legroom. The use of advanced revenue management methods was also of great importance.

6. Conclusions

The analysis of the issues contained in the article focuses on the factors determining the functioning of the passenger air transport sector and market in the conditions of the globalization process and the growing intensity of competition. One of the important tools for building global connection networks is code-sharing, the increasing scope of which is becoming the main platform for partnership cooperation and an effective factor in improving the market position of bidders and expanding the network of destinations.

The air transport market, unlike other transport branches, has been subjected to deep processes of demonopolisation, deregulation and liberalisation. These conditions led to the process of changing the segment structure, which culminated in the emergence of low-cost carriers (Wang, 2017). These airlines introduced the generation of profits from non-ticket revenues on a large scale and the extensive use of advanced statistical programs with particular emphasis on Yield Management.

Consumers willingly use additional products selected a la carte, because they can decide for themselves whether they prefer the lowest price or maximum convenience. The range of available options is expanding greatly, which increases personalization in transport. The current trends in air transport also include participation in marketing programs that increase the level of loyalty of passengers towards the airline

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