

ASSESSMENT OF THE IMPACT OF THE BOEING 787 DREAMLINER FLEET ON THE DEVELOPMENT OF LOT POLISH AIRLINES

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***Abstract:** This article describes the impact of the Boeing 787 Dreamliner long-distance aircraft fleet on the development of Polish Airlines Lot after 2012. The paper presents both the benefits resulting from the introduction of the Dreamliner fleet and repercussions, having a negative impact on the operations of the Polish national carrier. To assess the impact of the long-distance fleet on the operations of the flight, quantitative data from the Polish carrier's financial statements, such as: revenues, operating profit, profit on sales, were used. In order to determine the prospective income that can be generated by an individual Boeing 787 Dreamliner, the flight booking system of the Polish national carrier available at <https://www.lot.com/pl/pl/> was used. For the purposes of booking simulation, three travel classes were considered and the average price for each travel class was selected. The forecasts were also presented in statistical terms, specifying the amount of revenues on selected routes. The article also referred to the marketing phenomenon, called the Dreamliner's effect by the American producer of airplanes and analyzed the key features resulting from the use of the Boeing Dreamliner 787 aircraft. Technical data had been taken from the website of the American producer Boeing, www.boeing.com. The importance of the jet aircraft as a means of transport, which contributed to the revolutionizing the passenger transport market, was also pointed out.*

***Key words:** Boeing 787 Dreamliner, Lot Polish Airlines, fleet, purpose-random selection*

***JEL codes:** R11, R40, R41*

1. Introduction

Civil air transport is one of the fastest growing modes of transport in the economy of a given country. The introduction of a jet engine into passenger jet aircraft can be considered a fundamental determinant of the development of civil aviation. (Simons, Withington, 2004) This

allowed airlines to offer air connections linking two distant points on the globe. Jet airplanes also began to offer much higher travel comfort than propeller or turboprop aircraft. The first commercial passenger plane with jet engines was De Havilland Comet, which was put into service in the 1950s. The use of Comet by the British airlines BOAC and American Pan Am, introduced a new quality of travel. Aircrafts with an encapsulated passenger cabin, have been able to perform aerial operations at a high altitude, up to 15 km above sea level, virtually inaccessible to propeller airplanes. Travel time has been reduced, thanks to which passengers have the opportunity to reach the destination in a much shorter time in more comfortable conditions. The next important stage in civil air transport was the design and implementation of Boeing 747 aircraft for common use in the 1970s. (Fecker, Konemann) Since the mentioned period, one can observe a significant expansion of two passenger aircraft manufacturers, the American Boeing and the European Airbus. At the beginning of the nineties of the twentieth century, an important role in the passenger air transport market also fell to producers such as the Brazilian Embraer, the American Bombardier and the Russian Tupolev and Ilyushin.

It can be assumed that the introduction of jet passenger airplanes to the passenger air transport market has contributed to shortening travel time and improving comfort during the flight. From an economic point of view, a jet plane can be a source of revenue for airlines as well as be a source of specific costs. Choosing the right means of transport in the form of an aircraft can contribute to the development of the airline. This development can be determined by choosing the appropriate method of financing the purchase of a new fleet.

Passenger airlines operate on the air transport market, where there is a strong marketing competition for a potential client. One of the determinants of the development of a given airline is the fact that carriers have a modern fleet. Modern long-haul aircraft in the case of Lot Polish Airlines are long-distance planes Boeing 787-8, 787-9, medium-haul aircraft such as Boeing 737-8, 737-Max and airplanes for regional connections such as Embraer 170, 175, 195 and Bombardier Q400.

2. Methodology and Data

The paper attempts to assess the impact of the Boeing 787 Dreamliner fleet on the development of Lot Polish Airlines. The assessment was made on the basis of a partial analysis of the financial statements of PLL Lot for the period from 2013 to 2017, data available on the website of the Polish Civil Aviation Office, www.ulc.gov.pl, referring to the statistical data of the aviation market in Poland. Information on the technical data of the Boeing 787 Dreamliner used

was taken from the website of the American manufacturer Boeing, as well as industry publications on passenger air transport. The quantitative method was used to calculate the estimated income that can be developed by a national air carrier in Poland during intercontinental flights. The research sample concerned five long-distance connections carried out by PLL Lot using the Dreamliner 787 aircraft on routes Warsaw-Toronto, Warsaw-New York, Warsaw-Tokyo, Warsaw-Beijing, Warsaw-Singapore. For each combination, the potential income that can be developed by the airline is taken into account, including the three-class configuration of seats on the passenger aircraft. The quantitative method was expressed in the application of the formula to calculate the potential revenue for the airline. The research sample of purpose-random selection was identified on the basis of the PLL Lot reservation system. The calculations were made on the basis of the PLL Lot flight reservation system, available on the carrier's website on 01/12/2018. The financial statement of PLL Lot for 2017 was obtained from the https://ekrs.ms.gov.pl/rdf/pd/search_df website, while the financial data for the years 2013-2016 were obtained from the financial database from the website <https://www.bisnode.pl/>.

3. Characteristics of the new product

PLL Lot was the first European airline to acquire a Boeing 787-8 aircraft for transcontinental connections.

According to the American company Boeing, the design of the Boeing 787 Dreamliner, initially referred to as 7E7, was to be a breakthrough in the global civil aviation history (Kang, Kim, 2008).

From an economic point of view, Dreamliner was supposed to be a cheaper airplane in operation for air carriers by using less fuel and constructing the hull and wings of the aircraft for the most part of composite material; The American manufacturer named his product - Dreamliner, the dream liner. (Boljevic, Jelaca, 2016) The features that distinguish the Boeing 787 from the competition products include:

- composite construction, which accounts for over 50% of all aircraft materials, thanks to which the aircraft is lighter than other long-haul aircraft, which in turn contributes to more efficient and fuel-saving, as well as extending the range of the aircraft,
- innovative design of the passenger cabin, which is supposed to ensure adequate travel comfort: cabin pressurization up to the pressure level at 1,900 m.n.p.m, larger windows and lighting system that contributes to alleviating the effects of changing time zones on

long flights. The new passenger cabin has been designed to increase the comfort of travel and minimize the so-called jetlag,

- the aircraft is characterized by a greater income potential for the airline, which can be implemented by: a higher cruising speed, increased operating cycles in which Dreamliner can be used, launching new flight directions, using classes in the passenger cabin and the possibility of more cargo while simultaneously transporting passengers on one plane,
- Dreamliner provides lower operating costs during aircraft operation due to exceptional fuel economy, lower maintenance costs for operational tasks,
- Boeing also points to advanced avionics, aerodynamics, optimized cockpit pilots, increasing the share of electrical systems responsible for airworthiness. The Polish national carrier received the first Boeing 787-8 in 2012.

Currently, the fleet of PLL Lot long-haul aircraft consists of eight Boeing 787-8 and three Boeing 787-9 aircraft. The version of the aircraft for the Polish carrier has a three-class configuration of seats in the passenger cabin: business class, BC-business class, offering 18 seats on the deck in a 2-2-2 seating arrangement, premium economy class, PEC-premium economy, which consists of 21 seats with passenger seating system 2-3-2 and economy class, EC-economy, consisting of 213 seats in the configuration of 3-3-3 seats.

Tab. 4 Technical specifications of Boeing 767 and 787

Boeing's model aircraft	Price	Range	Engine	Number in use	Seat
767-300ER	209,80 mln USD	11065 km	General Electric	0	218
787-8 Dreamliner	239,00 mln USD	13620 km	Trent 1000 Rolls-Royce	8	242/252
787-9 Dreamliner	281,60 mln USD	14140km	Trent 1000 Rolls-Royce	3	294

Source: (www1)

3.1. Dreamliner effect

The development of the airline can be determined by a fleet of long-distance aircraft. In the case of PLL Lot, the fleet of long-haul aircraft consists of 11 aircraft represented by the Boeing Dreamliner 787. The assessment of the adaptation of the introduction of a new fleet to the Flight

may be examined on the basis of, inter alia, financial statements in which the revenue and profit from sales play an important role: profitability (Diabat, et al., 2018) These parameters allow to determine whether the economic activity conducted by the company is profitable for it or contributes to the generation of losses and indicate the company's turnover in a given period. The Polish national carrier has decided to exchange Boeing 767 long-distance aircraft for the Boeing 787 model. The need to replace the fleet in an airline is usually dictated by two factors: a technical factor that determines the age of the aircraft, its ability to continue to operate, and the economic factor relates to the cost-effectiveness of maintaining an older generation of aircraft in the fleet. Both the technical and economic factors are interrelated, because the opportunity to replace the broken part, the repair of the defect requires certain financial outlays, which the carrier must ensure to repair. The average age of Boeing 767 aircraft in the PLL Lot fleet for the period in which the gradual replacement of the 787 model was over 20 years.

There are cases in the civilian air transport market where the period of use of a particular aircraft exceeds 30 years. However, such a long service life is associated with more frequent inspections and technical repairs, which contributes to the generation of additional costs for the airline. The longer period of using the aircraft is also a potentially greater threat to the safety of flight operations. Owning a long-haul fleet in the fleet allows the airline to gradually develop by expanding the network of international connections. This is important for potential cooperation with another airline based on the so-called code-share agreements under which an air carrier may offer flights to destinations between which the airline has direct air connections. Under a code-share agreement, part of the flight is carried out on board another airline who is a party to the contract. Another advantage of having a fleet of long-haul aircraft for the airline is prestige, understood as the potential benefits for an airline carrier resulting from the purchase of a ticket by a passenger who gains the opportunity to travel in a particular class. Prestige in reference to the Dreamliner aircraft is primarily a new quality of the offered product, represented by the comfort of travel offered in the passenger cabin. The American Boeing 787 aircraft manufacturer, Boeing Commercial Airplanes, based on the predicted benefits and historical data provided by model users, introduced the concept of Dreamliner's effect, the Dreamliner effect to determine the benefits for airlines that have the latest Boeing product in their fleet. The manufacturer emphasizes the use of leading technologies in the aviation industry, the use of which has contributed to the creation of new opportunities for airlines around the world and significantly improves the quality of air travel. The effect of the Dreamliner is also in terms of the manufacture it also optimizes the efficiency of the air fleet

and the network of connections. Adaptation of a new fleet of long-distance aircraft in PLL Lot began in 2012. The period from the aforementioned date until 2017 can be described as turbulent time for a Polish carrier. The introduction of the Boeing 787 as a flagship aircraft in flight is not uniform. In the initial period of use, so-called childhood diseases occurred.

Despite the introduction of a revolutionary new product to the passenger transport market, the American manufacturer has not been able to avoid the problems associated with the use of Dreamliner aircraft by airlines. There are several significant drawbacks that have contributed to the temporary grounding of aircraft. The most serious reasons for the suspension of flights were malfunctioning of batteries and construction defects of engines were the source of the decision to periodically stop the operation of American aircraft.

4. Impact of Boeing 787 on Lot Polish Airlines

The introduction of new aircraft for transcontinental flights should contribute to increasing the attractiveness of the airline, by offering new travel comfort, rising the safety level of flight operations and aiming for new travel destinations.

After receiving the first Dreamliner aircraft in November 2012 by Lot Polish Airlines, in the next two months there was a failure of lithium-ion batteries on board of Dreamliners belonging to the lunch-custom of Boeing 787 Dreamliner aircraft, the Japanese airline ANA. As a result of this event, all Boeing 787 Dreamliner aircraft were grounded for a period of several months. The Polish national carrier, returned to use aircraft in June 2013. Losses incurred by the carrier, which was forced to rent other aircraft to operate transcontinental flights, were valued at approximately PLN 100 million. The trade secret is the exact amount and type of compensation offered by the American manufacturer. It can be assumed that for the sake of a long-term co-operation between Lot Polish Airlines and Boeing, and the prospect of supplying further Dreamliners to the fleet of national lines, one can assume that the compensation was at least satisfactory for the Polish carrier. (www2)

The second type of disadvantage which appeared during the operation of American aircraft was the issue of the failure of the British Rolls-Royce engines. The failure was identified in many Dreamliner models from various air carriers, and it referred to the Trent-1000 turbofan engines specifically designed for the Boeing Dreamliner 787 aircraft. The estimated costs of compensation and motor repair costs are estimated at GBP 1 billion. Polish planes, which were equipped with British manufacturer's engines, had to be inspected, which is connected with the grounding of aircraft and the need to rent other aircraft to operate air connections in

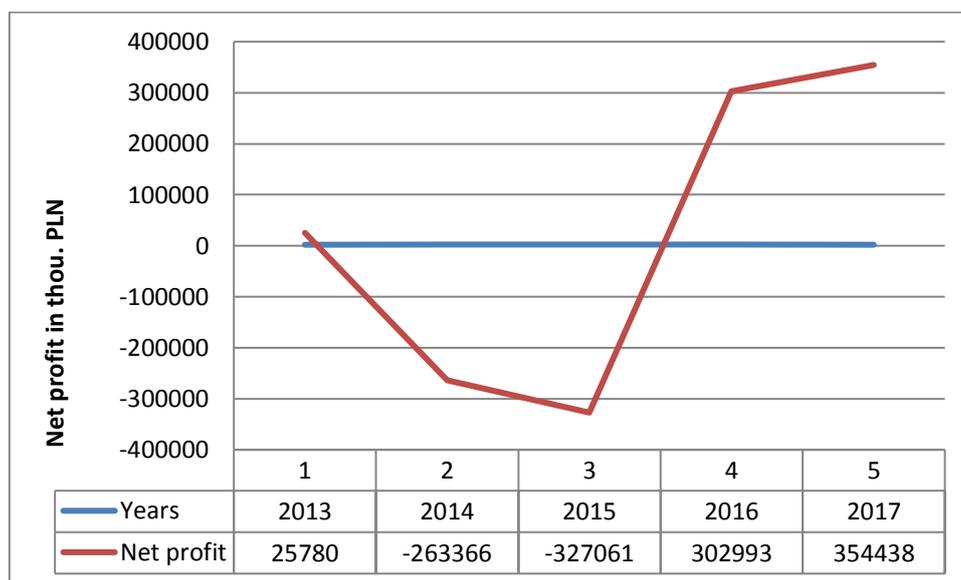
order to maintain operational capacity. Due to technical faults associated with the use of aircraft from the Seattle manufacturer, the Polish national carrier bears specific losses.

The negative impact of so-called childhood diseases, design defects on the development of PLL Lot can be identified in the areas of:

- **image:** grounding of the fleet, unrealized cruises may contribute to changing the preferences of carrier selection by a potential passenger, the airline's image itself is exposed to the loss of a certain prestige, to which the carrier has been striving for many years on the passenger carriage market,
- **competitive:** PLL Lot builds its competitive advantage based on the availability of modern long-haul aircraft, Boeing Dreamliner 787, on the one hand it allows to reduce the costs of crew training through the prism of having a standardized long-haul fleet, on the other hand, having one type of aircraft can affect the generation of additional costs when a model aircraft needs to be grounded for a certain period of time. The advantage of having a diversified fleet of long-haul aircraft is typical for large national carriers whose fleet size is given in hundreds of units,
- **economic:** grounding the fleet generates certain costs for the air carrier. PLL Lot bears the costs of renting aircraft from other carriers and leasing companies. Polish national carrier is also obliged to pay compensation for unrealized or canceled flights. The grid development of new connections, which can be implemented using a fleet of long-haul aircraft, is also inhibited. In the economic dimension, one can also point to the lost profits expressed in the absence of profits from the unrealized flight and real losses, directly related to the costs that PLL Lot must bear in order to maintain an adequate level of economic profitability. Long-distance calls are crucial for the national carrier both through the prism of prestige and the consideration of potential revenues that the cruise can generate while maintaining the rate of filling places at the desired level. The economic area for the Polish carrier is crucial because PLL Lot is trying to earn a profit and maintain profitability, thanks to which it will be able to open new connections based on passengers' preferences and strategic geographic areas for which demand for passenger air connections will occur. In the economic dimension, credit risk has also been identified in relation to cooperation between the Polish national carrier and travel agencies that organize trips using the 787 model, the risk is expressed in the possible collapse of the contractor.

The positive impact of the Boeing 787 Dreamliner fleet on the development of the national carrier can be assessed on a multi-criteria basis. (Bard et al., 2015) One of the criteria for assessing the development of Lot Polish Airlines is the economic criterion, which allows the study of the development of the line based on the analysis of financial statements. For the purpose of the analysis, selected items from the balance sheet and profit and loss account drawn up for the period from 2013 to 2017 were analyzed.

Fig. 2 Net profit of PLL Lot



Source: (www3)

In the financial statements for 2017, Polish Airlines Lot, showed revenues at the level of PLN 4.77 billion, while operating profit amounted to PLN 273.55 million, and net profit from sales PLN 354.43 million. For several years, the national carrier has problems generating and maintaining a level of profitability, allowing for stable economic activity. Large costs are related to the settlement of the company's obligations towards leasing companies. The flight uses both financial and operational leasing. In the literature on business financing, I refer to operating leasing as a cheaper option for financing companies. All Dreamliner 787 planes are leased for the most part through financial leasing. As per the balance sheet date 31/12/2017, the national carrier had only one Dreamliner aircraft financed in the form of an operating lease and 7 aircraft under financial leasing.

Polish Airlines Lot as a company with intercontinental scope of operations applies a security policy aimed at counteracting risks such as: currency risk, interest rate risk, aviation

fuel price risk, risk related to carbon dioxide emission, credit risk and liquidity risk. A significant part of financial leasing contracts is based on a fixed interest rate.

On the basis of the national carrier's financial report for 2017, it is not possible to assess the revenues and profits that have been obtained by using a fleet of Boeing 787 long-haul aircraft. Verification of these data requires obtaining information directly from PLL Lot. The presence of American manufacturer's aircraft in the colors of Polish Airlines Lot allows the carrier to make long-distance connections. Flagship transatlantic connections Flight performs to the United States to New York, Newark, Chicago and Los Angeles. An important aviation destination is Toront-Lester B. Pearson airport in Canada. The Polish national carrier is also trying to be present on the Asian market, which is why it offers direct flights to Tokyo, Beijing, Seoul and Singapore. The Asian air transport market is one of the largest markets in the aspect of passenger air transport. It is characterized by strong competition between airlines.

PLL Lot conducts its business based on five strategic assumptions such as: using the potential of a growing market, developing a network of connections, fighting for each client, increasing efficiency and the team involved. (Jardine, Safaei, 2018) These assumptions are realized, among others, during the use of the Boeing 787 fleet. Long-haul aircraft form the routemap of airline connections, allows to reach distant regions of the globe and open potentially profitable connections where demand has been confirmed by the analysis of preferences of potential passengers.

The Warsaw hub, from which the national carrier realizes the majority of long-haul flights can be an added value, due to the position of the leader of PLL Lot in Central and Eastern Europe.

The amount of revenues generated by the Boeing 787 Dreamliner long-haul fleet can be estimated based on the Lot Polish Airlines flight reservation system. (www4) The booking of flights has included such destinations as: Warsaw-Toronto, Warsaw-New York, Warsaw-Tokyo, Warsaw-Beijing and Warsaw-Singapore. A return flight option has been selected for each route, in the time frame: departure 09-10.12.2018, arrival on 09-10.01.2019. It has been assumed that connections are made by a Boeing 787-8 Dreamliner aircraft with a three-class passenger cabin. For each class the seat load factor, $LF = 86\%$ (www5), was taken into account with the data analysis of the Civil Aviation Office for the second quarter of 2018. It was also assumed that during the week a given connection is carried out three times, departure and arrival were treated as one cycle, so within a week the connection is carried out in three cycles. The

weekly cycles were multiplied by the number of weeks in the year, which gave 156 cycles during the year. The income was calculated based on the formula:

$$\text{Revenues per connection} = \text{ticket price} \times \text{number of seats in a given class of travel} \times 156$$

Tab. 2 Hypothetical revenues of Boeing 787 utilization

Air connection	Warsaw-Toronto	Warsaw-New York	Warsaw-Tokio	Warsaw- Beijing	Warsaw-Singapore
Travel class					
Economy class 213 seats, LF=183 seats	90.996179,04	78.558957,33	90.224241,12	116.089014,60	78.512138,64
Premium class, standard 21 seats, LF=18 seats	13.583643,84	137.748336,90	19.379018,80	23.163950,16	17.550505,44
Business class, standard 18 seats, LF=15 seats	24.272164,80	29.973200,40	31.274614,80	39.762941,40	32.009187,60
Σ Revenues PLN mln	128.851987,60	246.280494,60	140.877874,70	179.015906,01	128.071831,60

Source: own elaboration

5. Conclusions

The assessment of the impact of the Boeing 787 Dreamliner long-distance fleet on the development of Polish Airlines Lotnicze Lot, made on the basis of financial statements and

statistical data on the analysis of the passenger transport market in Poland is not clear.(Jamili, 2017) Based on the financial statements, it was not possible to indicate the exact amount of revenues and net profit from sales, which were worked out only on the basis of the use of long-haul fleets. However, it can be assumed that the introduction of Boeing Dreamliner 787 aircraft contributed to the development of a positive financial result in 2017 by the national carrier.

The introduction of the air transport of the Boeing Dreamliner 787 aircraft family to the passenger market was supposed to be a breakthrough in the history of civilian aviation in the opinion of the American manufacturer. The aircraft was to be a revolutionary product in terms of technology as well as in the economic dimension, through reduced costs of use and maintenance compared to other models of long-haul aircraft. However, after some time of using the aircraft by the airlines, it turned out that the Boeing Dreamliner 787 is not without drawbacks.

The introduction of a fleet of long-distance aircraft by PLL Lot is an important element of the business strategy on the passenger transport market. The business model of the Polish national carrier focuses on maintaining the dominant carrier position in Central and Eastern Europe, which offers direct flights to North America and Asia.(Marciszewska, Zagrajek, 2014)

For significant occurrences related to the use of the aircraft, it is necessary to mention defects related to the operation of batteries and revealed engine faults. The trade secret remains the amount and form of compensation for PLL Lot from the Boeing group. It can be assumed that the compensation will cover the financial losses incurred by the national carrier in connection with the need to cancel flights and the rental of other aircraft for long-distance services.

The positive impact of Dreamliner 787 aircraft fleet is evidenced by the quantity in the national carrier's fleet and the announcement of its successive enlargement. Thanks to the fleet of Dreamliner aircraft, PLL Lot can handle connections to North America, Asia. An important source of revenue is also charter flights performed by Boeing's aircrafts.

Forecasts by the Polish Civil Aviation Office (www6) regarding the projections of passengers served and the number of operations in Poland by 2035 assume that within the next decade, up to 74 million passengers will be served in Poland by 2028, and 560 thousands air operations will be carried out, which will constitute an increase by over 170% of passengers served compared to the current year. The purchase of a long-haul fleet by PLL Lot should contribute to strengthening the position of the leader of an air carrier in Central and Eastern

Europe. Extending the offered routes to the Asian continent can be a key success factor for the Polish national carrier.

To illustrate the potential revenues that can be developed by PLL Lot through the use of the fleet of Dreamliner 787 aircraft, the hypothetical amount of revenues generated on selected transcontinental routes based on the booking system of Lot Polish Airlines was calculated.

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