

EFFECTIVENESS ANALYSIS OF CLASSICAL AND WIDE BODY AIRCRAFT IN TERMS OF AIRPORT OPERATION

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Summary. Handling of the aircrafts is a set of activities, which are inseparable parts of the airport operations. Air carriers are charged for these activities depending mainly on the size and type of the airplane. Effectiveness of handling of classical and wide-body aircrafts from the view of airport operations is also influenced by the specific airport. Analysis shows advantages of handling of selected types of the aircrafts on the specific airport.

Keywords: handling of the aircrafts, effectiveness, classical aircraft, wide-body aircraft, airport operations, Airbus A320, Airbus A380, price list.

1. INTRODUCTION

Theme of the thesis is effectiveness analysis of classical and wide-body aircrafts in terms of airport operations. Thesis is basically about finding out if it's more efficient for airport operator to handle classical aircrafts, such as mentioned Airbus A320, or if it's better to focus on handling of wide-body aircrafts such as Airbus A380.

I chose Praha Airport a.s. for calculating of the effectiveness because this airport can handle both types of these aircrafts. Airport provides boarding bridges, aircraft stands and all needed equipment of course.

Effectiveness benefit is in the thesis calculated from times of handling of the selected types of the aircrafts and price lists of airport and navigation services provided by the airport.

First part of thesis generally describes handling of the aircrafts. Second part is focused on classical aircraft Airbus A320. Third part is similar as second but it's focused on wide-body aircraft Airbus A380. Fourth part contains specific calculations of earnings from handling of these two types of the aircrafts. Last part is a summary of found information's and it expresses the final results.

Goal of this thesis is to find out what's better for the airport and if it should invest and focus more on handling of the wide-body aircrafts.

2. HANDLING OF THE AIRCRAFT

Handling or technical handling of the aircrafts is set of activities by which we ensure operating and serviceability of the aircrafts. Handling is an inseparable part of the airport operations. These are the services provided by the operator of handling for the air carriers aircrafts.

The volume of handling is directly proportional to the capacity of the selected airport. In general, the capacity of the airport is determined by the ability of individual equipment and other means to handle regular rush hour traffic flows at certain time intervals.

Requirements on handling are simple. It has to be fast, exact, effective and mainly safe. The goal is to minimize time when aircraft is parked and handled on the apron. **Chyba! Nenašel sa žiaden zdroj odkazov.**

2.1. Services provided by handling operator

Aircraft guidance – handling starts with guiding the aircraft on the stand, this can be done in number of ways such as:

- by it's own engine power- this is when aircraft taxis on the stand and there's no need to use aircraft tractor
- aircraft pulled by tractor- this is when there's no need to guide the aircraft,
- guiding of the aircraft by the guiding vehicle or follow me – aircraft follows the guiding vehicle. **Chyba! Nenašiel sa žiaden zdroj odkazov.**

Putting the wedge under the chassis of the aircraft- it's done to ensure that aircraft won't move after parking on the stand. Using the prescribed characters of nonverbal communication informs the crew of the aircraft that the aircraft is secured against movement with help of the brake wedges. After the aircraft is secured the head of handling makes a visual control of the aircraft in case there's some damage on the aircraft. After this the head of handling gives signal to mount the boarding bridge. **Chyba! Nenašiel sa žiaden zdroj odkazov.**

Pulling and pushing of the aircrafts – this equipment is used to move the aircraft from the apron to the stand after taxiing from the runway, but also for moving the aircraft from the stand to the place from which the aircraft can move by the power of its own engines. It's also used to move the aircraft to and from the hangars for example in case of the repair or maintenance of the aircraft. These machines are divided into two groups to towing machines and pulling machines. **Chyba! Nenašiel sa žiaden zdroj odkazov.**

Mounting boarding stairs/bridges to the aircraft – Boarding stairs are used when aircraft is not equipped with its own stairs. Stairs should have lights and made of antiskid materials. Boarding bridges are special bridges that connect terminal and the aircraft entrance. Their advantage is mainly that the passengers can't mix with other passengers of different flight. Bridges are divided on fixed (can be used only for one type of the aircraft) and mobile (can change the length and height and can turn). **Chyba! Nenašiel sa žiaden zdroj odkazov.**

Loading and unloading of luggage, goods and mail – this category includes equipment for safe and fast loading of mail, goods but mainly luggage or different loads. It contains many kinds of loaders and similar equipment for example luggage trolleys, loading conveyor, container trolleys, container loaders. **Chyba! Nenašiel sa žiaden zdroj odkazov.**

Refueling of the aircraft – basic requirements in fueling of the aircraft are high quality of fuel, cheap and fast delivery of the fuel to the aircraft, sufficient supplies of the fuel but also provide safety and protection of the environment. Distribution of the fuel over the airport is done in two ways which are mobile (fuel is distributed by fuel trucks) or stabile system. (distribution of the fuel by pipelines). **Chyba! Nenašiel sa žiaden zdroj odkazov.**

Filling aircraft with drinking water – aircraft need except fuel also drinking water that is certified. Water tanks are made of anticorrosive steel and they have to fulfill safe norms. This equipment also contains hoses with universal adapters, devices that control the water amounts but also devices that avoid freezing of the water. **Chyba! Nenašiel sa žiaden zdroj odkazov.**

Filling the aircraft with compressed gases – the most used gases in the aviation are air (used as parallel to ASU for starting of the jet engines), oxygen (sucked from outside through the air conditioning but also oxygen under pressure, which is used for the time needed to get to the breathable level), nitrogen (used to control of the moving parts of the aircraft or as a filling of the shock hardware of the chassis and tires, nitrogen is used because of its firefighting characteristics). Bottles with a different gases have a different colors for example oxygen has blue, nitrogen has green. **Chyba! Nenašiel sa žiaden zdroj odkazov.**

Connecting aircraft to ground power source and starting the aircraft engines – main source of electricity in the aircraft is generator which starts to run after starting the engines.

On-board battery is of great importance to flight safety, it is therefore not desirable pumping its capacity on the ground. For this reason, an external power supply is used on the ground.

This devices ensure the supply of electricity to aircraft standing on the apron with its engine stopped. Civil aviation uses GPU - an external power source, APU - Auxiliary Power Unit and ASU - air starter for aircraft engines. **Chyba! Nenašiel sa žiaden zdroj odkazov.**

Air conditioning and warming the cabin – these systems are used to warm the cabin of the aircraft or as a protection from freezing of some parts of the aircraft. External air conditioning source is used when the aircraft is parked for a long period of time. These systems are divided depending on the type of the aircraft. **Chyba! Nenašiel sa žiaden zdroj odkazov.**

De-icing of aircraft and prevention against freezing of the aircraft – de-icing is the operation done to remove the ice coating from the aircraft to provide clean surface of the aircraft and protection against ice coating (anti-icing) is operation done to prevent the ice coating. If you experience icing conditions and an increased risk of icing, the aircraft must be treated with anti-icing fluid. Sources used for defrosting but also for ice protection are the same, the only difference is the use of mixtures on the treated aircraft. **Chyba! Nenašiel sa žiaden zdroj odkazov.**

Service of the toilet systems – these devices are used to drain the toilet systems of the aircraft. From vacuum toilets placed aboard the aircraft the waste is concentrated in the waste tank, and this tank is emptied during ground handling by another tank that is adapted for this operation. It's also known as sewage truck. **Chyba! Nenašiel sa žiaden zdroj odkazov.**

Catering – is known not only in aviation but also in other departments (hospitals, schools, transport). It can be defined as supplying of the meal or as providing the food and drinks. Goal is to provide an attractive gastronomic service for the adequate charge. The result is satisfied customer and profit. To ensure the catering there has to be catering technical basis for ensuring transport, loading and unloading. Ensuring catering does not mean only loading and unloading of food but also the very preparation of meals and drinks, packaging and of course professional team of staff. **Chyba! Nenašiel sa žiaden zdroj odkazov.**

3. CLASSICAL AIRCRAFTS

Classical aircrafts are also known as narrow-body or one-isled aircrafts. This category includes aircrafts with typical body width 3 to 4 meters with 2 to 6 seats arranged next to each other along one isle. This type of aircrafts doesn't allow transatlantic or intercontinental flights. These aircrafts are known as regional which can carry up to 289 passengers. **Chyba! Nenašiel sa žiaden zdroj odkazov.**

3.1. Airbus A320

it's a civil aircraft used for short and medium flights. This aircraft was the first civil aircraft with digital pilot system called fly-by-wired. This system doesn't allow pilot to take over full control of the aircraft, system replaces hand control of the aircraft with electronic control. It allows a no pilot control. The cabin of Airbus A320 is wider than in other aircraft in this category, bigger space for luggage over the passenger's heads and a fully digital FBS control system. Aircraft also provides a bigger cargo space with a larger doors, which makes loading and unloading a lot easier. This aircraft is a very attractive one for a low cost airlines because of low costs of performance and maintenance.

Handling of Airbus A320 - time needed for handling of this aircraft according to Gantt scheme is calculated to be 44 minutes. However the real time can be different depending on used equipment and a operational procedures on the selected airport in our case on Praha/Ruzyne Airport. Charge for full handling including mounting of the boarding bridge is 22040CZK and parking of this aircraft costs 3000CZK.

4. WIDE-BODY AIRCRAFTS

This is the type of aircrafts that has a body big enough to provide two isles in the cabin. These aircrafts are also known as two-aisled aircrafts with 7 to 10 seats next to each other which allows total capacity up to 850 passengers. Typical body is 5 to 6 meters wide but the biggest wide-body aircraft is more than 6 meters wide and allows to provide seats for 11 passengers in one row. Wide-body aircrafts were designed as combination of efficiency and comfort of the passengers but also to provide a bigger cargo space. Airlines quickly realized economic factors and reduced a bigger space for passengers to raise the earnings and profits. These aircrafts are also used for transportation of the commercial goods or in other special use. (army, science and research).[6]

4.1. Airbus A380

Airbus A380 is the biggest duo floor, four-engine civil aircraft in the world. It's also known as superjumbo jet. It can carry up to 853 passengers. This modern aircraft first flight was in 2005 in France. First commercial flights were made in 2007 after few modifications. Top floor is two times bigger than in Boeing 747 which means double usage of the top floor area. This aircrafts top speed is 1062 km/h. Standard traveling speed is around 900 km/h. It's flight distance is up to 15200 km. [7]

Handling of the Airbus A380 - time for handling of this aircraft is according to Gantt scheme approximately 90 minutes. Real times may vary depending to used equipment and operation procedures in this case too. Change for full handling including mounting of boarding bridge is 43000CZK. Parking cost is 6000CZK.

5. PRAHA AIRPORT, a. s.

Praha airport a.s. Is the operator of the Praha/Ruzyne Airport, which is the only airport in Czech republic with more than 5000 take offs and landings in a year. Airport is a subsidiary company of Czech Aeroholding a.s. This company covers companies owned by state, which operate in aviation industry. Airport also cooperates with Ministry of finances and traffic in Czech republic, bureau of civil aviation, air traffic management, airlines, with public authorities in the aviation sector but also beyond it , with airport users and also with the capital of Czech republic- Prague and villages lying close to the airport. [11]

This international airport's code is LKPR and is fully coordinated, which means that for all the flights (excluding the search and rescue flights or supersonic flights) it's necessary to ask for a airport slot for landing and take off from coordinator of the airport. Coordinator is independent association called Slot Coordination Praha. Capacity of the airport or hourly capacity of runway system of the airport is 46 movements in a hour during the rush hour. Maximum year capacity is around 212000 movements of the aircrafts with approximately 74% of usage. [12]

5.1. Praha Airport charges for the Airlines at the Praha Airport

Basic airport operation can be divided in two categories. Category that includes landing, taxiing and parking of the aircrafts and the category that includes handling of the passengers. The basic separation of the charges is to landing charges and airport tax. The charges used next in the article are from ICAO document 7100 from 2001.

Landing charges- these charges pay for costs of building, operation, maintenance and repairs of the runway, taxiways and aprons at the airport. This charge is usually calculated from MTOW of the aircraft and is usually proportional because it assumed that the heavier aircraft causes a bigger depreciation of the areas.[2]

Table 1 - Landing charges

weight MTOW in tons	charge for ton
up to 9	1 953 CZK
from 9 to 24	2 000 CZK + (MTOW-9) x 198 CZK
from 24 to 49	5 000 CZK + (MTOW-24) x 172 CZK

from 49 to 100	9 300 CZK + (MTOW-49) x 164 CZK
over 100	100 x 176 CZK + (MTOW-100) x 88 CZK

Noise charges – this charge is part of the economic charge category. Noise is one of the negative effects, which airport tries to reduce. Noise charges depend on the noise that aircraft makes. Airports use categories of noise of the aircrafts according to ICAO. Flight is classified and charged depending on category in which the aircraft is. Profits from these charges are used to cover the costs for system for measuring of the noise but mostly for providing the actions in building the noise barriers for the towns near the airport.[2]

Table 2 Noise charges

Category	Cumulated difference	Charge for a ton MTOW
1	15 EPNdb and more	5,50 CZK
2	from 10 to 14,9 EPNdb	11,50 CZK
3	from 5 to 9,9 EPNdb	28,5 0CZK
4	from 0 to 4,9 EPNdb	57,00 CZK
5	< 0 EPNdb, or uncertified aircraft	114,00 CZK

Parking charges – these charges form just a small part of earnings of the airport. These fees are used to cover the costs related to use the aprons and parking areas for the aircrafts. first two hours of parking are usually free of charge depending on the airport. This also depends on the size of the aircraft. Charge for next hours depends on MTOW of the aircraft and on park time (day, night).[2]

Table 3 Parking charges

area	time	charge/ton/hour
Apron:	between 5:00 – 19:00 UTC	14,00 CZK
	between 19:00 – 5:00 UTC	7,00 CZK
Parking area:		7,00 CZK

charges for a passengers service – also called airport tax. Charges for using the airport by passengers. These charges are used to cover the costs of building, operation and maintenance of the terminal. Airport tax is based on number of flying out passengers or transfer passengers on selected airport. Charge amount is divided depending if the passenger start his journey at the selected airport or is just traveling through this airport.[2]

Table 4 Charges for a passenger service

Charge for the flying out passenger older than 2 years	525,00 CZK
Charge for the transfer passenger	190,00 CZK

Navigation charges – these are divided on terminal (R=txN) and trackside charges (single charge).[2]

5.2. Current conditions at the Praha Airport

Airport currently provides 3 boarding “fingers“, for terminal 1 it’s an A and B boarding “fingers“ and for terminal 2 it’s a boarding “fingers“ C. There are 29 boarding bridges for the handling of the aircrafts out of which 2 can be used for Airbus A380 and other 23 can be used for Airbus A320. We can see areas for a long time parking on the north part of the airport out of which 14 can be used to park the Airbus A320 in the current conditions.

6. EFFECTIVENESS ANALYSIS

6.1. Main items of the airport's income

Airport currently provides 3 boarding "fingers", for terminal 1 it's an A and B boarding "fingers" and for terminal 2 it's a boarding "fingers" C. There are 29 boarding bridges for the handling of the aircrafts out of which 2 can be used for Airbus A380 and other 23 can be used for Airbus A320. We can see areas for a long time parking on the north part of the airport out of which 14 can be used to park the Airbus A320 in the current conditions.[3]

6.2. Analysis and calculations

There's a comparison of two model situations in this analysis namely when airport is fully occupied by classical aircrafts and when it's fully occupied by wide-body aircrafts.

In both cases there's a calculation with handling of the aircraft in 90 minutes on every available stands and then longtime parking for next 3 days from 8:00 on a first day to 20:00 on third day. Parking will be on a distant but also on close positions of the "finger" A simultaneously

6.3. Comparison of the charges

Table 5 Comparison of the charges

	A320	A380
Airport charges	5 421 494 CZK	5 544 872,1 CZK
Longtime parking on distant stands	652 680 CZK	1 646 400 CZK
Longtime parking on close stands	351 722 CZK	1 489 600 CZK
Technical handling	1 217 400 CZK	690 000 CZK
Total	7 643 296 CZK	9 370 872,1 CZK

Charges for the wide-body Airbus A380 aircraft are recognizably higher than charges for classical Airbus A320 aircraft which means that in this case from the view of the operator of the airport it's more efficient to handle wide-body aircrafts.

there's no big difference in airport charges even when there's a difference in number of aircrafts in each category. Difference is shown only in longtime parking in both positions. Next big difference is in the charges for handling which is up to 1217400 CZK for classical aircrafts. This high sum is affected by the number of aircrafts handled in defined time.

Calculated sum of the income is for a specific type of the aircraft. Income level are very different in a little changes. There are a lot of factors that affect the income level. For example number of passengers in the aircraft, manufacture date of the aircraft and a noise charge, aircraft size. For example charges for handling in winter time affect defrosting of the aircraft.

Calculations were focused on civil aircrafts in a specific part of the Praha Airport – North. These calculations can be applied on the other parts of the airport for example south or east. We can also apply them on cargo aircrafts.

Both types of aircrafts have it's advantages and disadvantages which affect real effectiveness of specific type.

Table 6 Table advantage and disadvantage chooses aircrafts

advantage	A320	disadvantage
- Shorter handling, - smaller area needs, - smaller taxiways and lower category of the airport.		- More movements, which means greater possibility of potential collisions of aircraft, - need for higher number of equipment , - high staff cost (high number of staff).
advantage	A380	disadvantage
- Less equipment, because of handling of less		- Need to invest in buildings on the airport and

aircrafts simultaneously, - more passengers transported, higher costs form non-aeronautical activities, - lower number of staff, - high income from landing and handling charges.	buying of the equipment for handling, - bigger depreciation of the motion areas caused by bigger weight of the aircrafts, - bigger consequences in case of collision, materially or casualties.
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7. CONCLUSION

I analyzed effectiveness of the classical and wide-body aircrafts from the view of the airport operations in this thesis. Calculations are applied on classical Airbus A320 aircraft and wide-body Airbus A380 aircraft and on Praha Airport. I calculated what more efficient for the airport. With using of model situations I came to conclusion that in actual situation it's more efficient for this airport to handle even if only few more bigger aircrafts because income are bigger from these aircrafts if we're not looking at current equipment in the airport.

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