Analysis of Riga International Airport Flight Delays

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Abstract. During the preparation of this research, the negative impact of aircraft flight delays on airport and passengers were described and analysed. A detailed analysis of aircraft flight delays at Riga International Airport was performed. The result of the analysis demonstrates the season character of flight delay as well as the tight relation between ground handling services and aircraft flight delays. Special effect of flight delays was noted due to movement of ground handling vehicles at the aerodrome. Analysing the delays and their causes will be helpful to improve the prediction of future delays and reduce them as well as reduce of the waiting and downtime of the aircraft on the ground.

Keywords: Ground handling · Flight delay · On-time operation

1 Introduction

In recent years, the increase number of aircraft flight delays in the National Airspace System (NAS) has been the subject of several studies [1]. Flight delays became a fact of each air travel system user and sometimes it has dramatic consequences when the passengers have connection flight. Flight delays have negative consequences on airlines, airports and passengers. On-time operation of the airports and airlines schedules are the target of all airports and airlines stockholders in order to fulfil with passengers and customer requirements as well as getting more new customers [2]. As far as delays are considered as one of the most sensitive remembered performance indicators of any transportation system, it is quite important to give definition of this terminology.

In aviation sector delays are understood as the period of time by which a flight is late or postponed in other words a delay is the difference between the scheduled and the real time of departure or arrival of flight [3]. In other words, delays are defined as "the time lapse which occurs when a planned event does not happen at the planned time" [4].

Taking into consideration airports all over the world, we can note that approximately 20% of all flights have delays by several reasons as well as near to 4% flights are cancelled (see Fig. 1 and Table 1).

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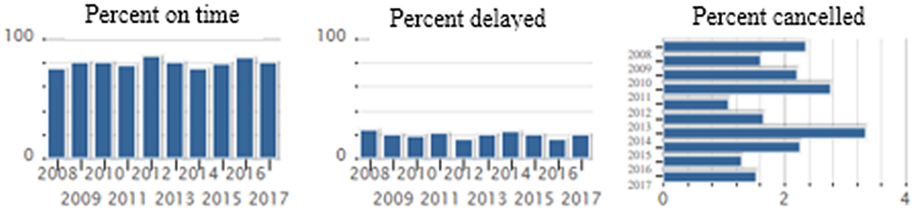

Fig. 1. Worldwide flight delay [7].

Table 1. Worldwide flight delay [7].

Year	Ontime arrivals	Ontime (%)	Arrival delays	Delayed (%)	Flights cancelled	Cancelled (%)	Diverted	Flight operations
2008	2,213,622	73.90	704,709	23.53	70,671	2.36	6,508	2,995,510
2009	2,116,172	79.47	497,520	18.68	42,970	1.61	6,134	2,662,796
2010	2,096,035	79.81	466,350	17.76	57,717	2.20	6,316	2,626,418
2011	1,918,094	76.59	511,002	20.41	68,901	2.75	6,242	2,504,239
2012	2,104,374	84.30	360,463	14.44	26,615	1.07	4,776	2,496,228
2013	2,077,611	79.40	490,102	18.73	43,520	1.66	5,379	2,616,612
2014	1,783,676	74.66	519,682	21.75	79,494	3.33	6,234	2,389,086
2015	1,867,232	78.27	458,474	19.22	53,715	2.25	6,194	2,385,615
2016	1,897,646	82.87	357,236	15.60	29,839	1.30	5,105	2,289,826
2017	1,824,076	79.17	439,424	19.07	35,162	1.53	5,281	2,303,943

In last decades, the expansion in aviation transport has not been smooth. It has expanded in spurts, where periods of growth and increased service were followed by industry recessions and cost cutting [5]. However, this expansion has seriously strained the air travel industry on the ground, where the infrastructures such airport gates, runways, and air traffic control systems, have begun to cause massive delays [6]. Delays have thus become a standard element of air travel.

When the airports commence the organisation of their schedules, they must commit their resources to satisfying their customers', this require all service providers involved in ground handling processes to ensure high efficiency of handling activities and avoiding delays [8]. To explain the level of complexity of flight delays, it is important to understand the network entirely starting from passengers' registration at origin airport and ending by baggage delivery at the destination airport. There is a known relationship between levels of delays and fares, aircraft sizes, flight frequency and complains about airline service [9–11].

From scheduling point of view, which is often built up months before the day of operation, the predictability of operation has a major impact to which extent the use of available resources (aircraft, crew, etc.) can be maximized [12].

Flight scheduling based on where and when the airline will fly. Schedules are set to make the profitability as maximum as possible. The revenue and cost associated with each schedule are based on very different views of the same information [13]. At the same time the schedules are subject to inconsistency due to several reasons. Flight delays

could be seasonal or due to current conditions of operations, lack of equipment, bad management, etc. One of the main parts of airports and airlines expenses and losses is that losses are coming from flight delays. Delays of the aircrafts by reasons are tightly related to the ground handling services are quite often observed. Analysing of delays and their reasons will be helpful to improve the prediction of future delays and reduce them as well as reduce waiting and downtime of the aircraft on the ground.

The analysis at the European airport delays shows that:

- 80% of delays on flight arrival could be forecast from the delay on departure.
- The airline which flight destination has been studied allows a very small margin between the scheduled and the real flight and taxiing times, which does not allow absorption of any part of departure delays.
- 70% of delays on departure, could be forecast from the departure plane load factor, when the plane is not significantly delayed on arrival.
- There is some evidence that the scheduled stop time plays an important role in absorbing the arrival delays. For instance, a 45-min scheduled stop time does not allow a delay recovery, if the departure plane is 80% loaded. The shorter the station stop time, the greater the sensitivity of the delay on departure to the delay on arrival (see Fig. 2) [14].

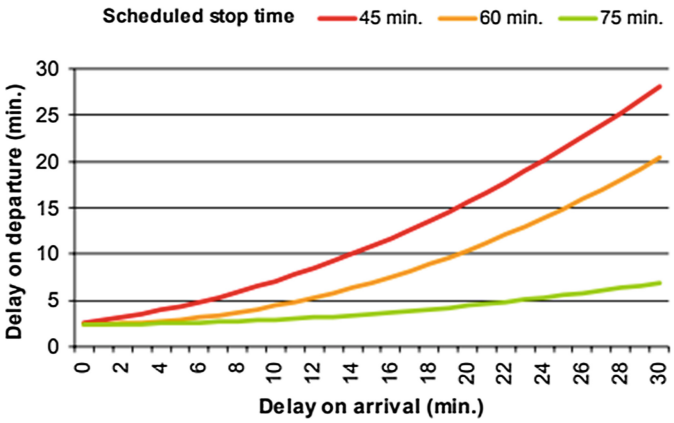

Fig. 2. Departure delay sensitivity to the delay on arrival [14].

From economic point of view, the direct costs originated by flight delays amounted in Europe to 1,250 million euros during 2010 according to the European airline delay cost reference values report from the Westminster University [15].

2 Aviation Sector in Baltic States

Reviewing the air transport passenger flow for Baltic states, we can see that in recent years the demand for air transport has been rising as demonstrated below (see Fig. 3). Based on the data presented on Fig. 3, we can make confirmation, that in each of the

Baltic States, Latvia, Lithuania, Estonia there is a significant increase in demand for passenger transport. In Lithuania it was 13%, in Latvia it was 4.6% and in Estonia 2.5%.

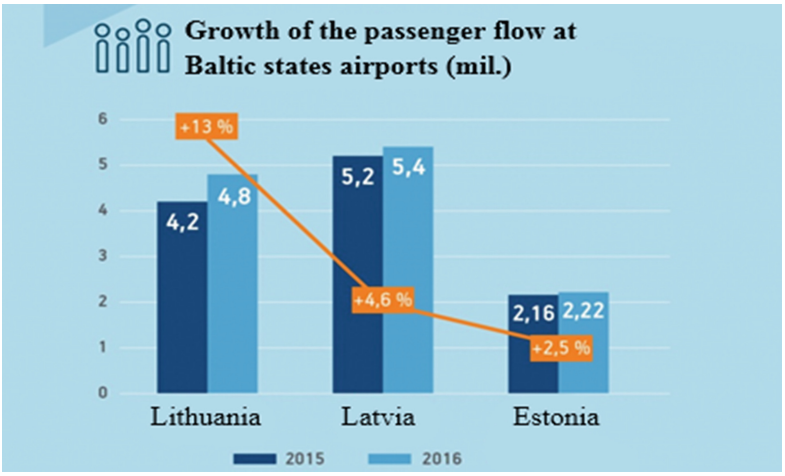

Fig. 3. Growth of the passenger flow at Baltic states airports [16].

Figure 4 demonstrates the growth in certain Baltic state airports in all three countries separately.

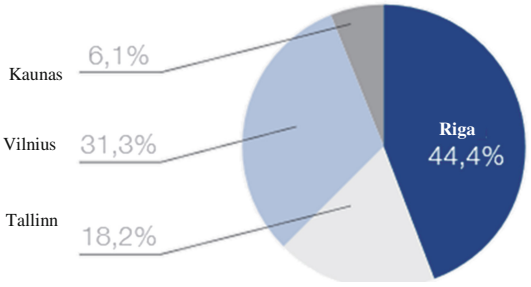

Fig. 4. Distribution of passengers at airports in the Baltic States in 2016 [17].

Related to passenger flow in Latvia, we can note the tendency of stable growth, not only for last 2 years, but for the period from 2004–2016, including the period of world-wide economic crises at 2008. Figure 5 demonstrates the growth of passenger flow for Riga international airport.

In Latvia, the aviation sector provides 0,7% GDP, at the same level as the light industry, at the same time the number of specialist involved in aviation sector for the year 2015 in Latvia increased by 100% comparing to year 2005 (see Fig. 6).

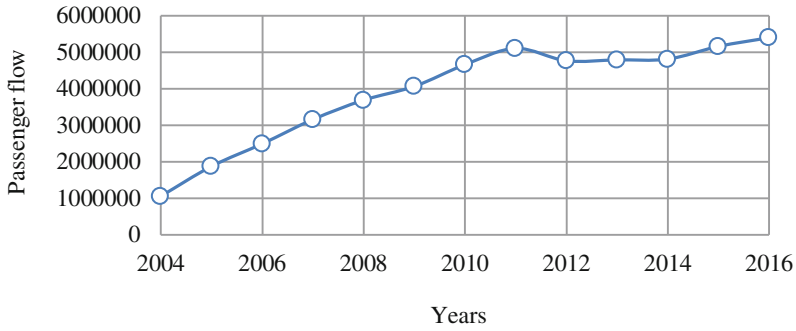

Fig. 5. Passenger flow growth in Latvia [18].

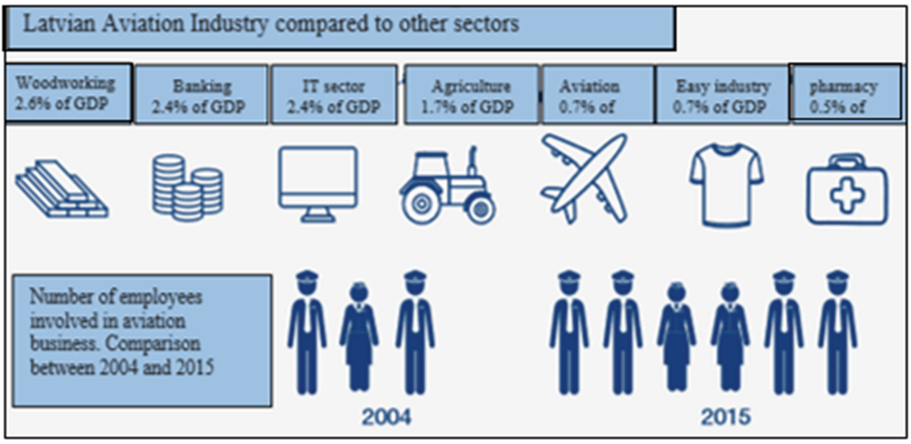

Fig. 6. Latvian Aviation Industry compared to other sectors [17].

During this research, we plan to perform statistical analysis of Riga International Airport flight delays, and then in future link and use the results of the analysis in our research.

3 Analysis of Aircraft Flight Delays at Riga International Airport

Using the data collected by the Riga International Airport statistical bureau, we note that more than 9000 (9251) flight delays were registered at Riga international airport in 2016. All flight delays were categorized by delays codes. Approximately 70 reasons of flight delays were registered. The total time of all flight delays in 2016 was 3200 h. For illustration, flight delays were grouped to months (see Fig. 7), from this figure, we can note that the influence of seasons on flight delays. The delays number increase by approximately 30% during high seasons, from 5–8% to 10–11%.

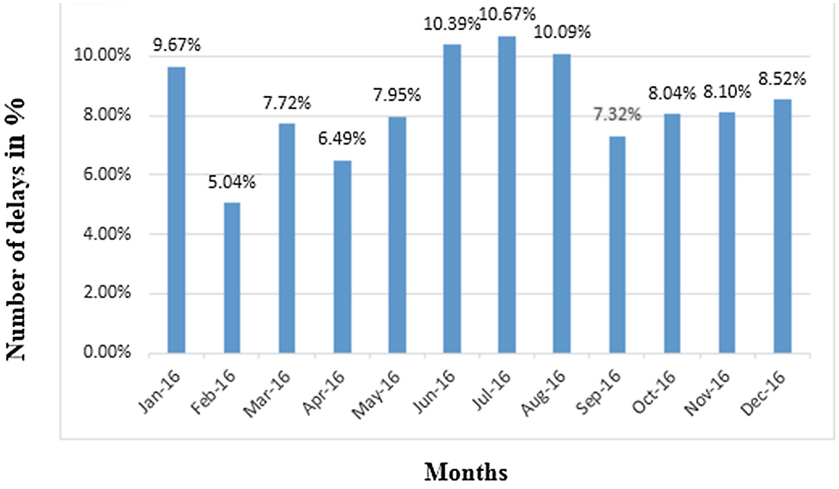

Fig. 7. Seasonality characteristic of flight delays.

Major part of delays was caused by reasons related to Fig. 8a:

- availability of aircrafts at Riga International Airport;
- restrictions at airport of destination or departure – airport and/or runway closed due to obstructions, etc., awaiting load from another flight, late arrival of aircraft from another flight or previous sector) – Total delays time for this category was more than 1 500 h. Average flight delay time was 19 min;
- technical maintenance of aircrafts including scheduled and non-scheduled maintenance and flight diverting due to maintenance reasons – total delays due to this reason was more than 600 h. Average flight delay time was 54 min;
- delays due to discrepancy with ATC data (Air Traffic Control) – total delays time for this category was more than 300 h. Average flight delay time was 19 min;
- delays due to ground handling process – total delays time for this category was more than 2500 h. Average flight delay time was 15 min.

For further and more detailed analysis, the flight delays by reasons not related to airport operation procedures (Air Traffic Control, weather, crew, etc.) were grouped separately from other flight delays reasons. This analysis mainly will deal with reasons related to airport operations procedures (group A of Table 2). The reasons in group B will be not discussed during this research as far as our research focuses on optimization of ground handling vehicles movement at the aerodrome. There are a lot of researches dealing with other reasons of flight delays such as [19] which deals with weather impact on flight delays and [20] which deals mainly with air traffic flow management.

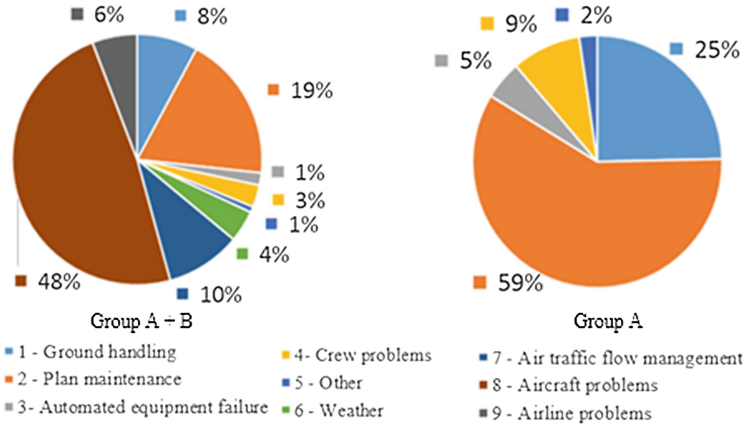

Fig. 8. Distribution of the flight delay times (h) for selected groups in accordance with Table 2.

Table 2. Characteristic of main flight delays groups.

No	Problems group	Numbers of delay	Time of delay total (h)	Time of delay total (min)	Average of delay (min)
Group A: characteristic of main flight delays related to airport procedure					
1	Ground handling	1 188	251.72	16 510	15
2	Plan maintenance	676	602.92	36 175	54
3	Automated equipment failure	209	50.92	3 055	15
4	Crew problems	472	91.42	5 485	12
5	Other	140	23.73	1 424	10
Total of the group A		2 685	1 020.70	62 649	23
Group B: characteristic of main flight delays related to other procedures					
6	Weather	468	131.43	7 886	17
7	Air traffic flow management	975	311.20	18 672	19
8	Aircraft problems	4 851	1 550.35	93 021	19
9	Airline problems	272	186.37	11 182	41
Total of the group B		6 566	2 179.35	130 761	20
TOTAL of groups A + B		9 251	3 200.05	193 410	21

Taking into account above mentioned correction, the flight delays related to ground handling services at Riga International Airport will be more than 25% of total delays time (see Fig. 8b).

From Fig. 8b and Table 2 it is seen that main cause of flight delays is technical maintenance of aircraft, the second by importance is ground handling services 25% of total delays. As far as ground handling process is quite wide, and there are a lot of reasons hidden behind, and not all of them related to ground handling vehicles movement at the aerodrome. Description of ground handling causes are illustrated in Table 3 and Fig. 9. At the meantime in Table 2, we can note that more than 600 flight delays or 49% of total delays related to ground handling causes, directly related to ground handling vehicles movement at the aerodrome (group B, D-I), as well as 44% from total delays were related to passenger's registration and errors in baggage registrations.

Table 3. Characteristic of flight delays related to ground handling services.

No	Problems group	Numbers of delay	Time of delay total (h)	Time of delay total (min)	Average of delay (min)
A	Check-in error	676	133.78	8 027	12
B	Baggage processing	2	0.23	14	7
C	Cargo	83	21.15	1 269	25
D	Loading/ unloading	507	129.27	7 756	15
E	Servicing equipment	36	4.83	290	8
F	Aircraft cleaning	18	2.62	157	9
G	Fuelling/ defueling	17	4.17	250	15
H	Catering	13	2.15	129	10
I	Operation requirements	74	8.25	495	7
TOTAL		1426	306.45	18 387	13

By performing analysis of flight delays related to the use of ground handling vehicles movement at the aerodrome, we can see that the main cause of the delays in this group is tightly related to aircraft loading/offloading procedure (group D, Table 3 and Fig. 9), more than 500 aircraft flight delay.

Maximum duration of flight delays is 15 min, total duration of flight delays by this reason is 130 h or 85% of delays in this certain group. Next causes are presented here in after (see Fig. 10).

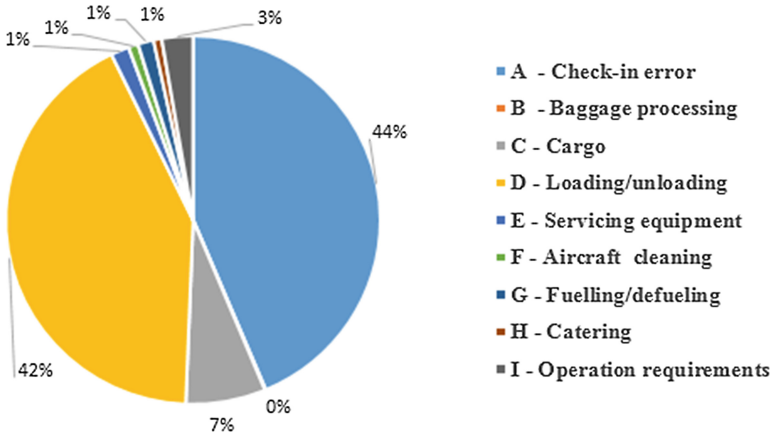

Fig. 9. Distribution of the flight delays times (h) due to ground handling services for selected groups in accordance with Table 3.

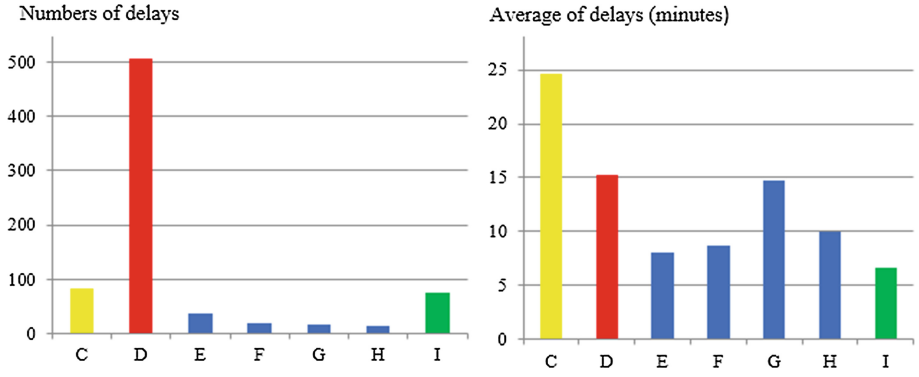

Fig. 10. Characteristic of flight delays by cause of ground handling movement at the aerodrome.

As we can see from above presented data, one of the main factors that play a key role in increasing the efficiency of airport operations is reducing the downtime of the aircrafts on the ground by reasons related to ground handling services.

The most important way to improve airport efficiency is control and optimization of ground handling vehicles movement at the aerodrome.

In order to deal with the delays related to ground handling movement at the aerodrome at Riga International Airport, a simulation model will be developed for fragment of Riga International Airport, where we plan to test and simulate the operation of above mentioned airport.

The authors of this research currently are working on the optimization of ground handling vehicles movement issues by using simulation modelling [21]. The researched methods of increasing of the effectiveness of ground handling vehicles movement are based on the implementation of prioritization rules of vehicles movement and changes in the geometry of sections of the road on which traffic congestion may occur. Data on

flight delays at Riga International Airport are used by the authors to validate the simulation model of ground handling vehicles movement, as it becomes possible to compare the results of statistical modelling with real data. The models tested in this way can be used to optimize the ground handling vehicles movement in large airports with intensive traffic.

4 Conclusion

The influence of o ground handling vehicles movement at the aerodrome on aircraft flight delays was observed.

The analysis of flight delays data for Riga International Airport demonstrates that the number of flight delays increases by approximately 30% during high seasons. Unfortunately, we could not analyse the delays by day time and dropped it to companies as far as this data is confidential.

By analysing the reasons of flight delays, we note that these reasons are divided into two main groups, one group is related to services which are not directly related to airport operation procedure. This group was not studied during this research as far as it is not the subject of our research. The other group is tightly related to airport services. Analysing the second group the relation between flight delays and various aspects of airport services was observed. Analysis shows that there is a considerable impact of ground handling services on the flight delays. Taking into consideration that all ground handling services are performed by using ground handling vehicles especially loading/unloading, servicing equipment refuelling, etc., we can make conclusion that optimization of ground handling movement vehicles at the aerodrome will reduce the flight delays times.

As it follows from the analysis, which were performed above, the effectiveness of the organization of ground handling vehicles movement is not the most important factor of flights delays at Riga International Airport. However, at many airports, there is much more intensive traffic of ground handling vehicles observed and this intensive traffic increases the importance of this factor.

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