



A method to evaluate the time of waiting for a late passenger



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ABSTRACT

The paper presents the problem of searching for the right amount of time needed to wait for a passenger who is late for boarding a plane. This problem, although practically ignored by airline and handling agents' operational manuals, is common and very important for flight punctuality, and thus for both passenger satisfaction and the financial performance of air transport companies. The discrete Dynamic Programming task for finding the minimum amount of time wasted on waiting for a late passenger, depending on the moment in time in which the passenger arrives, is formally defined in this paper. The task is solved based on sample data. Dependence of the results on the average period of time needed to find the luggage of a passenger who did not arrive for boarding is examined. The paper also presents the preliminary results of the impact of the random variable describing the arrival time of the last passenger on the moment when the decision to stop waiting should be made. The function, which allows to determine the expected value of that lost time, was specified for different moments of the end of waiting by taking into account the random characteristics of the arrival of the last passenger. The obtained results show that in each of the analyzed cases there is a global minimum of that function. The moment for which the minimum occurs can be considered as the optimal (in terms of time wasted on waiting) moment to stop waiting for the late passenger.

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1. Introduction

Today, time plays a very important role in air traffic, both for airlines and passengers. Air carriers (like any other entrepreneur) expect the largest income at minimum cost. Each carrier's strategic goal is to best utilize its aircraft fleet, thus to carry out a maximum number of flights in the shortest time possible with the greatest occupancy (load factor) of an aircraft (Clark and Vincent, 2012; Mayer and Scholz, 2012).

However, the fastness and timeliness of carriage depends on many factors, one of which is aircraft ground handling. In this paper, the boarding procedure is considered as an important source of primary delays in air transport. According to the International Air Transport Association (IATA) classification, the delay, which the work here refers to has been placed in the group "Passenger and baggage", which consists of nine subgroups of delay causes (IATA, 2014):

- late check-in due to passenger acceptance after the deadline (IATA code: 11 PD)

- late check-in due to congestion in the check-in area (12 PL)
- errors during passenger or baggage check-in (13 PE)
- problems with booking errors, especially overbooking (14 PO)
- discrepancies during boarding, missing checked-in passenger (15 PH)
- problems with a VIP passenger, missing personal items (16 PS)
- late or incorrect order given to the catering supplier (17 PC)
- problems with baggage processing, sorting, etc. (18 PB)
- boarding or deboarding of passengers with reduced mobility (19 PW).

Delays in this group have constituted, in recent years, about 5% of all delays and place fifth among categories of delays caused by the air carrier (Guest, 2007). In recent years, different coding schemes of delay causes have been proposed. Studies demonstrate that these allow for advanced delay analytics, e.g. large-scale delay propagation tracing in an airline network (Wu and Truong, 2014).

1.1. Airlines and the problem of late passengers

Airlines use various and mostly intuitive approaches to the problem of late passengers. The applied procedure gives only a general indication of the action taken. In addition, as will be further

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revealed, these procedures are often contradictory.

The Ground Handling Manuals of many carriers ignore how to act in such situations. In order to make a decision about waiting for a late passenger it is necessary to consider many factors, not always those related just to cost evaluation of lost time of passengers from a considered flight. One of these factors may be, for example, the weather forecast announcing bad weather at the destination airport. Another factor may be the work time of the cabin crew, which is subjected to certain standards and cannot be exceeded. It is also necessary to take into account the number of transfer passengers in relation to the total number of passengers and their status (VIP, Business Class). Another important factor influencing the decision is the planned arrival time at the destination airport. If it is close to the closing time for the destination airport then the aircraft must arrive on time, and waiting for late passengers is unacceptable. Restrictions on arrivals may result from procedures that have been introduced to reduce noise and emissions. The list of airports with such restrictions is relatively long (Wilder, 2014). Another criterion that must be taken into consideration is whether the late passenger has checked baggage on board. If not then the decision to stop waiting is easier because it is not necessary to search for that baggage.

The most common official position of airlines is that late passengers should not be waited on. The decision to wait, especially in the case of charter airlines, can be made only in exceptional circumstances and only after consultation with the airline operating center (Titan, 2012; SATA, 2011; Neos, 2005). However, some operating instructions clearly indicate that in case of discrepancies in the checked-in and boarding number of passengers, the handling agent should organize a search for the absent person and give an individual announcement about boarding completion and the number of the boarding gate (Rossiya, 2013). This procedure, however, is rare. In addition, in these instructions there is no limitation in the period of time that can be spent on searching for the absent passenger or on waiting for him or her.

For example, one of the largest European airline carriers (which requested anonymity so its name will not be provided), operating on a global scale, also as part of a large airline alliance, believes that the carrier should not wait for a single late passenger.¹ Personnel operating boarding should endeavor to complete it 10 min before the scheduled departure time, and then the aircraft door should be closed. If 12 min before the scheduled departure time it is stated that a passenger who has checked-in baggage does not show up, the personnel should start the procedure of searching for and unloading the luggage. This operation takes approximately 3–10 min for an aircraft in which bags are placed directly in the baggage holds. This time period depends on the location of the luggage (close to the baggage hold's door or further, beneath the other baggage) and if the company has a support system to carry out the procedure of searching. For aircraft in which the bags are first loaded into containers and then into the aircraft, baggage unloading time can be much longer, as it depends not only on the baggage position in the aircraft but also on the availability of special equipment, without which it is impossible to move the containers. If there is insufficient equipment of this type at the airport, it is highly probable that there will be a need to wait for these activities to end. The time needed to wait before unloading the baggage is in this case very difficult to estimate, but it can be as high as several tens of minutes. An essential element of the procedure is the principle that once searching for luggage has started, then even if the passenger arrives for boarding before the end of the search, he or she will not be allowed to board the aircraft.

In this article we consider only the situation when luggage is placed directly in the hold of the aircraft, without containers. Even a superficial analysis of the presented procedures shows that the average time needed to unpack luggage of an absent passenger is 7.5 min, which means that it is impossible for the aircraft to be ready to leave the parking area 10 min before the scheduled departure time, as assumed by the airline. As can be seen, this general procedure is internally inconsistent. The absolute priority of the departure time as declared by the respondent airline is, in fact, not executed. The described procedure for boarding also does not take into account the reserve, which in many cases could reduce the departure delay or even allow for departure on time. The way to deliver the passengers to the plane is also not included and can vary considerably. There is, therefore, great potential to improve current procedures, as operating based on fixed values of time, in our opinion, does not give the assumed results.

1.2. Overview of the state of research

In the literature there are many studies on searching for the optimal boarding strategy in which the requirement of minimizing the loading time of passengers has been taken into account, e.g. (Nyquist and McFadden, 2008; Soolaki et al., 2012; Tang et al., 2012; Milne and Kelly, 2014; Bazagran, 2007; Bachmat and Elkin, 2008; Steffen and Hotchkiss, 2012; Steffen, 2008; Qiang et al., 2014) are some of the many interesting papers on the topic. It should be noted, however, that regardless of the boarding strategy, an airline can face the problem of a passenger that is late for boarding the plane. This problem is particularly severe in situations when a passenger has checked-in baggage that has been loaded into the hold of the aircraft. On the one hand, the late passenger should be waited on because, in accordance with the regulations in force (European Parliament, 2008), the aircraft cannot take off if not all owners of baggage located in the holds are on board. Once the decision to stop waiting is made, the baggage of the person absent must be removed from the aircraft. This, of course, requires time and can generate delays. If such a decision is made too early, there is the possibility that the passenger will arrive during the search for his/her luggage. On the other hand, waiting too long may result in loss of the take-off slot, and thus may result in an increase in carrier costs for other passengers, the airport, or even for the crew of the aircraft which is restricted with its working time. Extending the time of occupying a parking space, especially at smaller airports, forces the aerodrome operator to change the use of a fixed timetable of gates and parking areas so that other aircraft can be handled without disruptions.

The decision problem discussed above is an issue that should be considered in a broader context. There are many factors affecting the operation of air carriers in the face of danger or flight delay. Work on this subject was conducted, for example, by Xiong and Hansen (2013), who analyzed the circumstances in which carriers decide to cancel a flight in the event of changes to take-off slots. The issue of the availability of slots was also undertaken in our work. There are many methods for slot reallocation, and these may have an impact on the solution to the decision problem posed in this work (Bard and Mohan, 2008; Torres, 2012; Bertsimas et al., 2011).

The problem of late passengers is relatively rarely undertaken in the literature. Ferrari and Nagel (2005) took it into account as interference in their analysis of the impact of boarding strategy ability to minimize turn-around time. It was also mentioned by Yfantis (1997), who proposed the baggage tracking system as a part of the baggage security services support. Such a system is important from the point of view of our work because it has an impact on the time needed to search for luggage if it is necessary to unload it from the aircraft hold. This time has been included in our model.

One of the key elements included in our model is the probability

¹ Airline X, 2014. Procedures in case a passenger is late for boarding, personal communication.

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