



Note

Assessing performance variability of ground handlers to comply with airport quality standards



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ABSTRACT

The increasing competition in the air transport industry continuously pushes ground handlers to improve their performance. Recent European regulations prescribe that the managing body of large European airports (more than 5,000,000 passengers/year or 100,000 tonnes/year of freight) have to define quality standards of service level for ground handler operations. In case a handler fails to meet these minimum requirements, the airport has to report it these irregularities, potentially imposing a fine or even suspending, partly or fully, the handler's services. As always recognized by the passengers, one of the most critical quality standards is the baggage handling waiting time. This paper defines a methodology to assess whether the handler fits the requirements of first baggage delivery for both the overall process and the specific segments (flight, conveyor belt, departing airport, day of the week, etc.). The methodology, analysing the performance by a two-dimensional perspective (structure and frequency), will help the decision makers in defining mitigating actions to take the performance under statistical control, respecting the requirements and preventing any drift.

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1. Introduction

Ground handling covers a wide range of services that support airline air operations. It may include both technical services, such as maintenance, fuel & oil services, freight handling, and passengers' essential services, i.e. check-in, disembarkation, surface transport, baggage handling, comfort.

This industry experienced a very dynamic development and growth, since the introduction of Council Directive 96/67/EC (EU, 1996). In accordance with the liberalisation of the air transport, the Directive aims at developing the competition among players to increase the efficiency of the ground handling activities, to decrease the average costs, increase the quality levels of services and enhance the choice for airlines (Soames, 1997). The definition of quality, which has to include safety matters, baggage delays, environmental matters, etc., evolves in a two-party service level agreement between airlines and ground handlers.

After the Directive's implementation, Airport Research Center (2009) showed a decreasing trend on prices and an increase of competition, given the large number of third party handling

companies entering the market. Anyway, statistics on quality level were unclear. While many airport managing bodies and airlines are generally satisfied, others observe that quality levels suffered from this competition on costs (Costantino et al., 2013).

Hence, in 2013, the European Parliament (EU, 2013) asked for a development of ground handling quality levels to safeguard airports and airlines operations (Burghouwt et al., 2014). The regulation requires that large European airports with more than 5,000,000 passengers/year or 100,000 tonnes/year of freight for at least the previous three years set minimum quality standards to respect. These standards are (e.g.) maximum boarding and disembarkation time, maximum time for delivery of first and last baggage, minimum training level, maximum time for de-icing an aircraft, etc. Airport managing body has the right to impose a fine, restrict or prohibit a ground handler from supplying services if that supplier fails to comply with the requirements. Monitoring service performance acquires a fundamental role in airport management (Bezerra and Gomes, 2015; Chen and Chang, 2005).

This paper defines a methodology to assess the handler quality level in accordance with the minimum standards set for the operations, e.g. the maximum waiting time for delivery of first baggage. It allows verifying if the handler fits the standards and highlighting potential critical segments that, even if in compliance with the standards, may require early mitigating actions. The methodology

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is easily applicable to other kind of performance as for last baggage delivery time and several other processes as well (waiting time for baggage check-in, time for passenger boarding/disembarkation, time for transferring passengers between connecting flights, etc.).

2. Method

As stated in Annex 1a, the EU Directive prescribes that the airport managing body shall set a maximum time for delivery of first and last item of baggage, for the airport as a whole or for an individual terminal (EU, 2013). The airport information system collects data about the block-on time of each landing aircraft and the delivery of first and last baggage. These data are made available to the handler’s decision maker, which can compare them with the one reported by its operators. The following 4-step strategy (segmentation, structure analysis, frequency analysis, criticality analysis) can be applied to any of the two databases to assess the first baggage delivery time, with respect to the standards.

2.1. Segmentation

This stage consists of classifying the data of the information system (block-on time and first baggage delivery time). Although the relevance of segmentation can differ from case to case, according to the characteristics of the specific handler and airport, main variables to consider are, for example, airline, flight number, departure airport, aircraft and baggage conveyor belt. The delivery time in minutes is then the difference between these two terms.

2.2. Structure analysis

This stage consists of 3 sub steps:

- o *Target Evaluation.* The first baggage delivery time (T_1), is a continuous random variable to represent with a probability density function (PDF). In detail, rather than T_1 , it is possible to evaluate the PDF that computes the gap between the first baggage delivery time and the relative target time T_1^* , i.e. $\Delta T_1 = T_1 - T_1^*$. Naming L_1^* the number of first baggage to process within a target waiting time (on 100 occasions), the L_1^{*th} percentile of ΔT_1 , i.e. $L_1^{*th}perc(\Delta T_1)$, describes the performance. $L_1^{*th}perc(\Delta T_1) \leq 0$ represents a segment which complies with the requirements, while $L_1^{*th}perc(\Delta T_1) > 0$ a process out of specification.
- o *PDF Shape.* The normal distribution represents the performance variability under statistical control (no systematic cause acting). The gap between target delivery time and real delivery time for an ideal process is unimodal (it peaks at a single value), symmetrical (symmetrical variations on both sides) and ideally ranging between $\pm\infty$.

Table 1
Structure profile for the segments PDFs.

Shapiro-Wilk test	Skewness and Kurtosis	Time limit respected	Structure class
Reject H_0	(Skewness > 0) V (Kurtosis < 0)	NO	A
Reject H_0	(Skewness < 0) V (Kurtosis > 0)	NO	B
Accept H_0	-	NO	C
Reject H_0	(Skewness > 0) V (Kurtosis < 0)	YES	D
Reject H_0	(Skewness < 0) V (Kurtosis > 0)	YES	E
Accept H_0	-	YES	F

A significance test on the data of each segment can assess the normality of ΔT_1 PDF. These tests generally compare the scores of a sample to a normally distributed set of scores with the same mean and standard deviation, where the null hypothesis (H_0) is “sample distribution is normal”.

One of the most common normality tests is Kolmogorov-Smirnov test (K-S test). By the way, even with the Lilliefors correction, K-S test is not enough accurate as it is very sensitive to extreme values (Ghasemi and Zahediasl, 2012). The Shapiro-Wilk test (S-W test) provides a bigger power than the K-S test (Steinskog et al., 2007). The PDF of a segment that rejects H_0 is very different from the ideal normal distribution and thus it suggests the existence of systematic causes.

- o *PDF details.* Once rejected H_0 , it is possible to characterize the PDF skewness (lack of symmetry) and kurtosis (pointiness). An asymmetrical PDF with a long tail to the right (higher values) has a positive skewness, while an asymmetrical distribution with a long tail to the left (lower values) has a negative skewness. A flatter distribution has a negative kurtosis, while a distribution more peaked than a normal distribution has a positive kurtosis. According to the target of the method, PDFs of segments with a long tail to the right are critical as they represent waiting time greater than the standard time. At the same time, flatter PDFs represent a big undesired variability.

Table 1 shows a 6-classes structure profile, combining all the possible exits of the test and the PDF details.

2.3. Frequency analysis

Once defined the relative frequency of the segments F_i as the ratio between the operations number of the segments and the total operations, Table 2 shows 4 classes of frequency. The handler’s decision maker defines the limits of the classes, to represent the impact that the segment has in terms of the percentage of first baggage to process within a target waiting time, i.e. L_1^* : the larger the frequency F_i , the more critical the class.

2.4. Criticality analysis

The last step consists in combining the results of the two analyses, i.e. structure class and frequency class analysis, in order to obtain a synthetic evaluation. The heat map in Table 3 offers a two dimensional holistic and concise classification to prioritize strategic decisions. The colours represents the segments’ contribution to the performance.

3. Case study

The methodology has been applied to a ground handler working

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