



# Monitoring an airport check-in process by using Bayesian networks



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## ABSTRACT

Enterprises oriented to continuous improvement optimizes its activities for enhancing performance of processes and of the entire organization. Monitoring a process involves the responsibility to manage the quality both in terms of efficiency, by conforming goods/services to given standards, and efficacy, by meeting customer requirements. As a consequence, internal and external quality should be treated as being on an equal footing and should be monitored simultaneously. The paper discusses how to jointly analyze perceived and provided quality through Bayesian networks. We show, by an application to an airport check-in process, the advantages in evaluating improving actions that can be achieved when perceived and provided quality are properly combined in a unique statistical tool.

## 1. Motivation

Nowadays, airports play one of the most strategic role in the transportation sector. This is the reason why every airport puts a scrupulous emphasis on improving the quality of services. For all airports the main goal is to pursue success both internally, by respecting declared standard, and externally, by satisfying passengers. The internal and external achievements are measured by studying the provided and the perceived quality respectively. In the literature, analytic studies conducted for testing the overall performance (Francis et al., 2002; Humphreys and Francis, 2000, 2002) in terms of overall level of service (Correia et al., 2008) or of structural features (Hackett and Foxall, 1997; Rowley and Slack, 1999) can be found; other studies examine the key drivers of satisfaction with the airport service from the passengers' point of view (de Barros et al., 2007; Fodness and Murray, 2007), but there are not relevant studies that tried to connect the two perspectives together.

In addition, recent research has reported that the check-in is a crucial process since it is the first operational step that passengers meet during the journey. Some contributions (Correia, 2000; Correia and Wirasinghe, 2003; Correia et al., 2005) highlight that there is high correlation between ratings of total time and walking distance and that there are also fairly strong connections between the total time and check-in. As a consequence, the check-in process represents a very interesting and strategic area of analysis, for both managers and researchers.

The main contribution of the present paper is to propose a monitoring tool for dealing with the provided and the perceived quality, with the final aim to support decisions in an integrated quality managing system. This paper discusses, by means of an application to an airport check-in process, the potentiality of Bayesian networks to manage the data flow. The paper is organized as follows. A literature review is proposed in Section 2. Section 3 describes the background of Bayesian networks. The application is discussed in Section 4. Conclusion and discussion are addressed in Section 5.

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## 2. Literature review

The process management is strongly related to the achievement of two goals: efficiency and effectiveness. Improving the effectiveness means to correctly identify customer requirements; the efficiency is pursued by reducing the variability of the process. Thus, the enhancement of both objectives leads to increase revenue and to improve company performance (Greasley, 2004). Many methodologies as the six sigma and the balance scorecard (Kaplan and Norton, 1996, 2006) are developed in a multiple perspective and encourage managers in achieving their goals through the success of organization as a whole. This means to invest in customer satisfaction whilst the output of the organizations' production processes and their performance are monitored. Amongst the theoretical models aimed at investigating the service quality concept, the Kano model (Kano et al., 1984) is the most relevant contribution arguing an integrated approach between the provided quality and customer satisfaction based on a classification of different types of quality (attractive, one dimensional, must-be, reverse and indifferent). Additional methodologies are essentially tools for letting managers able to understand and interpret market as the outlet for their products and services. This group includes several studies on the relationship between the satisfaction, loyalty and profitability constructs (Oliver, 1980; Gronholdt et al., 2000) and on the factors affecting satisfaction while considering the role of product/service innovations (Kano et al., 1984). In this context, the internal perspective of a company, linked to the internal business process is part of a broader model including the customer perspective and financial aspects (Kaplan and Norton, 1996, 2006). Even if the concept of service quality is very discussed in literature (Grönroos, 2000; Parasuraman et al., 1985; Teas, 1993; Zeithaml et al., 1990; Dabholkar et al., 2000; Kano et al., 1984), few authors have addressed the relationship between performance results and customer satisfaction (McCune, 1989; Tornow and Wiley, 1991; Choi and Eboch, 1998; Renzi et al., 2009). To identify where performance improvement should take place, it is necessary to prioritize performance objectives firstly and then, to compare performance measures against performance standard. Usually, efficiency and efficacy are monitored separately and provide information that can be exploited by managers for simultaneously improving goals. However, this could be misleading with respect to an integrated approach. In fact, it is interesting to analyze whether the efforts put to satisfy the service quality standards are perceived by customers. In other words, it should be studied if external quality parameters are aligned with user needs so that an improvement intervention on the production process generates positive reactions from the customers. As a consequence, internal and external quality should be treated as being on an equal footing. Therefore, the need to find solutions for connecting both the two perspectives of internal and external performance is growing considering that this can represent a key factor of success to produce and manage integrated information useful for obtaining better results. The framework on which this paper is mainly focused is the airport sector that has traditionally been regarded as public utilities to be operated and financially supported by central and local governments. In recent years there has been a trend toward making airports financially self-sufficient through the introduction of commercial goals and, in some cases, private ownership. The main data of the sector showed that the flow of passenger is growing in many international airports (ACI Rapidex, 2013) and this affects quality experience of passengers at airport terminals. Hence, the airport is becoming a complex place in which different cultures interact and passengers have both a travel and purchase experience, often having to spend several hours in transit or waiting for their flights. Within the airport, several actors operates to guarantee provision of services and assurance of standard of service quality to the passengers. The role of the airport management companies is becoming more crucial because they have to manage, check and coordinate different actors, to which processes are outsourced, and that are engaged in the process management of traveling service (check in, luggage delivery, etc.) and other facilities (restaurants, shops, parking, etc.). Hence, internal and external customer chains are identifiable in that context and they need to be monitored through an integrated system.

Competition is fierce in this sector, and airports are adopting different tactics to collect and retain more customers than their competitors. In the context of increasing global competition, there is a continuous increase in customers' expectations and subsequent demand for improved service quality (Chen and Hu, 2013; Tsai et al., 2011). Hence, the hard role of a management airport company is to develop integrated strategies and operations to handle processes in an effective and efficient way. Humphreys and Francis (2002) emphasize that airports need to be aware of the importance of an objective evaluation of their performance. Moreover, they recommend the adoption of a performance measurement system for airports noticing that "Airport managers and governments measure airport performance for three main purposes: to measure efficiency from a financial and an operational perspective, to evaluate alternative investment strategies to monitor airport activity from a safety perspective and to monitor environmental impact" (Humphreys and Francis, 2002). A further purpose is to enable managers and planners "to monitor the operational performance and to identify areas for improvement." (Doganis, 2005). The airport facility is the first and last point of contact of the tourists on their trips. Therefore, the services must be managed / executed efficiently in order to minimize travel time and to allow free time in the commercial areas of the airport (Martín-Cejas, 2006). Gorst et al. (1999) argued that customer satisfaction could be seen as a cyclical process that can increase or decrease over time. Each cycle begins with what the customer thinks or expects. Given that the customer uses the service in the course of time, the classification changes to be a past experience. Two fundamental forces that drive the strategy in the field of air transport safety and customer service (Appelbaum and Fewster, 2003).

As a result, the literature review shows that prolific streams of research have shed light on significant aspects of achievement of efficiency and effectiveness in the airport. Nevertheless, these studies appear to be very specific. In fact, in our knowledge, a debate of scientific and rigorous methods or tools for simultaneously monitoring internal and external quality indicators is poor. The present paper aims at proposing a tool for jointly analyzing perceived and provided quality, both measured on the same controlled process, through a real dataset relative to an Italian airport. The statistical model discussed in the paper studies the relations between two faces of quality and between quality and overall satisfaction. The paper intends to show the potentiality in simultaneously managing internal and external quality indicators and opens the discussion to how to design the monitoring systems in order to optimize the integrated approach.

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