10th International Scientific Conference Transbaltica 2017:
Transportation Science and Technology

Evaluation of a Security Control Lane with the Application of Fuzzy Logic

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Abstract

The article presents a model for the evaluation of a security control lane at an airport with the application of fuzzy logic. The model allows for carrying out a multi-criteria evaluation of a security control system by considering its capacity, efficiency of prohibited item detection and level of service. The approach presented is complementary to the existing scientific considerations, which, however, have been analysing the system by taking into consideration only one of the aforementioned criteria. Theoretical membership functions were adopted on the basis of which the authors show the advantages of the model developed, the possibility of determining functional relationships between specific input variables and their influence on a security control lane evaluation. The approach proposed allows for selecting an optimal structure of a security control lane and an optimal structure of the security control process.

1. Introduction

Passenger air transportation is generally considered to be one of the safest means of transport. The ICAO organisation defines the air transportation system as ultra-safe. An ultra-safe system should be understood as a

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system in which there is less than one safety (catastrophic) breakdown per million cycles of the process [1]. This is achieved by systematic work on systems that ensure safety during the air transportation process. Important issues related to it include both methods concerning safety management within the scope of technical damages and also protection against unlawful intervention of third persons. The aim of the security control (SC) process is to make it impossible for anyone to bring prohibited items indicated in [2] to the airside. This process is carried out on all passengers during passenger handling (PH). However, security management activities carried out during PH have a negative impact on the level of service. In case of many airports, SC is implemented using a centralised system [3]. This means that the process takes part between the landside and the airside. That is where PH streams of every flight operating at a similar time combine. Due to heterogeneity of the amount of flights to be handled at a given day [4], the stream of passengers reporting to SC is not uniform (Fig. 1). Unfortunately, because of that, even though the estimated annual capacity of an airport is appropriate for the annual number of passengers, temporary values can be exceeded.
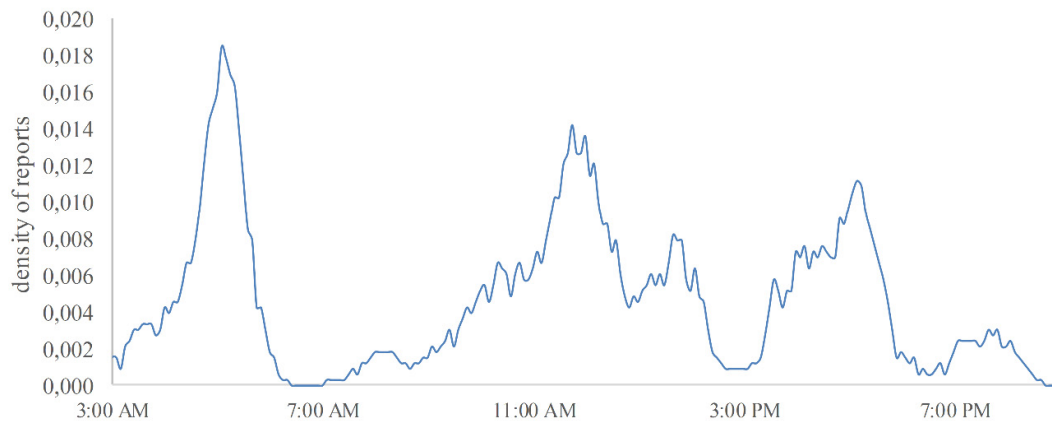

Fig. 1. A probability density function of passengers reporting to SC during a given day at Wroclaw Airport.

Regulations concerning SC allow for carrying out the process with the use of various methods [2]. However, they do not impose a map of the process. Because of that, different configurations of the SC system are applied. Thus, it is worth analysing various configurations of the system in order to find the most appropriate one. From the point of view of a manager of an airport, the SC system configuration should be characterised by high capacity, while from the point of view of regulations – by a high level of safety (efficiency). The level of service (LoS) is also important when taking into consideration passengers. There have been no scientific studies yet covering such a wide range of issues. The aim of this article was to develop a model that will allow for simultaneous studying of efficiency, capacity and LoS.

The following part of the article is divided into the following sections:

- State of the art – contains an overview of current studies on SC,
- A fuzzy model of a multi-criteria evaluation of a security control lane – contains a description of a model of a multi-criteria evaluation of SC,
- Conclusion – contains a summary and plans for further research.

2. State of the art

The issue of the SC process efficiency is discussed in scientific papers that are varied when it comes to their specificity. The influence of various factors on the efficiency of the process of securing an airport is described in the [5] paper. An interesting conclusion drawn up from the analysis conducted was that the assignment of weights