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SECURITY AND HINDRANCE AT AIRPORTS

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Abstract. The significant growth of the economy in a number of countries, together with the liberalisation of civil air transport now represents a significant impulse for the development of tourism, practically-oriented almost in all countries of the world. This trend is confirmed by the world WTO, ICAO and IATA statistics. The growth of air transport brings the need to ensure the fast and comfortable passenger and their baggage check-in with high security level fulfilment. In the checking process, with permanently growing volume of passengers, a critical place appears for which an optimal solution is currently intensively being searched at different levels. In this article there are analyzed options of selected types of contemporary and prospective technical equipment which are used during security checks, in the process of passengers check-in at the airport. The aim of this discussion is focusing on the choice of technology, suitable for the analysis of passengers´ behaviour, and evaluating options for the detection of potential dangerous security risks.

Key words: New tourism markets and destinations, tourism by air, security check, security control, facility

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JEL Classification: R4

1. Introduction

Together with the significant growth of the economy, the air transportation system has opened up new destinations and at the same time has formed new forms of tourism, such as travel to long distances (Bieger & Wittmer, 2006), etc. It was just the air transport, which has influenced the passengers in the selection and planning their routes, with respect to the time possibilities when overcoming large distances for relaxing or exploring new knowledge. Today aviation plays a central role in supporting tourism, which in its turn affects economic development of a country (Beifert, 2016). Over 52% of international tourists is now travelling by air (Aviation benefits, 2013). Tourism is particularly important in many developing countries, where it represents a key part of economic development strategies. Tourism continues to increase by the help of improved transport and communications facilities (Chew, 1987). Air transport in the world is currently being provided by around 1,700 airlines with approximately 27,000 planes on more than 3,700 airports. They produce the performance around 30 million of scheduled flights, by which more than 3.3 billion passengers can be transported (ICAO Annual Report, 2014). It is a fact, that for the vast majority of flights Airbus and Boeing planes are used.

The ICAO annual overview reports that there was a 5.8% growth of scheduled passenger air traffic observed in 2014, compared to the 5.5% growth in 2013. Described situation corresponds to the slight improvement of world real gross domestic product (GDP), from 2.5% growth in 2013 to 2.6% in 2014 (ICAO Annual Report, 2014). The continued strong international air traffic expansion was especially observed in the United Arab

Emirates and China, and a strong growth was experienced in domestic traffic in both the Russian Federation and India. In the Middle East area there was a growth of 11.2% and the total growth in the world air traffic reached 9%.

The significant information for aircraft manufacturers and air traffic operators are predictions about scheduled passenger and freight traffic growth in over the next 20 years, i.e. by 2034 (ICAO Outlook 2013 Forecast, 2013), considerably different growth of air traffic in different areas of the world is expected. For the group of countries with developing economies, and the current number of 6.3 billion population it is expected a yearly RKP (Revenue Passenger Kilometre) growth of around 5.8%, while at the same time for economically advanced countries with a population of 1 billion, a yearly RKP growth is expected to be just 3.8% (Leahy, 2015).

2. The growth of air transport volume and airport check-in process quality

From the point of the current and prospective growth of the air transport volume it is of great importance for travellers to secure the minimum possible time spent on the way and to secure trouble free check-in process at the airport. Nowadays there is no problem to meet the need of speed of the flight for modern aircrafts, which corresponds to the first defined requirement. However, increasing density of the air traffic can become a source for undesirable delay of flights formation. Delay value suppression is enabled by using the application of ***air traffic flow management*** (ATM Lieuwen, 2012) and by appropriate implementation of the digitalized processes of take-offs and landing phases of aircrafts (AMAN, DMAN, 2010). The sustainable development of air transport requires uncompromised commitment to safety and security maintaining, as well as facilitation of all processes which take place at airports. Aviation is focused on global safety and security, and the approved safety and security standards are generally valid worldwide. In present days the air transport is making an effort to meet the needs of the security-driven requirements at airports (20th Session of UNWTO General Assembly).

Due to the large number of transported passengers, modern high capacity aircrafts together with the frequency of their movements at the airports require high demands on the check-in process. The classical method of manual or semi-automatic check-in procedure was a prerequisite for creating long queues in front of the check-in desks. These types of check-in procedures require a certain amount of time and demand traveller's movement and their manipulation with baggage in the narrow and slow-moving queue. The introduction of electronic tickets (Crosby, 2015) with the possibility of individual (Atkinson, 2015) and baggage (Ghee, 2011) check-in process brought a necessary solution. An e-ticket offers many advantages for both travellers and airlines, including security, flexibility, cost and convenience. At the same time, e-tickets also provide the standard assurances like the traditional paper ticket, such is seating choice, travel time options and other possibilities.

The mandatory introduction of machine-readable passports with personal biometric data (ICAO Doc 9303) plus implementation of biometric authentication technology at airports (ACI, 2005) give the possibility for quick passenger's identification. The probability rate of risk definition for individual passengers can be defined by using digital records from a specific airline database about passengers and their way PNR (Passenger Name Record). Increasing rate of risk probability definition can be obtained by using additional information about passengers ADI (Additional Passenger Information) from their personal or other documents (Council Directive No 82/2004EC), or from the police sources. Based on this assessment then the required level of security checks for individual travellers can be defined.

Described process of possible risks rate evaluation, with the subsequent definition of the desired degree of security checks for individual passengers has led to the idea of creating a concept of several ways of fully automated security checks system defined as "Checkpoint of the Future". In addition to the requirement to achieve a higher degree of safety, the main objective of the suggested solution is better utilization of existing technologies together with the introduction of new technologies with advanced capabilities to increase operational efficiency. Such a solution is able to fulfil requirements for quicker and simpler checking process (IATA Executive Summary, 2012). The fact that safety inspection itself is focused on technologies for the identification of dangerous objects has a significantly negative impact on its effectiveness. The lack of this narrow orientation is the fact that for a

well-trained terrorist the object of the searching may not be the thing for committing an illegal act (Ploch, 2015).

Therefore for meeting the stated goals, besides high-quality of technical equipment and organization of the security checks at airports, the important element is the professional level of personnel dealing with security checks. The process of formulating the reliability model for the evaluation of risks in the activities of the operator (Savič 1998, 2003) or the safety management (Bojanc, 2013) is being developed for the area of activities of security staff at the airports within the project. The concepts are based on the principle of profiling passengers, the main principle is the analysis of their behaviour (behavioural analysis), which may take place before the beginning of security check. A wide range of publications is dedicated to the issue of behavioural analysis (for example a multidisciplinary Journal of the American Association of psychologists Behavior Analysis: Research and Practice).

3. Technology for behavioural analysis during the security check

Some of the functions of the human body, which suggest some non-standard behaviour, can be sensually suppressed, or adapted (for example, heart rate). For the maximum effectiveness of the behavioural analysis in security checks it is therefore necessary to implement monitoring of such functions, which cannot be effected by the any type of training. These symptoms are referred to as extrasensory ones. A number of scientific projects deals with the development and subsequent application of technologies for the analysis of the behaviour of passengers at the airport.

The Israeli company WeCU Technologies Ltd. is developing technologies, which are oriented to the field of psychology, intended for the detection of terrorists at airports (Carmon, 2010). The requirement on company the ***WeCU technologies*** is to be able to evaluate reactions to specific images which indicate that someone is a potential threat. The technology involves a short projecting of subliminal visual perception that only a terrorist would recognize.

The FAST technology (Future Attribute Screening Technology), on the development of which the American Draper Laboratory and Technology Square Cambridge participated, represents a set of technical facilities with joined and communicating elements. They are used for the non-contact collection of selected physical and nonverbal reactions of the passenger's bodies, which reflect the state of their minds. On this basis the scientific theory, named ***Malitent***, describing the rated phenomena can be confirmed or disproved (Middledton, 2011). The controlled person is either asked to answer a few questions, or watching the images presented on the monitor. During this process the physiological responses of the controlled person are scanned without any contact with the person.

In 2013 the company Fujitsu Laboratories published ***the people's heart rate measurement technology RTPM*** (Real Time Pulse Monitor), based on the detection of changes in face lightness, caused by changing of blood flow in a face (Fujitsu, 2013). During the measurement the absorption of the green light by haemoglobin is evaluated. The system having no contact with the person automatically evaluates the data, which is influenced by the movements of the face, or the entire body. A standard digital camera can be used for recording.

Another modern technical method for security evaluation is ***the technology of voice analysis***, which is being developed by the Israeli company Nemesysco (Nemesysco, 2012). The company is engaged in the research and development of technologies for the analysis of the voice, with the purpose to detect emotions, to prevent frauds, to manage stress and other Layered Voice Analysis LION. The aim of the analysis is not the content of the speech, but the elements and the flow of human speech abnormalities, which are characteristic for different situations. The method is therefore not dependent on the language, which the assessed person speaks.

One of the modern means for the security with restrictions of the influence of the human factor and saving costs of the operation is using ***the intelligent video analysis of the camera shot***. For the purposes of securing the protection of civil aviation against illegal acts for example the ***heat mapping*** can be used. Through the connection of cameras and analytical software it is possible to obtain the graphical monitoring of people´s movement on

the scene. For example, it is also possible to obtain the analysis of abnormal movement of the individual person through the monitored scene including the analysis of the trajectory of his movement (Active Allert, 2009).

4. Multi-criteria analysis

As indicated above, a possible way how to speed up the flow of passengers in the process of security checks at the airport, with reducing of the demands on the passengers´ behaviour, is using behavioural analysis technology. For the practical implementation it is, however, necessary to determine which technology may be the most appropriate one for this purpose. A possible way, when it is given a definitive set of **m** (discrete) variants, which are evaluated by the **n** criteria, is the multi-criteria analysis variant. The aim is to make a decision, which variant is according to the given criteria assessed best. The multi-criteria decision making is a marketing tool for the mathematical calculation of the correct marketing strategy on the basis of predetermined criteria and assigning weights to these criteria.

In the framework of the scientific research project at the University of Business in Prague in cooperation with Prague Airport, and other partner institutions, there were established ten criteria (K1 to the K10), which can significantly affect the efficiency of the process required safety checks, when using behavioural analysis. Their overview is given in table 1.

Table 1. Selected criteria

K1	Analysis time
K2	reliability
K3	medical harmlessness
K4	method applicable to the disabled
K5	transparency from the passenger´s side
K6	Ethical Code
K7	time for analysis evaluation
K8	complexity of operation
K9	possibility to be reflective
K10	influence of human factor

Source: Authors

The real values for the individual criteria Kj described above according to the behavioural analysis technology variants are listed in table 2.

Table 2. Criteria values for behavioural analysis

Criteria	Unit	WeCu	Voice	Malintent	RTPM	Video
K1	sec.	60	30	20	20	10
K2	%	80	80	99	30	90
K3		zero	zero	low	zero	zero
K4		yes	yes	no	yes	yes
K5		high	low	low	low	low
K6		yes	yes	yes	yes	yes
K7	sec.	10	5	60	5	5
K8		low	middle	high	low	low
K9		low	high	high	middle	high
K10		zero	zero	middle	low	low

Source: Authors

Looking at the individual defined criteria, it is obvious that, in the process of making decisions on the choice of technology for behavioural analysis, all criteria have not got the same weight. When the analysis is carried out to set the correct choice of the variant it is necessary to determine the weight of the individual coefficients. According to the 10-point scale, where 1 indicates the smallest and 10 the highest priority, there was set the weight of coefficients for each of the criteria in collaboration with experts from the field of security controls. The chosen value of ***weight coefficient*** $\mathbf{v^j}$ is growing with the importance of the considered criteria in the behavioural analysis system.

Table 3. Weight coefficients for individual criteria

	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	Σ
Points	9	10	9	2	8	7	8	3	10	9	**75**
v^j	0,120	0,133	0,120	0,027	0,107	0,093	0,107	0,040	0,133	0,120	**1**

Source: Authors

In the moment when the variants evaluation according to the criteria is quantified, the data for the evaluation of the correct variant of behavioural analysis, determined by the linear partial functions, can be organized into a criteria matrix. The elements of this matrix express the i-th variant according to the j-th criteria. Lines correspond to variants, the columns correspond to criteria. For calculation of the linear partial utility functions h_i^j the following relation was used

$$h_i^j = \frac{x_i^j - x_i^0}{x_i^* - x_i^0}$$

where x_i^j is the criteria value, x_i^0 the worst criteria value and x_i^* is the best criteria value.

Table 4. The criteria matrix of the correct variants of behavioural analysis

Criteria	Units	v^j	X^0	X^*	WeCu	Voice	Malintent	RTPM	Video
K1	sec	0,120	60	10	0,000	0,600	0,800	0,800	1,100
K2	%	0,133	30	99	0,725	0,725	1,000	0,000	0,870
K3	0	0,120	0	1	0,000	0,000	0,000	0,250	0,000
K4	0	0,027	0	1	1,000	1,000	0,000	1,000	1,000
K5	0	0,107	0	1	0,000	1,000	1,000	1,000	1,000
K6	0	0,093	0	1	1,000	1,000	0,000	1,000	1,000
K7	sec	0,107	60	5	0,909	1,000	0,000	1,000	1,000
K8	0	0,040	0	1	1,000	0,500	0,000	1,000	1,000
K9	0	0,133	0	1	0,000	1,000	1,000	0,500	1,000
K10	0	0,120	0	1	1,000	1,000	0,500	0,250	0,250

Source: Authors

The resulting degree of conformity $\mathbf{s_i}$ of individual‘s technology with established criteria K^j can be expressed by relation

Table 5. The value of the resulting degree of conformity

Technology	WeCu	Voice	Malintent	RTPM	Video
$\mathbf{s_i}$	0,474	0,775	0,623	0,596	0,785

Source: Authors

The higher the number $\mathbf{S_i}$ expressing the value of conformity is, the more the given technology matches the selected criteria. The results of conducted multicriteria analysis show, that the most appropriate technology for behavioural analysis in the security control procedure of the passengers flow at the airport appears to be the possibility of using signals, which are recorded by digital video cameras. Using of the thermal camera appears to be very effective for monitoring the temperature in the area of the face using the methods developed by Fujitsu Company. The advantage of the method is the higher speed when performing security checks and at the same time the possibility to divide passengers for their own inspection process according to given degree of risk.

5. Optimizing system of security checks at the airport

When we search the conditions which are necessary for the implementation of optimized system of security checks at the airport, it is necessary to take into account the following factors:
sensitivity of the system, which indicates the possibilities of system failure when it is in contact with non-standard situations, request for a quick and for passengers non conflict pass through security check system, optimized costs necessary for implementation of corresponding technical means necessary for security checks, high moral and professional preparedness of the security check personnel for a trouble-free implementation of the tasks.

Non-standard situation is represented by a failure or breakdown of technology designed for the security check implementation, human error, or a combination of both phenomena. Security check system should therefore be designed in the way to be able to handle difficult situations – e.g. a failure of any technology, or a mistake caused by the human factor – in these cases it should affect it just in the short term slowdown of the flow of passengers trough security check, not on the effectiveness of its implementation. The solution of this problem is a consistent backup, allowing operability of the system without reducing its effectiveness. A possible way is a backup in the form of "staff-technology-staff".

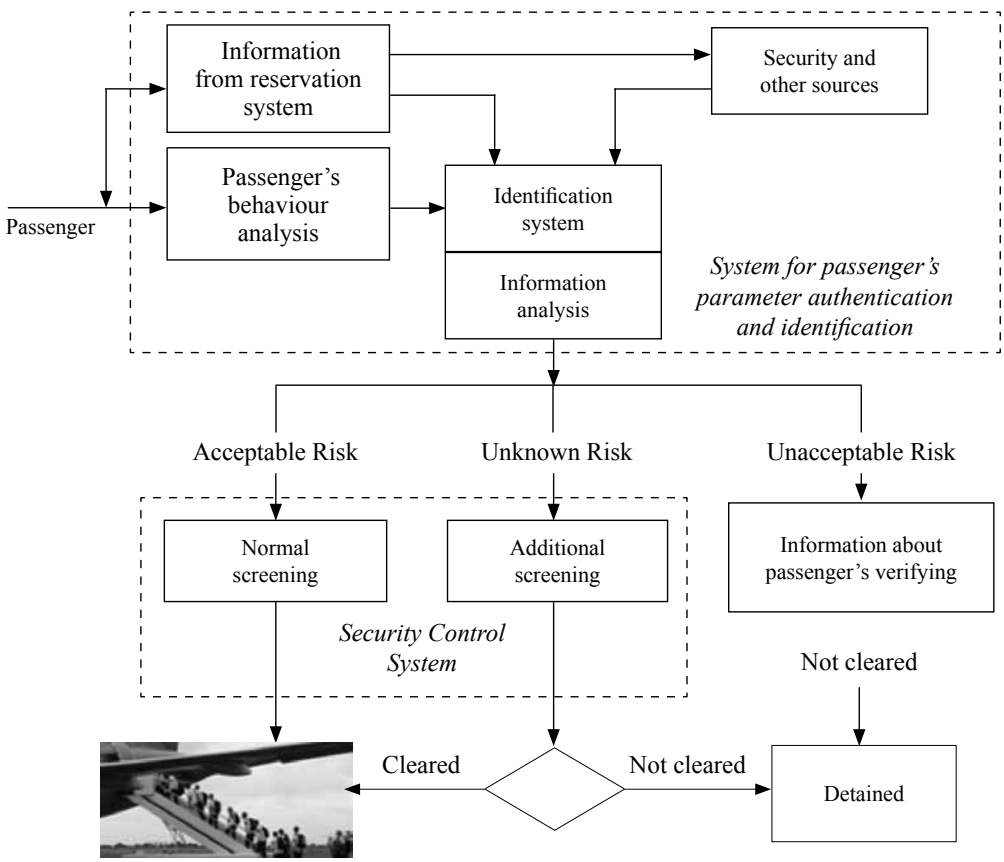

Fig. 1
Source: Arranged by Authors

Conclusions

Nowadays one of the most important means of transport in tourism is the air transport. Air transport and tourism are more or less interlinked today. Tourism is also a key factor, and in some cases a stimulator of changes in the air transport. It was, above all, tourism which brought for the air transport the development of new business models, such as e.g. charter airlines. Air transport in particular has brought economic benefit to the Asia-Pacific region from economically stronger American and European partners, and this region is predicted to become the boom area for tourism by the year 2020. This trend could be reduced by different travel restrictions or the threat of terrorism. Air operators, aware of this fact, are spending vast sources on the purchase of powerful, comfortable and reliable aircrafts, for airports modernization and perfect air traffic services implementation. The intensive security checks not only prolong the time required for check-in, but at the same time they can be in many cases stressful for passengers and in some cases could be inefficient, too.

The results of conducted analysis of security check systems can serve as a support for the implementation of appropriate construction and organizational adjustments of workplace for security checks. Alternatively it can also serve as a basis for the adjustment of training of security check personnel with the aim to obtain required optimal solution of security control process at airports. The result of presented discussion is then a definite orientation to the methods, suitable for detecting potential risks according to emotions and behaviour of passenger´s analysis, before starting the actual check-in process. For optimizing of that process is, however, necessary to build a program that will be able, on the basis of inputs about the nature of the individual elements and their share in the operability of the system, to determine if there appears a failure or breakdown, percentage of uptime of the system. On this basis we can then provide the ideal failed elements backup so that the probability of failure of the system was maintained at the required level.

A major problem for optimizing the process of security checks is currently a question of the costs which are needed for implementing the appropriate level of technology to ensure reliable operation of the system security checks with a high degree of sensitivity. The decisive criterion in this matter is the relationship between the necessary level of acquisition costs corresponding to the safety control devices and the real possibilities of the airport.

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