DEVELOPMENT AND APPLICATION OF A NEW CONCEPT OF SECURITY CHECKS AT AIRPORTS AND OTHER CRITICAL INFRASTRUCTURE OBJECTS

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Summary. This article describes airport security workers as a key element of protection against acts of unlawful interference in civil aviation. Then there will be described factors of working environment affecting their convenience. The anonymous questionnaire among security workers of an airport forms source of valuable data for the research part of the article.

This article also discusses the choice of technology for the analysis of passenger behaviour and the allocation stage in a potential dangerous threat to civil aviation security. The choice of technology is based on the result of the multi-criteria analysis and selected criteria requirements of the principle of operation, efficiency and other important features for the applicability of the technology to process passengers and baggage handling at international airports. The applicability of the results there are included technologies for non-contact monitoring of extrasensory manifestations of the human body indicating which is detected an abnormal behaviour.

Keywords: Behavioural Analyses, Security Checks, Aviation Security, Environmental factors, Airport Security Staff, Working Environment, Workplace

1. INTRODUCTION

To keep and to continue the privilege of "the safest" in air transportation, it is necessary to continuously analyze and improve approaches to addressing security concerns of both the operational safety and security of air transport, and critical infrastructure against acts of unlawful act.

An integral part of protective nets are security checks of passengers and baggage, air cargo, as well as airport employees. Element of safety inspections is to check detection (screening) which represents the application of technical or other means aiming to detect potentially dangerous objects. They could be exploited by attackers. In the fight for the most advanced technology for detecting potentially dangerous persons and prohibited items or speed up passenger flow modification procedures or editing workstations screening had been so far however ignoring the factor that ultimately decides the extent to aviation safety - the human factor with all its positive and negative qualities.

2. CURRENT SITUATION AND PROSPECTS FOR THE FUTURE

According to data from the non-governmental association IATA takes advantage of air transport approximately 3.5 billion passengers. [5] The figure which down to small fluctuations caused by objective factors, increasing every year since 1950. IATA published in 2014 at an international conference in Athens anticipated trends in the number of air passengers between 2014 up to 2034 [11]. It predicts the average steady growth in demand for air transport 3.9% per annum, while the optimistic variant envisages even with annual growth of 5.6% passengers. According to information from the ACI of the year 2012 constituting the costs of ensuring security on average 20% of total operating costs of the airport operators in Europe [6]. From these data it is clear that optimization of security checks procedures is highly relevant topic to be addressed systematically on several lines.

It can be stated that the approaches to implementing process optimization measures security checks at airports are concentrated primarily to increase the throughput flow of passenger during security

checks, the spatial resolution of workplace ergonomics to reduce the physical stress on operators [16,17,18], increasing the intensity of regular or random security checks [3] or research on the possible use of technology for behavioural analysis of the passengers to their differentiation for multi-stage security checks [2] in the framework of IATA Smart security [5]. The effect of the conditions of the working environment on operator´s reliability in implementation of screening is not dealt in aviation or even at other elements of critical infrastructure as.

3. INCREASING EFFICIENCY THROUGH CUSTOMIZATION OF ERGONOMICS HABITATS SCREENING

In terms of ergonomic assessment of the working environment on the performance and reliability of work activities it is necessary to mention the National policy on safety and health at work of Czech Republic which includes, as one of its priorities, to establish research and development focused on prevention of existing, new and potential risks at so called "workstations of special character", which can include security screening workplace at airports and other objects of critical infrastructure.

Basics of the ergonomic design of workspace are included in the technical standards. The fundamental ergonomic principles and concepts dealt with EN ISO 26800 Ergonomics - General approach, principles and concepts [14]. With regard to workplace screening is the most important ISO 9241 Ergonomic requirements for office work with visual display terminals concrete Part 6 Requirements for work environment [18] which describes the principles of solving the working environment with regard to the intensity of light, noise, temperature, mechanical vibrations and electromagnetic fields. Furthermore it is CSN 01 2725 Guidelines for colour adjustment working environment which sets the colour dependence on light intensity and guidelines for modification of colour and optical workplace conditions. The necessity of an integrated approach to designing institutes with regard to the technical, social workers and physical requirements and the consequences relating to occupational cool, health and performance deals with EN ISO 6385 Ergonomic design principles work systems [15]. Implementation of the principles of environmental survey to determine the feeling of comfort and well-being of people in a specific environment deals with EN ISO 28802 Environmental assessment using environmental survey involving physical measurements and subjective human responses [16]. EN ISO 15265 Ergonomics of the thermal environment - Risk assessment strategy for the prevention of heat stress or discomfort in thermal working environment describes the strategy assessment and interpretation of the risk of human physiological limitations or reduced comfort when working in that environment. Given the nature of the workplace screening may also consider the use of standards EN ISO 11064-6 Ergonomic design of control centres - Part 6: Environmental requirements for control centres [17] which sets environmental requirements for control rooms and other operational areas controlled systems with regard to thermal environment, air quality, sound, light and vibration environments.

Key role in the research of optimization tools and methods to meet International Air Transport Association IATA which presented a vision called "Checkpoint of the Future" in 2011. [5] It assumed a complete change in the design process of security checks with emphasis on differentiation of passengers according to their potential risk and subsequent screening with regard to inclusion into just one group. The project envisaged the use of automated through metal detectors, body scanners, detectors of trace particles of explosives and chemical elements adhering to the clothing of passengers and detect carried drinks in containers. These technologies so far proved technically unfeasible and therefore IATA in cooperation with the Airport Council International ACI project transformed into the Smart Security [6]. Its aim is to examine the usefulness of new technology solutions while maintaining a high level of security and speed up the flow of passengers at security checks.

The largest governmental organizations in civil aviation ICAO published for the first time in year 2002 a Doc. 9808 Human Factors in Civil Aviation Security Operations [19] which in chapter 2.8 emphasizes that applying the methods of ergonomics is important, among other things, to minimize errors of airport security screeners.

One of the youngest organizations dedicated to the field of civil aviation security the US Transport Security Administration TSA. It was created as a result of the terrorist attacks of September 11, 2001 and its aim is to provide a highly effective system of protection against unlawful acts not only in aviation. This help of test teams specializing in the identification of areas and means to increase the efficiency of security checks, particularly in relation to the advanced methods of detecting dangerous objects and increasing the frequency of thorough personal searches at selected airports not only in the United States but also at foreign airports where there is a direct flight to the United States [12]. TSA also in 2012 published Checkpoint Design Guide [10] which defines dimensional and spatial concept of security checkpoints at airports in the United States. According to section 1.1 in the case of building a new or re-configurated of existing stations should take into account the working environment factors such as air temperature, air humidity, its quality, lighting and noise and so that workers developed an acceptable and comfortable conditions. The individual factors are not further elaborated.

As a part of the planned research in this area it is apparent that the need to respect the principles of ISO standards in the experimental stage then standard methods of measurement and evaluation of physical and chemical factors in the work environment which deals with the National Health Institute. From the literature review also follows a general interest in solving the problems of man-machine interaction with regard to human error and its reliability in relation to the conditions at the workplace. Worth mentioning is also the Framework Agreement on work-related stress [20] which was signed by representatives of European employers and employees. It explains that "... all employers have a legal obligation to protect the safety and health of workers. This obligation also applies to problems of work-related stress assuming that presents a risk to health and safety." The objective is to evaluate the employer whether in the workplace leads to stress. If so, then employers should look for ways to eliminate it. This agreement of the year 2004 has not yet been brought into the national legislation of the Czech Republic transposed and its implementation is planned together with an amendment to the Labour Code in 2017.

During analyzing the relevance of the topic of the project there was simplified pilot study at the airport Praha / Ruzyne in which a form of anonymous questionnaires were interviewed screening operators of their work environment. The aim of this project was from available sources to determine the inner (psychic) and external factors of working environment for security checks staff and who influences its effectiveness and efficiency at work. The research part is dealing with the analysis of the social environment of security workers at airport Prague / Ruzyne. The results obtained with questionnaires were compared with theoretical information and on the basis of these results were outlined ways to minimize or eliminate the influence of internal and external factors of working environment which may affect the efficiency and security staff error rate.

The results of this research show that airport screening operators are negatively affected by mental workload in their work, being most influenced by the pace of forced labour, negatively affects them also work in continuous mode, bullying and relationship problems in the workplace. The psychological stress felt by working for long or irregular working hours and 70% of respondents complained that because of the workload does not have enough time for their hobbies and family. From the psychological factors are among our respondents appear bossing a significant degree (62.5%) bullying. Unlike the theoretical data, our respondents complain, for example, at a disproportionately low remuneration for work done, concern about workplace health, too much responsibility, working at night. When it comes to external factors probably the most important influence on the quality of work performed for our respondent’s temperature air for most it is considered 80% of workers. Important by the respondents also space - 60% of people consider their workplace in terms of space as insufficient and more than half complain of inadequate facilities designed for relaxation during breaks. For 55% of employees are important light intensity and over 40% of respondent’s finds noise and smell as a significant negative impacts on their work. In the case of external factors affecting the quality of work is theory coincides with the results of our research.

4. INCREASING EFFICIENCY THROUGH THE IMPLEMENTATION PROCESS OF BEHAVIOURAL ANALYSIS PEOPLE

The current concept includes checking the actual passenger walk-through metal detector frame and checking the passenger cabin luggage through X-ray machine. In case of any object placed on the body or clothing of the passenger, the passenger is subjected to more personal search involving physical inspection by palpation performed by security staff at the concrete airport.

According to response to the commission or attempt to commit a wrongful act the number of prohibited items is increasing. The actual security check for passengers not only becomes very unpopular even the very air travel gets complicated. In order to relieve these restrictions are currently stands at stations installed screening technology allowing for example to return some items to the list of allowed aboard aircraft. An example of such technology can be a scanner liquids and gels EMA which is installed at all international airports in the Czech Republic and belongs to a group of many of the licensed technology to carry out the detection of explosives. Through the use of such technology it is already possible to take with you on board liquids and gels that are scanned by devices with negative results. Liquids and gels were from August 2006 until the time of application systems for detecting explosives prohibited on board the aircraft.

The fact that several years is holding procedures in the same principles can have on the efficiency of security checks a negative effect in the term of a narrow view of the entire issue. As a consequence of this approach is then subjected to the same level of security checks, for example, an elderly lady travelling to a vacation and a person who intends to carry out some illegal act, which of course may not directly be a terrorist attack. The basic shortcoming of this traditional concept is the fact that only focuses on potentially hazardous objects which can represent like for instance the knitting needles mentioned older ladies. This concept has not taken into account that for a well-trained person does not need to use such items to commit the offense. The modern concept of security checks at airports should therefore be based also on identifying potentially dangerous persons and not only on the principle of identifying potentially dangerous objects such as it is nowadays.

Behaviour analyses of passengers based at security checkpoints or in a public area of the airport is one of the possible variants of passenger profiling. Applied behaviour analysis involves monitoring manifestations of the human body which may indicate some ulterior motives. Some of these phenomena can be sensually suppress or modify (eg. heart rate, etc.). Therefore for maximum effectiveness of this kind of analysis it is necessary to choose monitoring such manifestations that cannot be trained to affect them. These manifestations of human behaviour are known as extrasensory. Behavioural analysis of passenger screening at airports could therefore be the main point for the modern concept of security checks. On the base of this analyses individuals can be associated with the level of potential danger and on this stage would then be set thoroughness perform safety checks, for example a supplementary interview. Of course that even if the award is almost a zero risk of exposure for specific the passenger cannot be acquitted from security check. [2]

Practice confirms that based on behaviour analysis can determine the potential risk of the passenger. For example Delta Airlines uses the "profiling" of passengers as standard on all flights inbound going to US. For purposes of these activities has been created categorization of passengers in terms of their potential threat to civil aviation. At the theoretical level we can say that the analyzed passengers will fall into one of the categories listed below.

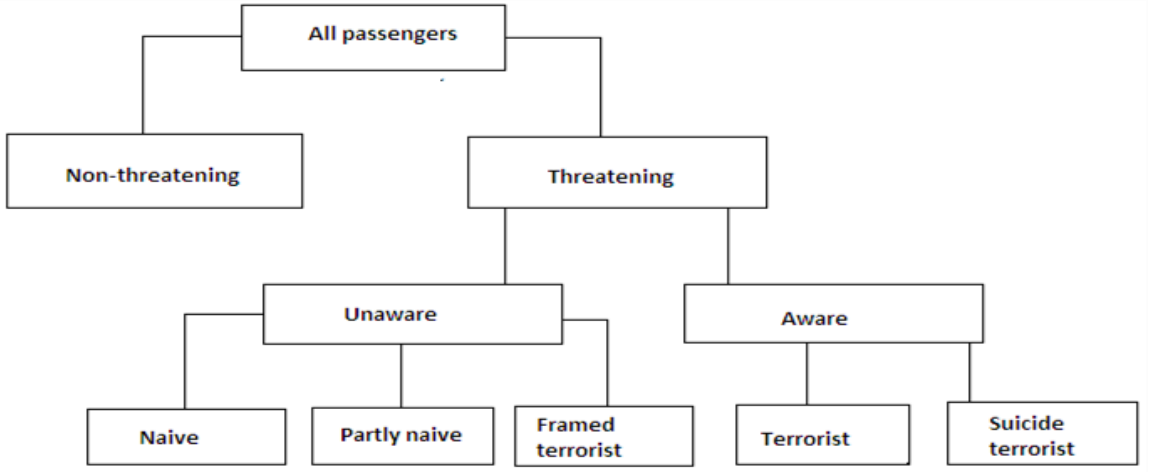

Figure 1 Categorization of passengers; Source: Internal materials airlines El Al

Group "Unaware Passengers" are passengers who may or may not know that they are participants in an unlawful act. These passengers are further divided into three subgroups.

"Naive Passengers" is a passenger who does not know that is involved in the illegal act. For these passengers it is virtually impossible to detect that they are a threat to the environment because they behave like ordinary passengers, not nervous, not at them any other way reflected a change in behaviour. Ex .: A passenger who is without his knowledge hidden in the luggage of an explosive device to commit a terrorist attack.

"Mostly Naive Passengers", travellers who know their offense but they do not realize its weight. For these passengers it is somewhat easier to detect psychological reactions that deviate from normal behaviour. Ex .: A passenger who under the prospect of financial rewards have the impression that some smuggling prohibited goods (eg. Narcotics, historical items, etc.) and yet in this course hidden explosive device to commit a terrorist attack.

"Framed Terrorist", a passenger who is not aware that committing illegal acts but cooperates or is a member of an organization involved in the commission of such acts. Ex .: A member of a terrorist organization who is unaware that he has hidden in the luggage of an explosive device to commit a terrorist attack.

These people not to commit the offense will be planted on any of the prohibited items, eg. an explosive device, which is detectable by any of the detection technologies commonly used for security checkpoints.

Group "Aware Passengers" are also divided into two subgroups.

"Terrorist", a person who is completely unaware of committing an unlawful act for the purpose of obtaining a sum of money, or the fulfilment of their personal, political, or religious needs.

"Suicide Passengers," a designation that was created after the terrorist attacks of 11 September 2001 and it is a person who is fully conscious again committing an unlawful act with the aim of suicide attacks and intending to kill the largest possible number of people including himself.

Persons above group connect one specific property, which has been also mentioned in the previous text. Such a person with special training can commit unlawful action is planned without the use of the object which is currently categorized as "prohibited". If we will just rely on an approved screening device at the security checks the detection result is negative. To determine the risk and subsequent revelations person with such malicious intent is therefore necessary to extend the screening of passenger profiling based on behaviour analysis.

The process of behavioural analysis can be added to the activities for the screening of passengers and their luggage only when the following criteria are unavoidable for use in airport terminal.

For maximum effectiveness analysis performed is sometimes necessary to carry out the monitoring of selected physical symptoms contact method, ie. measuring heart rate, blood pressure, etc.. For the applicability of behavioural analysis in terms of the international airport it is possible to carry out

monitoring of behaviours passengers only contactless method, eg. by a specially modified camera system. Additionally may be physical manifestations passengers tracked only on uncovered parts of the human body. Of particular concern is the winter season, a period when passengers are draped dress almost the entire part of the body except the head or face.

All processors for the behavioural analysis at an airport must be adjusted so that could accommodate the largest passenger volume especially at peak times and also at peak days. Of the screening checkpoint course should reflect this orientation. The dynamics of the movement of passengers required to conduct the analysis itself took place only several seconds. After being set the process will enable to maintain the smooth flow of passengers at a particular airport.

When applying the analysis of passenger behaviour in the process of security checks but there is also the question of how it is possible to ensure readiness for the planned cases in order to deceive the outcomes. The answer for this question can be reverse engineered using existing records of camera systems of those who tried to commit a wrongful act. From recent history it is known that the terrorists exhibited in the process of commercial checking clear signs of strange behaviour which unfortunately in some cases remained unnoticed by anyone. An example might be an unsuccessful attempt to commit a terrorist attack in 2001 when British citizen Richard Colvin Reid, known as the Shoe Bomber, on the line from Paris airport Charles de Goule in the US Miami explosive placed into the design of the shoe. From the CCTV at the airport it was clear his uncharacteristic behaviour. The culmination of his unconventional behaviour had been waiting for screening when R. Reid progressed in the queue of passengers and just prior to carrying out inspections of the queue and ranked stepped back at the end. Strange behaviour of this person however it was possible to identify and help other evidence. It was especially confused about his move around the airport terminal and excessive sweating. All of this is evidence of imminent danger but unfortunately not used to find hidden explosives. When using behavioural analysis would such a person his behaviour showed clear incentives for performing a thorough security checks including checking shoes X-ray device that would reveal explosive [12].

Based on research conducted by a group of volunteers from among students of University of Business in Prague were established basic guidelines for monitoring stress manifestations of the human body:

- Temperature face - a method in which with the help of thermal imager detects the temperature of the passenger's face, if you think of something amiss, warmed his face.

Note: The temperature of the human body cannot spontaneously influence, therefore, this method seems to be best. There is a presumption that a person who is ill will have an elevated temperature throughout the body and not only in the facial area. Therefore, with the thermal imager can see who is sick and who is showing signs of stress, for example due to unfair intentions.
Weight: 5

- Vocal vibration - voice trembling caused by stress

Note: Many people may be at the security check at the airport in a foreign country quivering voice, for example, fear that the worker does not understand their pronunciation.
Weight: 2

- Investigation instinct - a man always looking for something, eyes moving (eyes roaming)

Note: If a person comes somewhere that knows much or where it is for the first time, it automatically searches for something unusual and "mapping the destination". If it does just the beginning, it should be okay, but if he or she does that all the time, even while waiting in line for security checks, there would be something suspicious.
Weight: 3

- Observations pupil - pupil reactions due to changes in a person's mood

Note: Enlarging or reducing the pupil caused by various human feelings seems to be an effective method because it cannot be faked. Compared to the observation method, however, requires temperatures of face longer and more detailed observations security officer.
Weight: 2

- Excessive sweating

Note: Excessive sweating can be caused by various factors, stress, illness or just running to check at the very last moment and therefore clearly does not indicate a potentially dangerous passenger.

Weight: 1

- Eye contact - a person who is afraid or hiding something or lying, hold eye contact

Note: There are many people who are ashamed and an interview with a security guard for them can be very unpleasant. Consequently rather he sidesteps eyes and looks for example into the ground.
Weight: 2

Individual symptoms are accompanied by weight remuneration. Assigning specific risk passenger will therefore be based on the principle multi-criteria decision analyses analysis using the method of partial functions benefit when risk passenger will be divided into several variants (eg. low, medium, high, etc.) and its determination will be used for actual observation criteria set out above. The result of this observation will also be multiplied by a weighting of valuation criteria by the correct procedure for calculating the aforementioned multi-criteria analysis.

4. CONCLUSION

Aviation safety depends greatly on the reliability of the safety inspection from the perspective of Unlawful Acts. It is now carried out through modern and sophisticated technical solutions such as the need to multi-view X-rays or personal scanners. The key role of final decision about the admission of the passenger or staff into a security restricted area of the airport remains on the man. In the case of screening we talk about "screening operator" who is in their work environment surrounded with negative factors acting on his physical or mental well-being of human-machine-environment. These factors may not be detected immediately because the person has the ability and a high degree of adaptation. That does not mean they are not present and cannot be determinant in crisis situations fatal crash.

The current trend of security checks while heading to a faster and less discriminatory implementation of screening which is contributed mainly by the development of new and modern technologies. The nature of the concept of security checks indicates that the primary objective of checks is still "only" identifying items that could potentially endanger the security of air transport.

References

Journals:

[1] Priorities for occupational safety and health research in Europe: 2013-2020 [online]. European Agency for Safety and Health at Work, 2013, , 1-107 [cit. 2016-08-23]. ISSN 1831-9351. Dostupné z: https://osha.europa.eu/en/tools-and-publications/publications/reports/priorities-for-occupational-safety-and-health-research-in-europe-2013-2020

[2] DĚKAN, T., PLOCH J., ZÝKA J., Design the New Concept of Security Check at Airport with Comprehends Trend of Passengers Behaviour Analyses. Journal of Tourism and Services. Praha: Vysoká škola obchodní v Praze, o. p. s., 2015,VI(10/2015), str.: 45 - 63. ISSN 1804-5650.

Books:

[3] CROUCHER, R., Can better working conditions improve the performance of SMEs?: an international literature review. Geneva: International Labour Office, 2013. ISBN 978-92-2-127551-0

[4] STOLK, CH., et al.[EUROPEAN AGENCY FOR SAFETY AND HEALTH AT WORK]. Management of psychosocial risks at work: an analysis of the findings of the European Survey of Enterprises on New and Emerging Risks (ESENER). Luxembourg: Publications Office [of the European Union], 2012. ISBN 9789291917358.

Web sites:
[5] IATA Annual Review: 2016 [online]. IATA, 2016 [cit. 2016-08-06]. In: http://www.iata.org/publications/Pages/annual-review.aspx
[6] Joint Press Release: ACI and IATA Collaborate to Deliver Smart Security [online]. [cit. 2016-06-25]. In: http://www.iata.org/pressroom/pr/Pages/2013-12-12-02.aspx
[8] Policy Fast Facts. ACI EUROPE [online]. [cit. 2016-08-12]. In: https://www.aci-europe.org/policy/fast-facts.html
[9] Transportation Security Timeline. Transportation Security Administration [online]. [cit. 2016-07-15]. In: https://www.tsa.gov/timeline
[10] TSA Checkpoint Design Guide: Revision 4.0 [online]. 2012 [cit. 2016-08-05]. In: http://www.aci-na.org/sites/default/files/Checkpoint_Design_Guide_(CDG)_Rev_4_0.pdf
[11] IATA Symposium: 4 – 6 November 2014, Prague. IATA [online]. [cit. 2014-11-01]. In: http://www.iata.org/events/Pages/aviationhr-conference.aspx
[12] TSA behavior detection officers' ability to detect bad actors little better than chance, GAO study says. Advance Digital [online]. [cit. 2015-03-15]. In: http://www.cleveland.com/metro/index.ssf/2013/11/tsas_behavior_detection_activi.html

Standards:
[13] ČSN 01 2725. Směrnice pro barevnou úpravu pracovního prostředí. 1960.
[14] ČSN EN ISO 26800. Ergonomie - Obecný přístup, zásady a pojmy. 2012
[15] ČSN EN ISO 6385. Ergonomické zásady navrhování pracovních systémů. 2004
[16] ČSN EN ISO 28802. Hodnocení životního prostředí pomocí environmentálního průzkumu zahrnujícího fyzikální měření a subjektivní odezvy člověka. 2012
[17] ČSN EN ISO 11064-6. Ergonomické navrhování řídicích center - Část 6: Environmentální požadavky na řídicí centra
[18] ČSN ISO 9241. Ergonomické požadavky na kancelářské práce se zobrazovacími terminály. 1998
[19] ICAO Doc. 9808 Human Factors in Civil Aviation Security Operations. [online]. [cit. 2016-08-10]. In: http://srd.mcaa.gov.mn/images/pdf/durem/busad/ Doc%209808%20%20Human%20Factors%20in%20Civil%20Aviation%20Security%20Operations.pdf
[20] Rámcová dohoda o stresu spojeném s prací. Svaz průmyslu a dopravy české republiky [online]. 2004 [cit. 2016-08-13]. In: http://www.spcr.cz/cz/eu/esd/esd_stres.pdf