Univerzita Pardubice
Dopravní fakulta Jana Pernera

Methodology for Assessing the Impact of Workplace Ergonomic Factors on Airport Security Screener´s Reliability and Performance

DISSERTATION THESIS

2018 **Ing. Jan Zýka**

PhD student

Ing. Jan Zýka

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Supervisor

doc. Ing. Ivo Drahotský, Ph.D.

Supervisor specialist

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Research department

Department of transport management, marketing and logistics

Content

1 The current state of the studied subject

Air transport is legally considered to be the most modern, most comfortable and the fastest way to overcome long distances. Thanks to the effective access to risk management and implementation of the desired countermeasures is at the same time related to passenger kilometres statistically the safest mode of transport. Thanks to the global dimension, however, it is attractive every year for nearly three billion passengers, but it is also sensitive to potential attacks whose primary goal is to break security barriers, create feelings of fear, and in the final consequence to disrupt the economy of the airport operators, airlines, states or regions concerned.

In order to maintain the privilege of "the safest" it is necessary to continuously analyse and to improve approaches to safety issues both on the operational safety side, and also on the side of protection of air transport and its critical infrastructure against acts of unlawful interference – air transport security.

An integral part of security nets is security checks for passengers, luggage, air cargo and staff as well. The Security screening is an element of the security checks, which is represented by application of technical or other means of detecting potentially dangerous objects that may be used by the attackers for the unlawful acts. The effectiveness and reliability of screening depends, inter alia, on the type of X-ray equipment used, the spatial layout of the site, the additional technical equipment and, in particular, the quality of the worker's screening.

In an imaginary race of the most advanced technology for detecting potentially dangerous passengers and prohibited items or optimizing passengers flows by modifying the procedures or screening workplaces there has been neglected the factor, which finally decides whether the air transport will be safe or not – a human with all his positive and negative properties. The human factor is represented at several levels in an airport management system. The strategic one ensures the fulfilment of legal and regulatory standards, the tactical has the role of organizational and supervisory and the operational performs the executive operational functions of the airport. And

exactly the operational level is represented by airport security screener. Considering the key role of screener, the critical parameter of the optimum is his reliability, which is represented by performance and error rates when detecting prohibited and potentially dangerous objects hidden or forgotten in luggage. To be able to perform tasks with the highest confidence, it is necessary to identify work environment factors that could influence this reliability in order to minimize them subsequently.

According to IATA (©2016) the annual traffic in approximately 3.5 billion passengers and this figure has increased yearly since 1950, albeit with slight fluctuations due to objective factors (Figure 1). In 2014, IATA published at the International Conference in Athens the expected development of passenger air traffic between 2014-2034 (IATA, ©2014). This document predicts an average stable growth in demand for air travel of 3.9% per year, with the optimistic option even counting with an annual growth of 5.6% of passengers. However, it is clear that in such a globalized sector sensitive to unpredictable world events, the influence of various negative factors can be felt and the projected growth may be in the future for a short period weakened. According to ACI, security costs represent an average of 20% of the total operating costs of airport operators in Europe (ACI Europe, ©2015).

From these data, it is clear that the optimization of the security control process is a highly actual topic, which needs to be addressed systemically on several lines. This corresponds to the analysis of the current state of knowledge in the field, which is fully explained in the dissertation thesis.

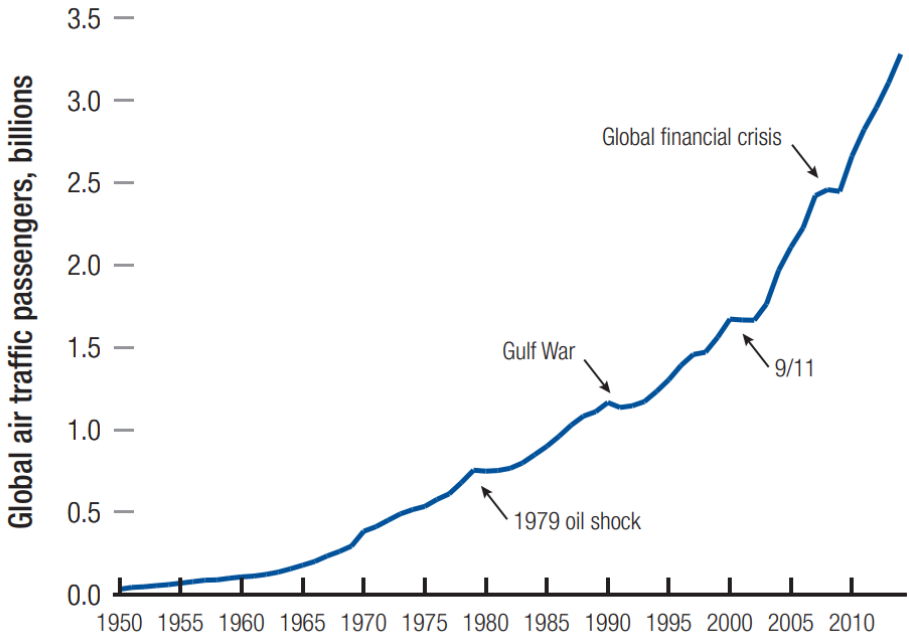

Figure 1 Global air passenger traffic trend 1950-2014 (Oxley and Jain, 2015)

In summary, approaches to implementing optimization measures at the airport security screening process focus primarily on increasing the throughput of passengers through security controls, assessing the ergonomics of the workplace's spatial solution to reduce the physical load on the operators (ČSN EN ISO 11064-6, 2005; ČSN EN ISO 9241, 1998), increasing the intensity of routine or random security checks (Croucher, 2013) or research into the possible use of behavioural analysis procedures (Děkan a Ploch, 2014) to differentiate passengers for multi-step security control within the IATA Smart Security project (IATA, ©2013). The influencing of the operators' working conditions to the reliability of the screening is not dealt in air transport or other critical infrastructure. For the dissertation it was therefore necessary to adopt the theory and practical implementation in the fields related to optimizing the reliability of working activities in terms of ergonomics of different workplaces outside the original field of research.

It has been found that when looking into the ergonomic design of workspaces, it is necessary to respect the principles of a set of ISO norms and standard methods of measurement and evaluation of physical and chemical factors in the work environment, which are addressed by The National Institute of Public Health. The literary research also shows a general interest in solving the issue of human-machine interaction in relation to human factor failure and its reliability in relation to the conditions at the workplace (European Agency, ©2013; Stolk, 2012; European Agency ©2009). And The Framework Agreement on Work-related Stress is also worth mentioning (Svaz průmyslu a dopravy, ©2004), which was signed by representatives of European employees and employers. It describes that "... all employers have a legal obligation to protect the safety and health of workers. This obligation also applies to stress-related working situations, provided that it presents a risk to health and safety. " The goal is for the employer to evaluate whether there is stress in the workplace. If so, then he should look for ways to eliminate it. However, this 2004 agreement has not yet been transposed into the national legislation of the Czech Republic. Its implementation was planned together with the amendment to the Labor Code in 2017, but finally Act No. 262/2006 Coll. has not been amended.

Closer to the topic of the study is the project "Evaluation of the impact of the working environment of the block supervisors of industrial plants on the reliability of operators' performance" (Skřehot et al., 2015), as it concerns the evaluation of the working environment factors, their relation to the performance and the error rate of the personnel using the human-machine interaction in the work tasks. Its principles have served as one of the inputs in the development of specific methods of the dissertation. In general, we can build on the basic vision of IATA Smart Security, which aims to improve the environment and experience for passengers during security checks. It can be assumed that the improvement of the passenger environment can also have a positive impact on the personnel carrying out the control. The means to achieve this goal is rather the construction of the workplaces themselves with respect to the passengers, not the identification and minimization of the negative factors of the working environment of the operators. The BEMOSA

BEMOSA final report (BEMOSA, 2013), which mentions "security decisions depend on employees", provides a stimulus to performing research at workers themselves.

The dissertation author made a simplified pilot study at Václav Havel Airport Prague in the early stages of the research, asking by anonymous questionnaires the screening operators for their work environment. The published results (Drahotský a Zýka, 2014) indicate, among other things, that 80% of respondents from 40 respondents complained, for example, about too high or low temperature and temperature fluctuations at deployed workplaces within the airport. The intensity of illumination, the number of monitors, or light advertising makes it harder to concentrate 55% of operators, 42.5% of workers are bothering excessive noise and 40% of odour.

Based on the analysis of the current state of issue, it is obvious that the subject of the dissertation thesis has not yet been fully solved at domestic and foreign universities. According to the above assessment, the realization of the optimization measures of man-machine-environment relations is desirable, which is being realized by more and more companies here and in the world as well. In addition to traditional Occupational Safety and Health (OSH) systems, they come with the application of methods for identifying ergonomic risks, evaluating them and introducing optimization measures. They aim at improving the quality of working life of employees, which can be expressed in terms of health, social, economic and production, ie reduction of occupational injuries or occupational diseases, elimination of discomfort and work well-being, reduction of the cost of treatment of employees or reduction of loss due to their absence and increase of employee motivation and performance (Moore, 2001; Skřehot a Marek, 2016).

Consequently, the dissertation thesis required an interdisciplinary approach to the ergonomics of workplaces to optimize the security control process.

2 Objectives of the dissertation

From the analysis of the current state of knowledge and its critical evaluation emerged questions that are not solved at present, although the partial steps towards their fulfilment are carried out on several fronts. However, with

regard to their fragmentation, there is a lack of a concrete, integrated solution and linking the logistics chain of security control with the human factor on the part of the screening controllers, who are mostly perceived as a stable element of the system with a fixed reliability of the performed activities.

On this basis the aim of the dissertation was set "**Methodology for assessing the impact of workplace ergonomic factors on airport security screener´s reliability and performance**" (further in the text as Methodology). That, as a management tool, defines the procedures for evaluating the conditions of the working environment and conditions at screening points at airport terminals. It should allow aerodrome operators to assess, with the help of review checklists, whether their employees - screening controllers are exposed to ergonomic risks potentially impairing the reliability of the human factor in identifying prohibited items in the luggage of passengers and other employees passing through screening points. The proposal for the implementation of the methodology for the operation of the international airport is also part of the dissertation. However, the goal and its solution were set in such a way that the final Methodology was also applicable after minor modifications to implement a solution into other transport sectors, as well as into other elements of the critical infrastructure and other objects where the protection of objects and spaces is carried out by security screening.

In order to meet the stated goal, it was necessary to carry out some partial steps in order to fulfil the partial goals of the dissertation:

1. To create a model of the screening checkpoint with the representation of the spatial arrangement of workplaces in relation human-machine-environment and a description of work tasks carrier by security screener and chronology of the tasks.
2. To identify sets of measurable ergonomic criteria and parameters of work environment.
3. To specify criteria for evaluating selected parameters.
4. To perform expert analysis
5. To determine the weights of the individual parameters based on the performed expert analysis.

6. To define intervals for values of defined work environment parameters.
7. To specify the degree of ergacity for defined interval values of the defined parameters.
8. To complete the Methodology for assessing the impact of workplace ergonomic factors on airport security screener´s reliability and performance
9. To develop a proposal for the implementation of the Methodology for the operation of an international airport.
10. To carry out a risk analysis for applying the Methodology.
11. To define benefits of the dissertation for relevant scientific disciplines and operational practices.

3 Used methods and way of solving

This chapter gives an overview of the most important managerial or scientific methods that have been chosen for the preparation of the dissertation, including a description of their specific use in the next steps leading to the fulfilment of the stated goals.

3.1 SHELL model

The SHELL model served as a basic insight into the modelling of human factors in socio-technical systems, the name of which is the abbreviation of the initial letters of the names of each block - software, hardware, liveware, environment (Reason, 1997). Regarding the topic and the aim of the dissertation, the LHE interaction should be monitored - Liveware, Hardware, Environment, ie human/worker (security screener), machinery (display terminal with X-ray images of luggage) and the environment of the security point. These three factors are also referred in the literature as 3M "Man, Machine, Medium" or "Man, Machine, Environment", among which there are physical, energy and information flows (Chundela, 2013).

3.2 Event-driven Process Chain model (eEPC)

The business process analysis method is used to construct a model of a screening site with an emphasis on the human-machine-environment

relationship and a description of the operations of the security screener, including time sequence of the operations. That is to implement the key part of the first partial goal of the dissertation.

The basic method, which allows to best capture the essence of the problem solved regarding the dissertation goal, is the EPC model - Event-driven Process Chain. As reported Řepa (2007), this model is a crucial part of the ARIS method for representing processes. It belongs to a group of dynamic models that create linkages between static source system and organizing resources, whose tasks is to create processes (activities or tasks) for static resources. An essential part of the EPC model is so-called objects that represent these resources. In principle, the following elements can be mentioned: events, functions, logical links, control flows that can be expanded in the case of so-called eEPC models e.g. organizational units, information sources, subprocesses, etc.

The process scheme of the cabin baggage detection process developed using the Extended Event-driven Process Model (eEPC) can be, including a detailed description, found in the part 4.1 of the dissertation.

3.3 System synthesis

In general, systemic synthesis means interconnecting knowledge gained through analytical approach and allows moving from small parts to object as a whole (Molnár, 2012). In the dissertation the method is applied to the composition of a set of evaluation criteria, which further assesses the selected parameters of the working environment within the expert analysis.

In the literary review, connected with the dissertation work, a preliminary list of planned assessed criteria, which can influence a human performance during working activities, has been compiled. Based on this overview, 90 parameters were determined in cooperation with experts from the practice by means of an expert assessment and with the help of a follow-up deeper literature search. These parameters can be considered deleterious and substantial in terms of reduced comfort and concentration, and can therefore be considered as an aspect influencing human performance and reliability

(such as the Performance Influence Factor or Performance Shaping Factor) within the screening point at the airport.

3.4 Cluster analysis

Cluster analysis is a multidimensional statistical method and is used to categorize and classify objects. Through it, objects are sorted into clusters (groups). A characteristic feature of such disaggregated objects is that objects in one group have sufficiently similar properties and properties sufficiently different from the other group (Řezanková, Húsek a Snášel, 2009). In the thesis, the principles of this method are used to categorize assessed criteria and parameters of the working environment. Ninety of the parameters listed above were grouped under these principles into nineteen criteria and then into six main categories - microclimatic conditions, physical factors, psychological stress, visual load, workplace premises and elements, workplace maintenance.

3.5 Human reliability assessment methods

The operator is part of the human-machine-environment system in the performance of the tasks assigned. In addition to analysing the work environment and determining the optimal values of its parameters, it is necessary to evaluate the psychic influences that affect Influences that affect employee concentration and well-being, and can lead to lower levels of reliability and performance. Psychology of work deals with this issue. It assesses the individual characteristics of the worker, the work processes and the social environment at the workplace. Processes of human factor reliability analysis are collectively referred to as Human Reliability Analysis or Human Reliability Assessment (HRA). Specific methods include THERP (Technique for Human Error Rate Prediction) or ASEP (Accident Sequence Evaluation Procedure). But for a general assessment of the impact of the workplace on the performance criteria as a basis for finding possible directions for their optimization the comparative procedures and methods of expert assessment can be used as well (Štikar et al., 2003). Such procedures are used in a section identifying sets of ergonomic criteria and working environment parameters and their optimal values.

3.6 Evaluation of the ergatic level using the HODERG method

The HODERG method, according to Král (2001), is used to assess the ergacity according to a range of criteria and parameters, which can determine work well-being in a human-machine-environment evaluation system.

The applicability of this method is limited by the following assumptions, which also outline the partial steps leading to its application:

- The ergatic level is measurable, i.e. it is possible to objectively determine the parameters, their units, the values of these units and the method of measurement.
- If the ergatic level is objectively unmeasurable, the verbal scale or relative scale, expressed as a percentage, is determined.
- It is possible to formulate ranges of ergacity to determine the limits of threats of individual ergatic criteria.
- It is possible to evaluate the significance of the influence of individual criteria and parameters on the weight by means of an expert method.
- It is possible to determine empirical dependencies that appropriately capture the linking of elements with the differentiation of significance of criteria and parameters (i.e. weights).

The ergacity of the system is determined by this relation:

$$E_s = \frac{\sum_{i=1}^{i=k} E_{ki}.V_{ki}}{\sum_{1}^{k} V_{ki}} \quad (1)$$

where:

E_s … the ergacity of the system

E_{ki} … index of ergacity of the i-th category of criteria

V_{ki} … the weight of the i-th criteria

k … number of evaluated criteria

3.7 Expert analysis

According to Janíček a Marek (2013), the expert method is "a means for carrying out expert analysis in the process of solving expert problems". Expert algorithms can be considered as algorithms or methods that can effectively solve expert problems and provide credible answers to expert questions. Authenticity subsequent expert evaluation is affected by many factors, including the quality of input data and the level of expertise and professionalism of experts and their ability to interdisciplinary thinking system.

The expert's assessment of the persons involved in the system of security inspections at airports or experts dealing with working conditions and environment is used for the dissertation's own solution. Specifically, verbal-numeric, correspondence and anonymous techniques were used. Classification of the degree of ergacity of defined E_{pi} parameters is the output of a partial solution.

The analysis was carried out in the form of an assessment of ergatical significance, in which the experts were asked to score the established criteria/parameters of the workplace in relation to the expected degree of correlation with concentration, performance or possible error in the implementation of assigned work activities in the human-machine-environment system. Experts were also able to optionally add a comment to each criterion or parameter. The assessment was conducted in electronic form via an interactive sheet of the MS Excel software. Ten experts were addressed, with the return and completing of the required data of 60%. Of the 564 total expected values, 558 were recovered, in six cases the experts were not able to evaluate the given parameter from their position. The scoring results are shown in Figure 2 – after the cluster analysis into nineteen criteria in the form of mean values of ergatic significance g_{ki}.

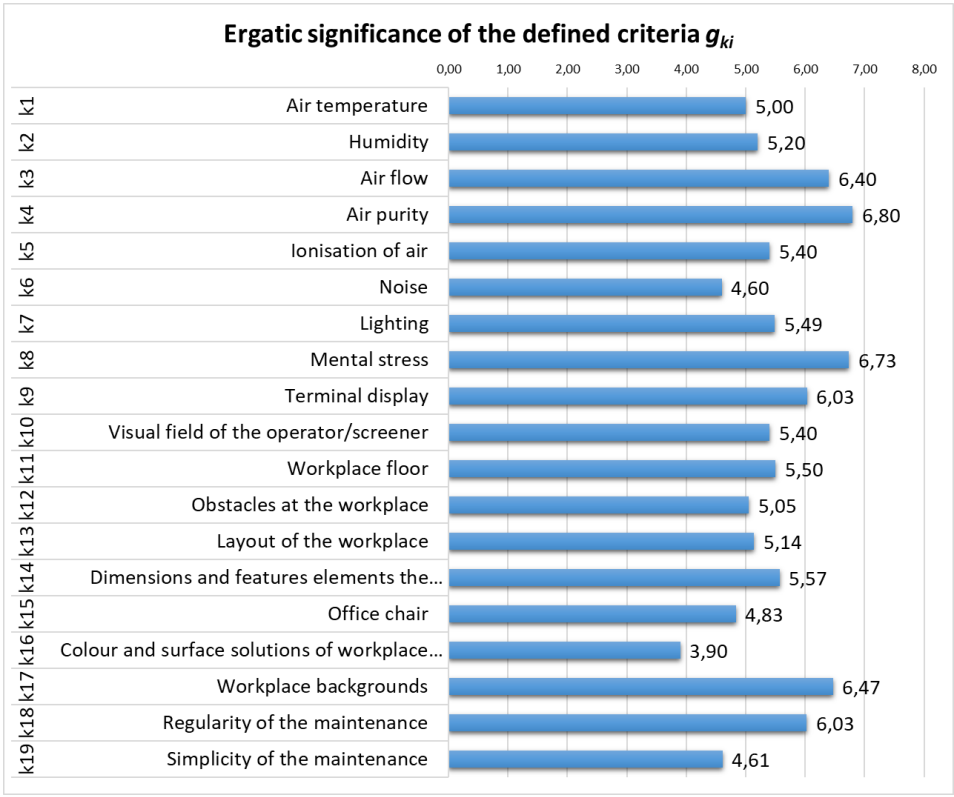

Figure 2 The resulting ergatic significance based on expert scoring (author)

3.8 Multidimensional assessment

Multidimensional or multipurpose evaluation. Its goal can be to sort objects into groups or to determine the order of the objects being evaluated (Synek, Kopkáně a Kubálková, 2009). In the dissertation, the method was used to identify the weighting coefficients for the purposes of determining the severity of the assessed criteria and parameters of the working environment and, ultimately, to determine the level of risk/ergacity in the evaluation checklists of the Methodology. Multidimensional analysis was performed based on expert analysis.

The output of the analysis is the determination of the weighting of the defined parameters V_{pi}. Ergatic significance was transposed on weights by an

exponential relationship (2) that better reflects the difference in results and assigns greater weight to more significant parameters:

$$V_{pi} = 2^{g_{pi}-1} \quad [1] \tag{2}$$

Based on this relationship, the scale shown in Table 1 was realized.

Table 1 The scale of the conversion of the ergatical significance to the weighting of the parameters

Mean value of the ergatical significance of the parameter g_{pi}	**Parameter weight V_{pi}**
0,00–0,49	0,5
0,50–1,49	1
1,50–2,49	2
2,50–3,49	4
3,50–4,49	8
4,50–5,49	16
5,50–6,49	32
6,50–7,49	64
7,50–8,00	128

source: author

3.9 Risk analysis for the application of the proposed solutions

The implementation of the risk analysis of the proposed procedures, which critically evaluates the measures elaborated within the Methodology, is also part of the dissertation's own solution. The purpose of this analysis is the identification of potential obstacles or weaknesses that govern the design and implementation of the present solution.

4 Achieved results

This chapter evaluates the achieved results of the realized technical experiment and the dissertation itself. It contains a risk analysis in the implementation of the proposed procedures and discusses possible directions for further research in the given area..

4.1 Summary of the technical experiment results

The objective of the technical experiment conducted by the author was to point out possible formal shortcomings in the way of measurement, recording of values or evaluation of the obtained data. The experiment was carried out at the Vaclav Havel Airport Prague. By recording the identified and indicatively measured values of the defined parameters and the subsequent calculation, the degree of ergacity of the evaluated criteria (Table 2), the categories (Table 3) and the workplace as a whole were obtained.

Table 2 Established values of defined ergacity criteria at the evaluated workplace

	Name of the criteria	E_{ki}
E_{k1}	Air temperature	0,96
E_{k2}	Humidity	1,00
E_{k3}	Air flow	not rated
E_{k4}	Air purity	not rated
E_{k5}	Ionisation of air	not rated
E_{k6}	Noise	0,87
E_{k7}	Lighting	0,81
E_{k8}	Mental stress	0,83
E_{k9}	Terminal display	0,68
E_{k10}	Visual field of the operator/screener	0,79
E_{k11}	Workplace floor	1,00
E_{k12}	Obstacles at the workplace	0,93

E_{k13}	Layout of the workplace	1,00
E_{k14}	Dimensions and features elements the workplace and the location of the controls	0,83
E_{k15}	Office chair	0,96
E_{k16}	Colour and surface solutions of workplace materials	1,00
E_{k17}	Workplace backgrounds	1,00
E_{k18}	Regularity of the maintenance	0,78
E_{k19}	Simplicity of the maintenance	0,70

source: author

Table 3 Established values of defined ergacity categories at the evaluated workplace

	Name of the category	**Calculation**	E_{kai}
E_{ka1}	Microclimatic conditions	$\Sigma(E_{k1},E_{k2})/2$	0,98
E_{ka2}	Physical factors	$\Sigma(E_{k6},E_{k7})/2$	0,84
E_{ka3}	Psychological stress	E_{k8}	0,83
E_{ka4}	Visual load	$\Sigma(E_{k9},E_{k10})/2$	0,74
E_{ka5}	Workplace premises and elements	$\Sigma(E_{k11},E_{k17})/7$	0,96
E_{ka6}	Workplace maintenance	$\Sigma(E_{k18},E_{k19})/2$	0,74

source: author

The resulting ergacity of the workplace under assessment was determined on the basis of section 4.7.2 of the dissertation as $\boldsymbol{E_s = 0,85}$. In accordance with section 3.6 of the dissertation, the risk of the workplace can be derived as $R_s = 0,15$ and it can be stated that the workplace of the screener evaluated in the experiment is included in the fourth class of ergacity, referred to as "normal risk" (see section 4.7.3 of the dissertation).

It can also be concluded from the above that the most upcoming operating optimum is the Microclimatic conditions category and the premises and elements of the workplace, in particular criteria air humidity, air

temperature, workplace floor, layout of the workplace, colour and surface solutions of workplace materials, office chair and workplace background. Conversely, visual load and workplace maintenance can be assessed as the least satisfactory, mainly due to an inadequate CRT monitor without adjusting the inclination and adaptation to operators of different growth and needs.

The implementation of the experiment also pointed to the necessity to modify some defined input data of the Methodology because they are irrelevant for the evaluated workplaces and the values would positively distort the final assessment (eg volume per worker). Therefore, the selected parameters have been eliminated, others have been modified to scale the values they can acquire. Such revised data is already part of the final text of the dissertation. In summary it can be stated that the methodology is applicable and does not have formal shortcomings.

4.2 Risk analysis of the proposed solutions

Although the author's attempt to create an objective tool for assessing the impact of ergonomic factors on the performance and reliability of the security screener, the author is aware of several risks that should be taken into account when applying it:

1. Expert analysis of the assessment of ergatic significance, ie the relation of the assessed parameter to the assumed correlation rate with concentration, performance or possible error rate in performing the assigned work activities of the security screener in the human-machine-environment system, was performed on a sample of experts from different professions related to the topic of the dissertation. However, it´s clear that the results could have been somewhat different in consultation with other experts.
2. The methodology assesses complex workplaces within the organization. In the case of the assessment of multiple screening points within a company or an airport terminal, some values may be the same - for example workplace background or workplace rotation

frequency, breaks, etc. These values can thus reduce the differences in the results of the individual workplaces E_s.

3. One of the major factors influencing the psychological well-being of screening operators are passengers. Specifically, their quantity, queues, behaviour, noise, discipline, etc. This factor is not developed in the work, because it was not its goal. For further research, however, it is one of the key factors to be addressed.
4. Validation of ergonomic optimization is a long-term process. Therefore, if the airport operator adopts optimization measures based on the outputs of the Methodology, an immediate increase in performance and reliability cannot be expected. Although partial results can be observed, comprehensive "before/after" comparisons should be made no earlier than one year after implementation of the measure. In this respect, the limiting factor can be a high employee turnover rate, which, however, can be managed by a comprehensive assessment of the performance and reliability of the workplace rather than the individual operators.

4.3 Further research in the area of interest

The author does not expect to end the research in the solution of the area by this dissertation. Contrarily it is planned to continuously refine the Methodology and facilitate its application.

One way to further improve Methodology is **to refine the weighting of the parameters** by optimizing the points of ergatic significance by establishing cooperation with other experts. In the case of their correct selection and a greater number of evaluators, more correlation between the proposed system of assessment and the real status is assumed.

The **application of the Methodology** is also planned at other control points within Vaclav Havel Airport Prague (the plan is to carry out measurements at the new central security checkpoint in Terminal 2) as well as **at other airports in the Czech Republic**. The author would like to extend the scope of the Methodology to selected **foreign airports** with the possibility of comparative analyses.

In order to simplify the recording of values and the calculation of the degree of ergacity of the categories, criteria and overall workplace, **an electronic version of the guided Methodology** is also planned with direct input of the measured values and automatic calculation. An interactive MS Excel spreadsheet document, a web interface, or a mobile application for the Android operating system come into consideration. The advantage of such a solution is first of all easy accessibility and ease of use.

In accordance with paragraph 3 of section 5.2 of the dissertation, further research should be directed to the **analysis of psychic conditions and factors** that can affect the mental state of the screening operators. These include, for example, the effects of passenger behaviour, the fatigue curve, out-of-work psychological stress, motivation factors, etc.

The proposed procedures should also be applicable after minor modifications to implement **optimization solutions in other transport sectors** as well as in **other critical infrastructure elements** where security of objects and premises are being secured through security screening, such as courts, prison buildings, nuclear power plants, sports stadiums, government buildings, etc. Here, it´s needed to consider adjusting the parameters in the evaluation checklists.

5 Benefits of the dissertation

The dissertation was elaborated in accordance with the framework approved by the state doctoral exam. Accordingly, the Methodology for assessing the impact of workplace ergonomic factors on airport security screener´s reliability and performance has been developed. Its uniqueness lies in a multidisciplinary approach combining the techniques of ergonomic assessment of the workplace and knowledge of air transport and the international airport environment in relation to the protection of civil aviation against acts of unlawful interference.

A necessary prerequisite without which the main aim of the work could not be fulfilled was the fulfilment of the objectives of the partial ones, which at the same time aimed at enriching the scientific knowledge in the related scientific disciplines.

With the help of the eEPC model, **the model of the security screening point was created**, in which the processes related to cabin baggage detection are shown.

Furthermore, **a set of ninety measurable parameters of working environment has been identified that could potentially affect the performance or reliability of the security screener**. These parameters were then clustered into nine criteria and six categories. The parameters were obtained on the basis of literary research and discussions with experts involved in the field of air transport security, psychology of work, transport psychology, ergonomics and microclimatic conditions of the workplace.

It was necessary to determine how to use these parameters for further research. **Criteria for the evaluation of the selected parameters were then set** for subsequent expert analysis. The already existing HODERG method with the so-called ergatic significance was used as a basis, which was slightly modified for the purpose of this work.

Even **the expert analysis** itself has to be considered as a useful and key part in which the experts approached assess the correlation between the effects of the identified parameters and the concentration or potential reduction in the performance or reliability of the operators. On the basis of the outputs of this analysis we determined the weighting coefficients of all defined parameters.

For each of the parameters, the **intervals of the values** they can obtain and **the degree of ergacity for the defined value intervals were determined**.

The created Methodology is a **comprehensive management tool that allows proactive assessment of security risks arising from the work environment** in which the security screener performs activities aimed at suppressing acts of unlawful interference in air transport. As such, the Methodology may be included in the Security Management System (SeMS) in-house tools, which, together with the Safety Management System, is considered to be the state-of-the-art and most effective method for managing security risks in aeronautical companies by focusing on basic security management aspects, including assignment of responsibilities, risk assessment and optimization of in-house communications. Ergonomic

checklists have existed until now, but **they were not**, by way of exception, **oriented to a specific type of workplace** and were used exclusively for the assessment of physical load or as a tool for assessing the workplace from the point of view of safety and health at work.

For the aerodrome operator, the implementation of the Methodology has the potential **not only to increase the reliability of the screening**, but it also **brings secondary benefits**, such as creating better comfort at the workplace, maintaining a higher level of mental and physical fitness, preventing health problems or minimizing fatigue. It could potentially be reflected in greater satisfaction and lower employee turnover.

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Abstract

The dissertation deals with questions of the connection of working environment ergonomics to the effectiveness of security screening in air transport. It analyses the techniques of optimization of the process of safety checks and ergonomics of workplaces, and subsequently the author proposes methodological procedures for assessing the influence of ergonomic parameters of the working environment on the screening performance and reliability. The methodology should serve as a managerial tool for assessing ergonomic risks in relation to the protection of air traffic from unlawful acts within the in-house Security Management System. The possibilities of application of this methodology were then experimentally verified at the international Václav Havel Airport Prague.