REALTIME OBSERVATION, IDENTIFICATION AND TRACKING FROM DANGEROUS PERSONS IN AIRPORTS - A LOGISTICS SYSTEM ROIT

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ABSTRACT. Background: The aim of this paper is to present and analyze a new method of the logistics disaster management and concentrates particularly on terrorist attacks of CBRN type (C - chemical attack/weapon, B - biological attack/weapon, R - radiological attack/weapon, N - nuclear attack/weapon) at the airports. Each of the aforementioned is an issue of great importance and high priority for the airport communication.
Methods: The research of a ROIT project (Realtime Observation, Identification and Tracking from dangerous people in airports) has been conducted in a way that enables the application of the three-step computer system. The program has been configured to identify, observe and protect from undesired actions of people suspected of involvement in CBRN.
Results: The main results of applying the device in different scenarios are: enabling reliable automatic identification and classification of potentially hazardous materials and substances, association of the materials with their owners or distributors.
Conclusion: Simultaneous passing information to the airport security guards, police and expert team guarantees that further purposes involve the independent opportunity to observe in real time the CBRN suspects as well as to eliminate them secretly and quickly from the rest of airport passengers after thorough and credible identification.

Key words: disaster management, logistics of security solutions, protection of critical infrastructure, passenger.

INTRODUCTION

Research and practical applications of systems of logistic management of terrorist threats constitute an underexplored field, and largely limited to the issues of direct identification of radioactive substances. Thus authors suggest a novel method of identification with the aim of providing a comprehensive solution encompassing various types of possible terrorist attacks, such as chemical, biological, radiological, and nuclear. The realisation of the assumed research objectives involved conducting analysis based on a three-stage computer system configured for the purpose of a reliable and automatic real-time identification of substances and people suspected of creating terrorist threats.

Nowadays the issue of safety faces challenges concerning efficient cooperation between all the public institutions, local authorities and administration offices. Additionally, their actions need to be supported by modern and integrated methods of management in case of crisis, which involves inter alia the exploitation of technical equipment and information system enabling monitoring and identification. Others include prevention of crisis occurrence and fast and effective rescue action. Realization of the aforementioned points is dependent on

ongoing improvement of technology, forecasting events that may happen in the future, computer data processing and elimination of risk results. These technologies are strictly connected with research problem concerning safety engineering consisting of civil safety and technological safety. There is currently much research done in order to invent and implement new strategies of passengers' protection. Modern techniques increasing the level of safety involve:

− antiterrorism protection (including so-called bio-terrorism and application of hazardous biological, chemical, radioactive, nuclear, high-energetic materials etc.),
− processes of management in case of crisis, safety and protection of network systems,
− integration of information system and connectivity,
− education; increasing the awareness of the danger.

In these areas the technologies assumed to be of the greatest importance for security are the following: sensor technology, observation, detection and spying technology, information, modeling and simulation systems. The aforementioned can be found in priorities of 6th and 7th CapTechprogramme as well as in technological priorities of European Defence Agency. It indicates the similarity between Polish priorities in terms of safety and the ones stated by European Union. Thus, it creates the opportunity to extend and continue the research using European fund and cooperating with foreign research centers in order to invent create innovative mutual projections [EDA Annual_Report 2011]. The topic scrutinized in the following article concerns the Disaster Management and concentrates particularly on terrorist attacks of CBRN type (C - chemical attack/weapon, B - biological attack/weapon, R - radiological attack/weapon, N - nuclear attack/weapon) at the airports. Moreover, it touches the topic mainly from the logistical point of view. It emphasizes the importance of application of various systems in order to increase the safety in the international airport transport and communication.
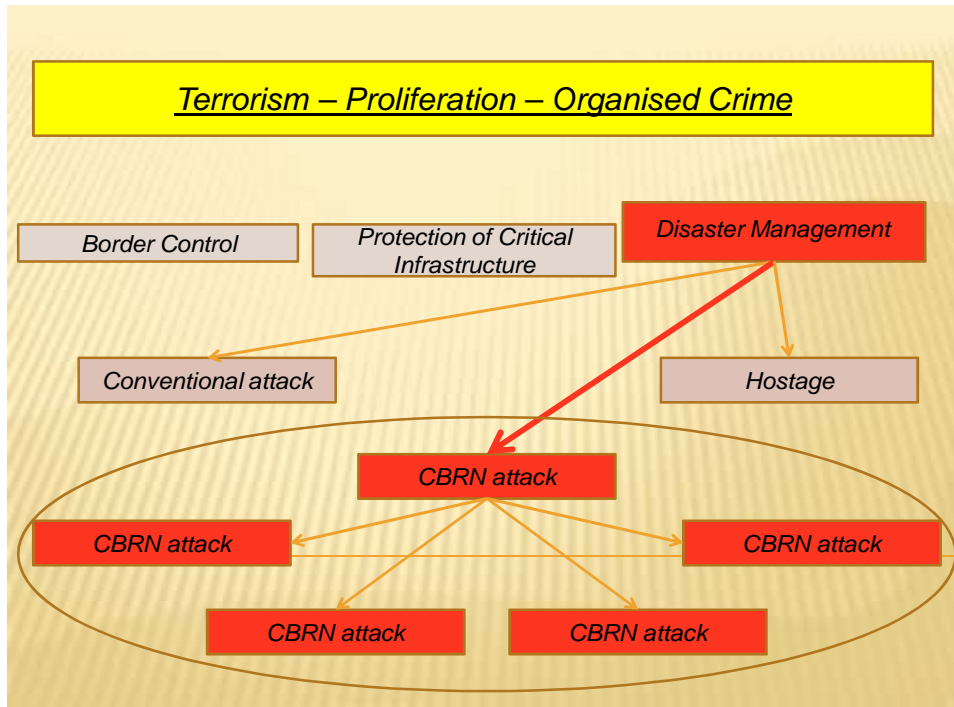
SOURCES OF THREATS IN AIRPORTS

Issues of guarding against terrorism and of early detection of threats from dangerous people at border checks in airports constitute the main focal points for which a variety of solutions are being proposed today. They are characterized by different cycles of processes and logistical operations. The supply chains constitute the "backbone" of modern economy. These cover manufacturers, logistics hubs, operators, platforms and control points. Protection of these elements requires an integrated approach to monitoring and assessment of risk, tracking of goods, to safe exchange of goods between countries and operators, and to fast and efficient control of goods and platforms. On the whole, it could be said that projects aimed at improving passenger safety target these three areas. The first include border control, then come protection of critical infrastructure, while the third covers disaster management - in case of identified dangers. Graphical presentation of all three components with the extraordinary complexity of the relationships emerging from presented correlation is illustrated in Figure 1.

According to what goes on within the international space of management of airports, taking into account all systems Interoperability, the authors of the article have outlined adopted solutions for the protection against class CBRN hazardous substances, their detection, decontamination and the logistics systems operating in this area. In this context, trends in the development of improved security at airports and implementation of specific solutions in Germany constitute an interesting aspect. Valuable resolution, assigned to individual sectors with regard to potential threats in 2015 appears to be of great significance (Figure 2). It could, therefore, be assumed that software programs for IT solutions in security, equipment and facilities connected with this software programs, as well as identification systems are strongly strengthening their position in the market, and in some cases, it would come to a concentration or drastic shifts in emphases. Modern airports are equipped with a range of alarm systems and technical systems that secure the safety and reliability of their

operations. Building Management Systems - BMS incorporate:

a) safety systems (fire alarm, burglar alarms, access control and CCTV systems),

b) information technology security (security system for computer resources, data transfer security system, systems for physical protection of telecommunication equipment),

c) building automation and control systems (air conditioning, elevator operations, lighting, supply of utilities - water, gas, electricity).

Source: own elaboration

Fig. 1. Exemplary relations between threats, capabilities and technologies
Rys. 1. Przykłady relacji pomiędzy zagrożeniami, możliwościami i technologiami

Source: www.sicherheit.berlin-brandenburg.de (18.12.2012)

Fig. 2. The market for security solutions in Germany in 2015 (in millions of Euro)
Rys. 2. Rynek systemów bezpieczeństwa w Niemczech w 2015 (w mln Euro)

BMS provides technical tools for management of security and comfort at work inside buildings under everyday conditions and during emergency situations. However, BMS cannot guarantee the safety of the airport under crisis situation, since damage to infrastructure and technical equipment result in breakdown of the system. Under such circumstances, outside help in form of crisis management is needed, which is a set of previously developed procedures, data recorded on an ongoing basis, based on information from the search and rescue services, and procedures designed to minimize the effects of terrorism (chemical, biological, radiological, etc.). This requires management and coordination of work from many areas, the study of operation systems as well as selection and testing of suitable sensor base [Valera and Velastin 2005].

ROIT SYSTEM'S LOGISTICS SOLUTIONS IN REAL-TIME TRACKING, IDENTIFICATION AND OBSERVATION OF DANGEROUS PERSONS IN AIRPORTS

Comprehensive equipping of emergency response services with all kinds of devices, and creation, on their basis, of systems of detection and notification constitute an initial and necessary condition of actions to ensure protection against effects of threats [Jane 2001]. Monitoring of security risks can logistically be conducted in a constant measurement network or in mobile measurement points.

Methods used in CBRN monitoring risks, in terms of method of drawing of samples for analysis, may be divided into two groups: sampling at the site of danger, remote detection and identification and measurement of concentration of dangerous substance. Accuracy and clarity of the measurements might not be very precise for first group of methods due to separation in space and time of the places of drawing samples and their analysis. Remote methods are free of these shortcomings and, depending on the measurement technique used, they allow for monitoring of the environment even at very

long distances. In the remote detection, methods and optoelectronic technologies that, being very precise tool at detecting and determining the concentrations of gaseous air pollution, are increasingly displacing traditionally used methods (e.g., wet chemistry methods, chromatography) in monitoring the environment, play a special role. The major advantages of optoelectronic methods include the possibility of full automation of the measurement, the uniqueness of the results, possibility of taking measurements without drawing samples, as well as integration of different electro-optical systems in the acquisition, processing and transmission of data.

There are two types of remote monitoring systems: a "stand-off" and a "remote"[Harig and Matz 2001]. The "stand-off" systems, for example optical sensors, can detect threats from a significant distance without coming in contact with the observed area. These are, for example, active laser systems - Difference Absorption Lidar DIAL or passive thermal imaging systems [Kovalev and Eichinger 2004]. A single "stand-off" station can cover a wide area, whose size depends on the coverage, field of view and scanning speed. "Remote" systems use various types of minute spot "in situ" sensors, where the data from these sensors are transmitted to the emergency centers via wire or wireless links. These centers analyze the data coming from the sensors' network and then determine the level of threat.

The proposed, in the research tests conducted by the authors, project of logistics solution of ROIT (Real-time observation, identification and tracking of dangerous persons in airports) system, has been designed in such a way that application of three-tier IT system, configured for identifying, tracking and protection against threats from people suspected of generating CBRN threats, is possible.
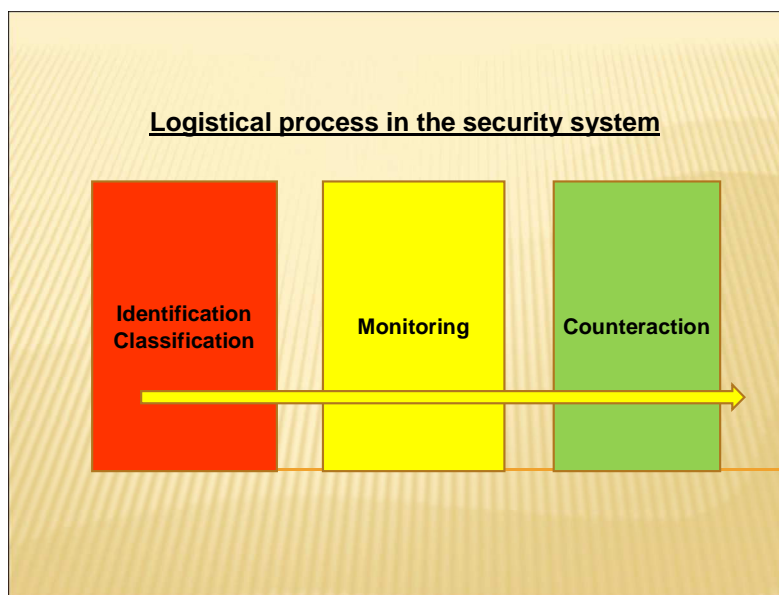
Practical application of the system is:
1. enabling of reliable, automatic identification and classification of potential hazardous materials and substances by

linking them to their owners or administrators,

2. creating the possibility of parallel transfer of relevant information to relevant airport services, expert teams, as well as to security officials and the police,

3. providing of possibility of real-time independent observation of persons suspected of generating CBRN threats, after

picking relevant information from jointly acting services and partners,

4. enabling discreet and efficient removal of this type of persons from the general flow of passengers in the airport, after their effective and reliable identification.

Sequence of logistic processes under the proposed system is shown in Figure 3.

Source: own elaboration

Fig. 3. Logistic process under the proposed security system
Rys. 3. Proces logistyczny w ramach proponowanego systemu bezpieczeństwa

The different sequences of the process will be discussed separately, to illustrate the scope and content of the product constituting the objective of a solution within the above project.

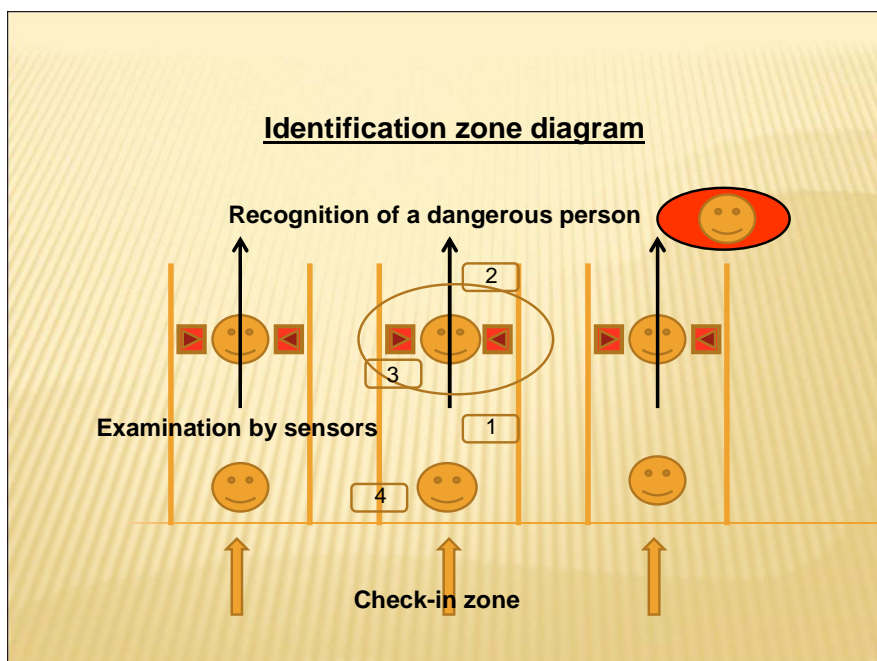### Identification / Classification

Automatic detection and the classification of persons suspected of generating CBRN threats should be implemented based on an intelligent detection system. To this end, each passenger must be subjected to a separate control for eventual possession of dangerous materials, without the need to generate excessive costs and burdens for the other passengers and the staff. This action should not affect on-going, efficient handling of passengers, and should not create congestion or other complications. Therefore, the process of identification and classification of

passengers, in terms of prevention of dangers, is carried out with use of innovative detection system in correlation with appropriate logistics system, independently and unnoticed by the object of such examination, or by the observed individual. The operation of the system may be described as follows: identification sensors continually "keep watch" over a specific area where controlled persons enter. This takes place within a single throughput neck within the check-in area and other similar places, they constitute narrowing bottle-necks designed for carrying out these activities. In the case of activation of sensors by one or more hazardous materials, the system classifies them according to the alarming level of activity and, after this classification set in motion appropriate intervention measures.

The pattern of Action of the system (Figure 4) explains the principle of

identification, during which time a person (4) is forced to pass through a specially shaped narrowing in the shape of a bottle neck (1). At the moment of crossing the narrowing, identification takes place in the active zone (2) as a result of activation of device (3). If identification tests come with positive result (if a person is in possession of Class CBRN dangerous goods), relevant classification will takes place and situation is assigned to appropriate alert level.

Source: own elaboration

Fig. 4. Diagram of the traveler identification system in the check-in zone
Rys. 4. Schemat działania systemu identyfikacji podróżnych w obrębie punktów odpraw

Table 1. Possible alert levels
Tabela 1. Możliwe poziomy alarmowania

Alert level	Hazardous material
0	No detected of hazardous material
1	Poisonous and intoxicating material
2	Chemical/explosive material
3	Radioactive material
4	Radioactive and explosive material

Source: own elaboration

Based on five levels of alerts (Table 1), it is possible to generate different described actions aimed at protecting against potential threats, in addition to stopping and removing suspicious persons and hazardous materials from the airports (in the framework of multi-level management of emergency situations). Based on this management system, all security link stakeholders (police, federal police, customs and private security providers) can adequately respond to the threat and plan joint action preventive measures appropriate to the situation (as part of the operational management of emergency situations).

Monitoring

After identification and classification, the next step is discreet observation of a person or object (through a coordinated monitoring combined with visualization as an image on a monitor). To do this, sensor-based IT system, which, depending on the level of alert assigned after screening, will be able to identify and observe these people or objects, should be designed. Screen monitoring is used for visual identification of persons and objects by the controlling staff with the help of the color classification corresponding to each level of alert.

Alert level	Color classification
0	Green
1	Yellow
2	Orange
3	Red
4	Violet

Source: own elaboration

Every object bearing signs of the potential threat is monitored as an image. Every image is accompanied by additional information corresponding to assigned level of alert. This visual aid is necessary equipment for the monitoring staff, which, based on an image

from the camera can send a more detailed description to the concerned air traffic security services. Therefore, a detailed characteristic of the person is based on the image from the control camera and provides information to facilitate accurate identification of a person perceived as potentially dangerous. The computer software and equipment should be able to limit tracking and observation functions to one particular room. The purpose of this restriction is to be able to configure, between operations, the linkage of used sensor systems and software, for "detection", to eliminate losses in information. In addition, an extremely important thing is to ensure the continuity of the information chain to consistently protect against any potential threats.

Source: own materials of Karp GmbH / Technische Hochschule Wildau / Projektlogistik GmbH

Fig. 5. Marking of an observed person experiment
Rys. 5. "Oznaczenia osoby" w ramach doświadczenia laboratoryjnego

Such a solution should therefore be configured in the form of information chain, connecting series of rooms and should enough the latest innovations in the field of detection and monitoring of risks. In summary, two partial aspects, namely: "determination of the control object" and "constant control of facilities that are crucial for the safety of air
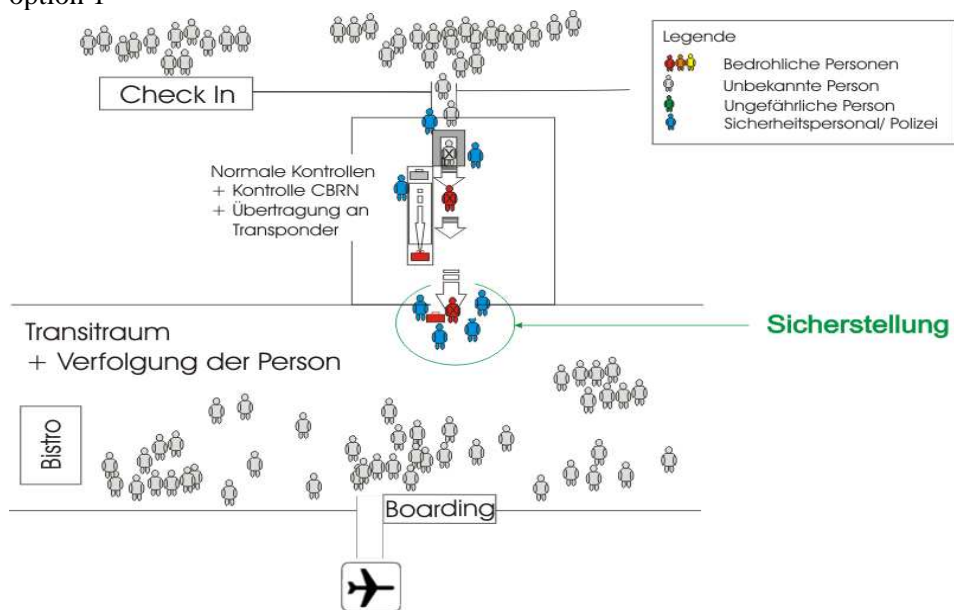
traffic by several watch zones", it can be said that they constitute the focus of the system of detecting and monitoring of potential threats. In this respect, a detection system has already been developed under the name "CASTAF" (Computer Aided Screening, Tracking and Fixing) [ZLUR-Projekte 2012]. The following figure shows the action of marking of an

observed person and the result of such marking within conducted laboratory experiment, containing the overall picture of the path of movement within the airport area of the monitored person.

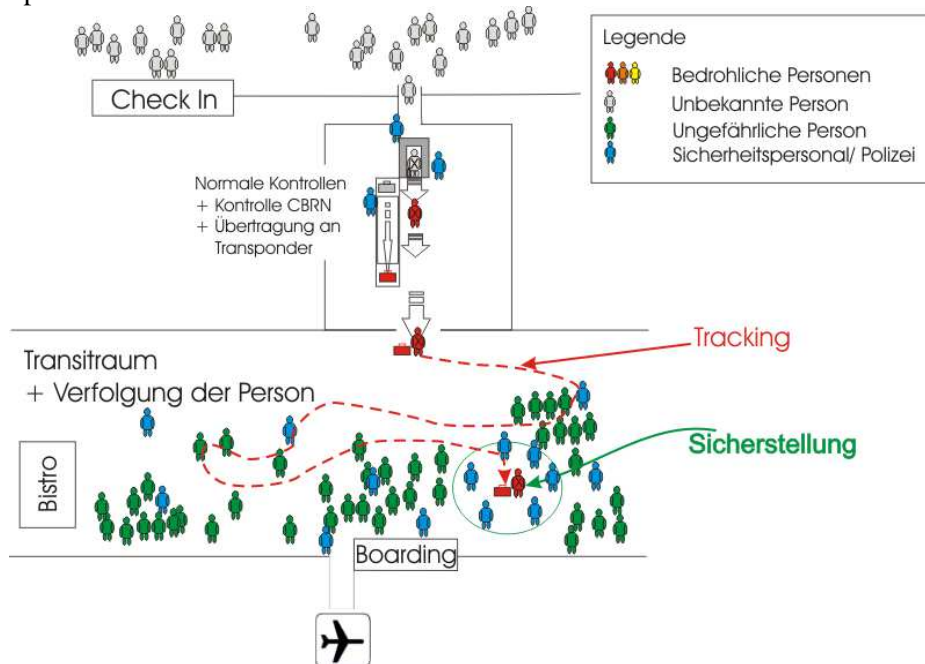### *Isolating of the person constituting a threat and securing of dangerous materials*

The final segment of the product is the ability to carefully isolate the person identified

− option 1

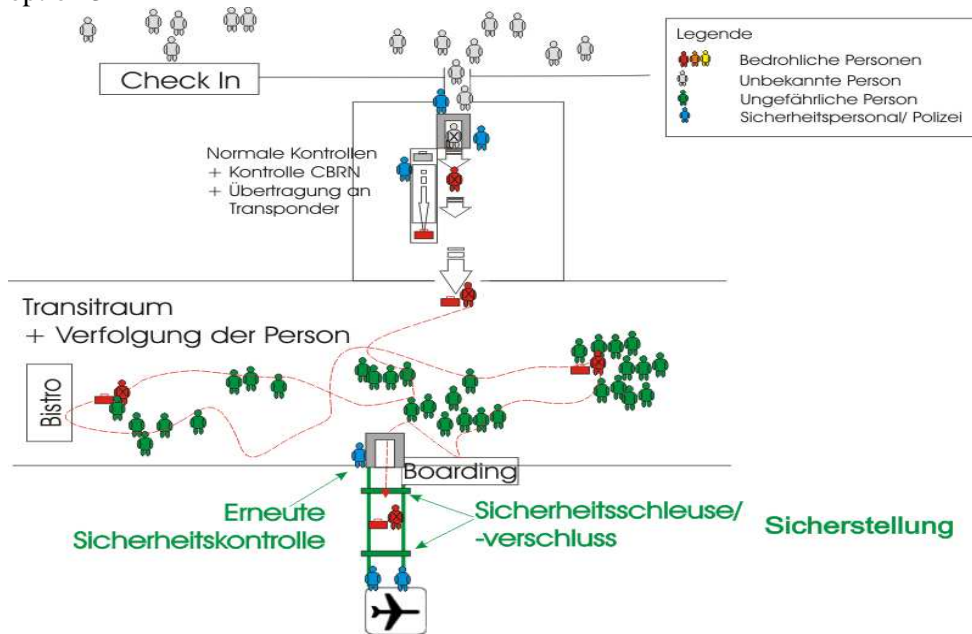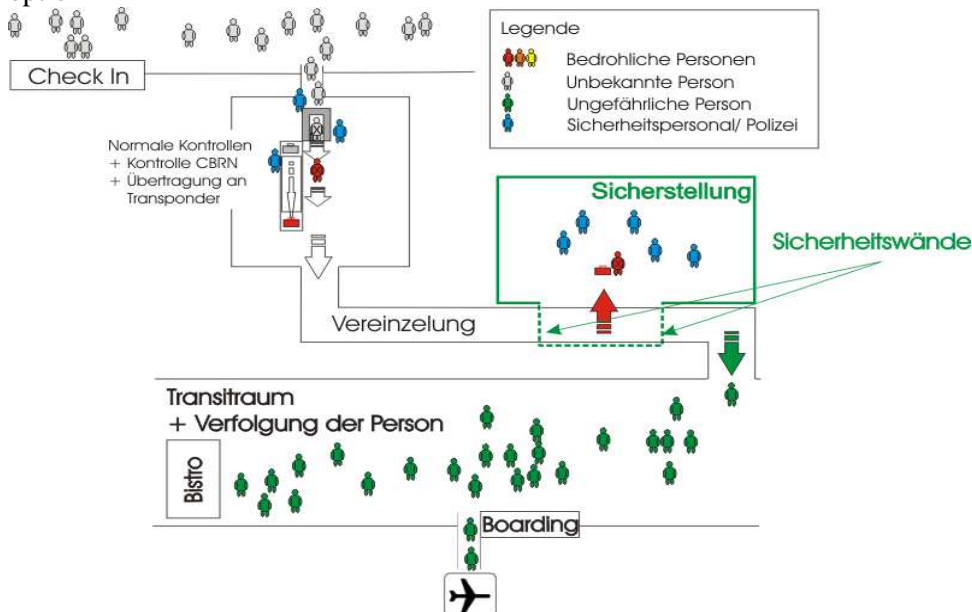as constituting potential threat and to secure dangerous materials, and thus effectively prevent danger. Alone the operations of securing (intercepting) hazardous materials and substances are individually correlated with a given level of alert, as well as with the spatial conditions of the room. Below different scenarios of detection operations and operations of securing dangerous materials in the following options (1-4) are presented:

Source: own elaboration

− option 2

Source: own elaboration

− option 3

Source: own elaboration

− option 4

Source: own elaboration

All of these options are basically achievable, however, they have their advantages as well as disadvantages. In conjunction with the emerging detection system and computer-aided, through appropriate software program, system of controlling the activities of monitoring of persons suspected of possessing dangerous materials and substances, a broad field of research and development has been outlined.

In this regard, partial scenarios are already in operation and they will be outlined below.

Alert Level1: Toxic substances and intoxi-cants (narcotics)

The potential threat posed by the person carrying such substances is assessed as low, as usually the objective is to prevent further transfer. As seen from many years of

observation of drug couriers, they do not carry weapons due to the small amount of substances being smuggled. For this reason, securing (intercepting) may take place anywhere.

Possible scenario securing (intercepting)

Alert Level 1: Detailed features of the person, their actual position and direction of movement are transferred to preventive services on site. A relevant preventive unit would, in a discreet manner, approach the indicated person and request the control staff for confirmation whether the intercepted individual is the one indicated. Intervention takes place smoothly and quietly as is only possible. Interrogation and securing narcotics or other substances take place in nearest office of preventive services.

Alert Level 2: Explosive / chemical / biological materials

This level is a potentially high risk for all those present at the scene (airport security services, passengers and the person creating the danger), due to existence of many hidden aspects of illegal transportation or of accomplishment of specific criminal intent:
Are explosive / chemical / biological materials only transported?
Does explosive material already constitute an element of a bomb?
In case of detection of a bomb, how is the bomb detonated?
In view of the above airport aspects, the prevention services must always start from the worst-case scenario and to subject all actions this scenario. The basic element of these activities is the creation of a narrowing, in form of artificial bottle neck, which should allow for isolation of the object of potential risks from freely accessible airport space, thereby extracting the source of danger from the surrounding.

Possible scenario of securing (intercepting)

The idea and objective of installing a bottle neck channel is to separate the source of the threat and the object bearing potential threats from the surrounding. To effectively accomplish this isolation, the person/object must be separated from the larger group of passengers. Intervention team of the airport security authority receives information on the level of alert, detailed features of the person as well as the location of potentially dangerous object. Due to the fact that bottle-neck channels constitute a fundamental part of the concept of security protection in airports, an isolated and monitored object must pass through such channel. In the meantime, SWAT team members take positions in a predetermined safety channel and its adjacent isolation space. Both the safety channel as well as the isolation space must be able, in case of an explosion, to absorb the pressures and forces arising explosion, in order, to suppress the effects of detonation to the greatest extent possible. Intervention, as far as possible, should not interfere with the normal passenger traffic.

Alert level 3: Radioactive materials

In fact, the procedure of conduct in this case is based on principles similar to alert level 1. Due to the fact that presence of radioactive material has been detected, it is assumed that it is case of pure smuggling. Therefore, the risk is focused only on the radioactive radiation. In addition to adhering to the rules of conduct of level 1 alert, the intervening officers must be equipped with protective gear, with this that their contact with radioactive material should be kept at minimum needed to carry out this function. The type of action to be taken while securing and intercepting radioactive materials, shall always depend on the management actions at the scene.

Alert level 4: Explosives with radioactive materials

The combination of explosives with radioactive material (dirty bomb), as well as combination with biological materials constitute the highest level of terrorist threat, due to the fact that an eventual explosion would cause a wide dispersal of radioactive /biological material, and thus resulting in high contamination of the environment - this produces significant damage accompanying the explosion. For the need of protect against such type of threat, course of action similar to alarm level 2 should be adopted, and complemented by additional protective measures for the

airport security personnel and the passengers themselves. To minimize the risk, efforts should be made to bring to partial stoppage or relatively slowing down of incoming stream of other passengers - but for the success of operations, the person being monitored should not sense that they and their intentions have been detected.

SUMMARY

The assumed research objectives have been fulfilled from research as well as practical perspectives. The proposed method guarantees the feasibility of comprehensive real-time observation of people of whom there exists a suspicion of creating threats of a CBRN nature.

Additionally, the system enables a discreet and efficient elimination of this type of people from the passenger streams (e.g. in an airport area), after their successful and reliable identification. The development of modern technology assisting government agencies in accomplishing strategic tasks of protection against terrorist threats, is interdisciplinary and involves many sectors of the economy and state agencies. In terms of logistics, use of IT and decision processes in crisis management, selected technologies the development of which research effort should be concentrated (as strategic and could be a future Polish specialty), should be supported by long-term programs funded by the state and the industrial sector. Based on experience from international attempts made in the past by persons transporting dangerous goods and materials by air, different scenarios of identifying, monitoring and stopping such people have been presented in this paper. The system of prevention currently being developed in

a comprehensive way, and logistics system supporting it are at present the main focus of research efforts undertaken in this direction in the European countries. Hence a good opportunity has presented itself so as to include research institutions and institutions of higher learning in international innovation and research works. One of the possibilities of running this type of projects appears in actions partially funded through one of the European framework programs, and this undoubtedly will facilitate development of a wide range of appropriate solutions in the above specified area.

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ROIT - LOGISTYCZNY SYSTEM NAMIERZANIA, IDENTYFIKACJI I MONITORINGU W CZASIE RZECZYWISTYM OSÓB NIEBEZ-PIECZNYCH W PORTACH LOTNICZYCH

STRESZCZENIE. **Wstęp:** Celem artykułu jest przedstawienie i poddanie analizie nowej metody zarządzania logistycznego zagrożeniami (Disaster-Management), w zakresie ataków terrorystycznych typu CBRN (C - atak chemiczny, B - atak biologiczny, dla R - atak radiologiczny i dla N - atak nuklearny) w portach lotniczych. Każda z tych form działalności terrorystycznej stanowi na całym świecie problem o najwyższym, priorytetowym znaczeniu w komunikacji lotniczej.

Metody: Proponowany w przeprowadzonych przez autorów badaniach projekt logistycznego rozwiązania systemu ROIT (Realtime Observation, Identification and Tracking from dangerous persons in airports), został opracowany w ten sposób, że możliwa jest aplikacja trójstopniowego systemu informatycznego, skonfigurowanego na potrzeby identyfikacji, obserwacji i zabezpieczenia przed niepożądanym działaniem ze strony osób, co do których istnieje podejrzenie o generowanie zagrożeń typu CBRN.

Wyniki: Praktyczna aplikacja systemu w różnych scenariuszach, co umożliwia niezawodną i automatyczną identyfikację oraz klasyfikację potencjalnych materiałów i substancji niebezpiecznych przy powiązaniu ich z właścicielami lub dysponentami.

Wnioski: Stworzenie możliwości równoległego przekazywania stosownych informacji do odpowiednich służb portu lotniczego oraz zespołów eksperckich i służb bezpieczeństwa, gwarantuje możliwości samodzielnej obserwacji w czasie rzeczywistym osób, co do których istnieje podejrzenie o generowanie zagrożeń typu CBRN, oraz umożliwia dyskretną i sprawną eliminację tego typu osób ze strumienia przepływu pasażerów w przestrzeni portu lotniczego po ich skutecznej i wiarygodnej identyfikacji.

Słowa kluczowe: zarządzanie zagrożeniami, logistyka systemów bezpieczeństwa, ochrona infrastruktury krytycznej, monitoring ruchu pasażerskiego, systemy zarządzania lotniskowego.

LOGISTIKSYSTEM ROIT ZUR ECHTZEIT-ERFASSUNG, IDENTIFIZIERUNG UND VERFOLGUNG GEFÄHRLICHER PERSONEN IN FLUGHÄFEN

ZUSAMMENFASSUNG. Einleitung: Im vorliegenden Artikel wurde eine neue Methode des logistischen Gefahrenmanagements (Disaster-Management) im Bereich terroristischer CBRN-Angriffe (C - chemischer Angriff, B - biologischer Angriff, R - radiologischer Angriff, N - nuklearer Angriff) in Flughäfen analysiert und erörtert. Jede von den genannten Formen der terroristischen Aktivität stellt auf der ganzen Welt ein Problem von höchster, prioritätsmäßigen Bedeutung im Flugverkehr dar.

Methoden: Ausgearbeitetes Projekt des logistischen Gefahrenmanagements ROIT (Realtime Observation, Identification and Tracking from dangerous persons in airports) wurde durch von den Autoren durchgeführten Forschungen so konzipiert, dass die Anwendung eines Dreistufen-Informatiksystems zustande kommt, das zwecks der Echtzeit-Erfassung, Identifizierung und Verfolgung der gefährlichen, der CBRN-Gefährdungen verdächtigten Personen in Flughäfen systematisch konfiguriert wurde.

Ergebnisse: Praktische Anwendung des Systems innerhalb von unterschiedlichen Szenarien ist es, eine einwandfreie automatische Identifikation sowie eine Klassifikation potenzieller Gefahrmaterialien und -stoffe in Verbindung mit deren Inhabern oder Disponenten.

Fazit: Möglichkeit einer parallelen Weiterleitung der betreffenden Informationen an die zuständigen Flughafen-Sicherheitsdienste, Experten-Teams und staatlichen Sicherheitsdienste garantiert die Möglichkeit einer selbstständigen Echtzeit-Verfolgung der Personen, die der Herbeiführung von CBRN-Gefährdungen verdächtig sind, zu gewährleisten sowie eine diskrete und reibungslose Aussonderung solcher Personen und Objekte aus dem Material- und Passageierfluss im Flughafenraum nach deren effektiver und glaubwürdiger Identifikation zu ermöglichen.

Codewörter: Gefahrenmanagement, Logistik von Sicherheitssystemen, Absicherung von kritischer Infrastruktur, Verfolgung des Passagierverkehrs, Managementsysteme in Flughäfen

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