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Original article

Police simulation systems in the education process of traffic police officers

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INFORMATION

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ABSTRACT

Technologies supporting the process of educating police personnel have become an indispensable element of the infrastructure of police schools. The primary source of financing for the technologies built is the National Center for Research and Development. In consultation with the Minister of National Defense and the minister competent for internal affairs, the institution carries out activities related to research for the benefit of state security and defense. In competitions for specifically defined research topics, projects that promise the most considerable real increase in national security are financed. The programs and projects being implemented aim not only to increase the Polish scientific and industrial entities' potential but also to strive for technological independence by creating Polish "know-how" in critical technologies in the area of national security and defense. The article presents technologies supporting the training process of traffic officers developed by Polish scientific and industrial consortia. The first presented trainer is Simulator Supporting the Training of Police Officers in the Implementation of Activities at the Scene of a Road Accident (project no. DOB-BIO9/06/01/2018). On the other hand, the second training solution presented in the article is the Emergency Vehicle Driving Simulator During Typical and Extreme Operations (project no. OROB 001101/ID/11/1). The mentioned projects were co-financed by the National Center for Research and Development as part of a competition for the implementation and financing projects in the field of scientific research or development work for the national defense and security.

KEYWORDS

security, the Police, new technologies, simulation systems, training, design

Introduction

The National Center for Research and Development, in consultation with the Minister of National Defense and the Minister of Internal Affairs, conducts activities related to research for the benefit of national security and defense. In competitions for specific research topics,

projects that promise to really increase national security to the greatest possible extent are financed. The objective of the programs and projects implemented is to enhance the potential of Polish scientific and industrial entities and strive for technological independence by creating Polish know-how in the field of critical technologies in the area of security and defense of the state.

The Police Commander in Chief has the power to create the subject of research or development works carried out as part of the tasks of the National Center for Research and Development (NCBiR), thus the Procedure for submitting and approving the subject of research and development works has been established in the Police [1]. Proposals of research topics are submitted for financing from the National Center for Research and Development funds for works in the area of national security and defense (BiO). At the Police Headquarters, research topics proposed by authorized Police organizational units are subject to initial formal assessment for completeness of the data provided. During this process, analyzes and consultations are also conducted aimed at optimal preparation of topics in terms of content and compliance of the reported issues with the scope of financing by the NCBiR. A collective list of topics is then prepared and submitted to the Chairman of the Scientific and Technical Council at the Police Commander in Chief. The Council decides on the topics of the BiO projects that will be presented at its forum. The purpose of the presentation is to familiarize the Council members with the proposed scopes of projects, eliminate errors, and indicate additional functionalities. Each of the proposed BIO project topics presented at the forum of the Scientific and Technical Council at the Police Commander in Chief is subject to individual assessment by all its members. The evaluation results determine the position of a given proposal on the list of projects recommended for implementation (the list submitted for decision and signature to the Police Commander in Chief) [2]. Similar rules have been introduced at the Ministry of Interior and Administration level, where the list of topics recommended by the Ministry is proposed by the Scientific and Technical Council appointed by the Minister of Interior and Administration.

The indicated procedure allows the Police to obtain the technology necessary, among others, to fight crime and train the desired skills in Police officers to allow them to carry out statutory tasks effectively. To meet the Polish Police's expectations in the field of research and development in the field of national defense and security, Polish scientific and industrial consortia actively participate in applying for the aforementioned NCBiR grants, having numerous successes in this area. The study aims to present new technologies (simulators) dedicated to the police education process of traffic police officers on the example of selected research and development projects [3].

The starting point for detailed considerations was to define the methods and scope of the research. The method used during the research was document analysis with the use of the qualitative analysis technique. In this method, the source data obtained from the project documentation of the Simulator Supporting the Training of Police Officers in the Implementation of Activities at the Scene of a Road Accident (project no. DOB-BIO9/06/01/2018) and the Emergency Vehicle Driving Simulator During Typical and Extreme Operations (project no. OROB 0011 01/ID/11/1) was analyzed. A distinct research limitation was the inability to present detailed descriptions of individual simulators in this study due to the reservations of intellectual property rights included in the contracts for the implementation and financing of the mentioned projects. Another method used by the author of the article was the analysis

and criticism of the literature, mainly the subject one, and specialist training programs for traffic police officers included in the Police Commander in Chief's decisions.

Traffic police training programs

Improving road safety requires many entities and institutions to carry out multi-directional activities aimed at systematic improvement of the road safety level [4]. The main tasks in this regard lie with the Police and focus on:

- traffic management and control (of the technical condition of the motor vehicle, the transport of dangerous goods, compliance with obligations or conditions of road transport, use of control and measurement instruments for speed measurement),
- preventing, combating, and conducting proceedings related to road traffic offenses,
- initiating and coordinating crime prevention programs and handling road incidents.

The indicated tasks determine the need for highly specialized staff who can be entrusted with performing activities when such events occur. The effectiveness of interventions and carrying them out following the Police procedures and principles requires the officers to continually improve their skills. Legal provisions and the technique and tactics of performing activities on the scene of a road accident are part of vocational training and professional development courses. Only systematic improvement allows mastering the right decision-making and carrying out effective and, most importantly, safe interventions. In the indicated scope, professional development is primarily organized in the form of specialist courses. Importantly, each Police officer, after completing basic training in further service, improves his/her professional qualifications by participating in numerous specialist courses. There are over one hundred such courses in the Police. The following can be mentioned as dedicated to traffic police officers:

- a specialist course in the field of road traffic – general part [5],
- a specialist course in the field of road traffic – special part [6],
- a specialist course for police officers performing activities at the scene of a road accident [7],
- a specialist course in the use of an infringement video recorder [8],
- a specialist course in the control of digital tachographs [9],
- a specialist course for traffic police officers in driving a road motorcycle [10],
- a specialist course in the use of manual speed meters [11],
- a specialist course in the field of improving the technique of driving a passenger car [12].

The programs of the specialist courses mentioned above were analyzed. Unfortunately, they did not contain the application of modern training forms with the participation of trainers, i.e., simulators. This situation is incomprehensible because the simulator for driving emergency vehicles during typical and extreme operations was officially put into use already in 2014. The official website of the Police wrote then: "The first classroom in the country equipped with police car driving simulators was opened at the Police Academy in Szczytno. It is here that police officers will perfect their driving skills in official cars. Thanks to two vehicles and three computer stations used for simulation, officers will be able to improve their skills in

chase driving, in a column, or during VIPs' protection. The official opening was made by the Police Commander in Chief, General Inspector Dr. Marek Działoszyński" [13].

An additional argument for the necessity to implement simulators to specialist training programs in the Police was the analysis undertaken by this formation, justifying the need for their application. That was reflected in the proposed topics for research and development projects concerning the construction of these simulators, submitted to the National Center for Research and Development. Two of them, dedicated to traffic police officers, are described in more detail later in the article.

Raising this issue is crucial as it shows a void between the desired state of affairs and the end result showing that traffic police officers still have not received a specialist training program at the central level, including training through the simulator commissioned in 2014. It is also vital because another simulator for traffic police officers is currently being built, described later in the study. It is hoped that mechanisms will be developed to make it possible to employ the built and those under construction simulators in the Police education process. It is related to the property rights specified in the contracts for the project execution and financing. Nonetheless, it happens that despite the goodwill of all parties to the contract, the transfer of rights to the simulators ordered by the Police does not take place. Indeed, the issue requires a broader look, which may contribute to its examination and presentation in subsequent studies.

Research and development works supporting the process of educating traffic police officers

Contemporary dangers in road traffic determine the Police's search for new, alternative training solutions, thanks to modern information technologies. An example is the *Emergency Vehicle Driving Simulator During Typical and Extreme Operations* [14]. The project aimed to create a comprehensive solution enabling the training of functionaries in driving emergency vehicles during typical and extreme operations [15]. The result of the project is a training system designed to improve various service officers' skills in driving emergency vehicles. Apart from perfecting the driving technique, the simulator enables driving training in simulated conditions of various threats (vehicle firing, "car-trap" explosion, tanker truck fire, and many others) and learning the tactical team driving for drivers going in a column or conducting pursuit and blockade activities. The simulations present groups of people and crowds of various numbers and a controlled, variable level of aggression, and unusual situations such as pedestrian's intrusion on the road, falling load, chase, or animals on the road. The system enables professional training of the personnel of crisis management entities. Thanks to the applied mathematical models and simulation methods, the system's reaction to decisions made by the participants is immediate and adequate to the situation. It is possible to practice various decision variants many times, which in consequence will allow for the staff's full preparation to fulfill tasks assigned to them, thereby creating potential of knowledge and experience in many areas that significantly exceeds the possibilities of conventional training [16].

Another project that is to be used in the process of educating traffic police officers is *Simulator Supporting the Training of Police Officers in the Implementation of Activities at the Scene of a Road Accident* [17]. The proposed system, due to the high level of detail and an extensive range of scenarios and variants tailored to the specific nature of the Police's operation, tactics

as well as police regulations and procedures in force in Poland, will be able to support the process of training and improving officers properly. A complementary training tool will allow practicing real-time events during the implementation of tasks with officers' participation in real places of interventions. The training conducted on this simulator will aim and maintain a high level of officers' training in developing correct reactions in the decision-making process during the implementation of a specific task. Such solutions will allow reflecting in the virtual world the computer training system scenarios of real actions undertaken by one or more Police (road traffic) officers. An essential element of such a solution is innovative technical solutions and adequately selected scenarios and variants of the course of the situation resulting from many years of experience of police officers.

The main objective of the project *Simulator Supporting the Training of Police Officers in the Implementation of Activities at the Scene of a Road Accident* is to build a simulator enabling the acquisition of practical skills to conduct activities on the scene of a road accident. The simulator should be a tool supporting the training of police officers of road traffic cells in performing activities on the site of typical and non-typical road incidents, such as mass accidents, land, air, and water traffic disasters, or other crises. The simulator will connect the virtual world with the real world through visualizing the road accident site for the trainees with the simultaneous possibility of performing official activities (inspection of the accident scene, documenting activities, providing first aid to road accident victims, etc.).

The simulation system will include the necessary elements of road infrastructure, including various types of road crossings, crossroads with tracks for rail vehicles, collision-free road junctions, tunnels, bridges, viaducts, crossings of rail vehicles: trams and railroads (guarded and unguarded), pedestrian crossings, bus stops, parking lots, maneuvering area, loading ramp, and airports. Besides, it will include a terrain database: highly urbanized (city center), suburban and industrial, high-mountain (roads with various degrees of inclination – long uphill and downhill roads and winding roads), highways, expressways, single and dual carriageway roads, roads with hardened and unpaved surfaces, and all road elements such as roadsides, pavements, crossings, tracks for rail vehicles, vertical and horizontal road markings, signs, traffic lights, and other traffic control elements. The system will enable the simulation of the behavior of road users, i.e., passenger cars, trucks and tractors with a semi-trailer, buses, tanker trucks (with their experimentally validated models of traffic dynamics), special-purpose vehicles, agricultural tractors, emergency vehicles, motorcycles, trams, trains, cyclists, pedestrians, wild animals of various sizes (deer, wild boar), and domestic animals (dog). It takes account of changing seasons (summer and winter conditions), time of the day (day, night, dawn and dusk), weather conditions (rain or snowfall, icing of the road surface as well as fog and smoke of various levels of intensity, speed and wind direction, etc.), and generating lighting for roads and vehicles.

The simulator will present the environment for the trainees with an image created using a high-quality projection system. A solution will be selected between projection systems on a flat, spherical, and cylindrical screen. They can be used interchangeably or at the same time at every stage of the exercise preparation, implementation, and evaluation. The instructor will be able to observe the course of the event and activities performed by the participants using 3D goggles, on the computer screen, or directly on the screen used by the participants. The projection system will be designed in such a way to minimize the probability of the trainees' simulator sickness. It will enable the simulation of road events and their real-time preview at

any time during the exercise and the visualization of the entire environment using 3D computer graphics (e.g., by providing an image through goggles that allow watching the digital world in a 360-degree image). Additionally, the participants must be able to perform any actions necessary to secure the place of the event and determine the course of the event. For this, IT, communication, and other tools (e.g., for measuring the braking distance of a vehicle) will be used. Besides, the system will enable reporting of the above activities on the documentation applicable in the Police, including forms, protocols, etc.

Another functionality of the system will be the ability to provide first aid to road accident victims. For this purpose, the system will be equipped with a set of rescue and training phantoms. They will make it possible to implement individually prepared scenarios, including ECG waveforms, and the entire management will be carried out remotely using a dedicated application.

The instructor will be able to prepare any road event scenarios and add any break-ins during the exercise, and thus diversify the level of difficulty. On the other hand, the trainees will be able to give orders to virtual participants controlled by the simulation system, e.g., ordering vehicles to be parked to participants of the event, securing the place by cooperating services, for example, the State Fire Service or medical rescue. After completing the exercise, the instructor will be able to recreate its course many times, observing it together with the trainees from any perspective. Additionally, the simulator will support the process of assessing the participant using an automatic assessment system, and will support the subjective assessment process performed directly by the instructor.

The simulator will be made under the international HLA standards[1]. It will create the possibility of connecting in the future the computer network of the system being built with other simulators operating in a shared virtual environment as part of the interoperability of simulation systems used in the training process by the Police. HLA is a general architecture for distributed computing systems, with an emphasis on simulation systems.

Testing the functionality of the trainers mentioned above shows that they are intended and used in the Police education system to improve the traffic police officers' competencies. Their construction is based on the design notifications of the administrator (design documents), in this case, the Police Commander in Chief. That shows a well-thought-out policy of retrofit-ting police schools with new training solutions. The assumption is correct. Unfortunately, for several years it has not found a positive solution in implementing the described technologies. In this regard, urgent regulations are required, which, it seems, were partially implemented in this year's competitions in the national defense and security of the National Center for Research and Development. However, the need to regulate property rights to pre-2019 project products remains unresolved.

Conclusion

Research and development work for the national defense and security, including safety and public order, performed by the Police initially covered mainly the area of forensic research. Due to limited funds, their development was not impressive. Research works, especially development works, gained real pace after creating the National Center for Research and Development. The Center supports commercialization and other forms of transfer of scientific

[1] Eng. High Level Architecture.

research results to the economy and the implementation of projects in national defense and security. These possibilities are widely used by the Polish Police, whose aim is to use the possessed scientific potential to create technical solutions, e.g., supporting the process of training their staff. The results of these projects include simulators. It should be emphasized that training people with the use of a simulator eliminates material losses and the risk of loss of life and health, which could be caused by an error resulting from the lack of a sufficiently high level of trainee's skills. Undoubtedly, the use of simulators in the training activities of the Police reduces the costs of the training. Unfortunately, as shown in the article, professional development programs at the central level dedicated to traffic police officers still do not take into account the possibility of increasing competences through simulators.

In addition to characterizing research and development projects, the effect of which are simulators intended for training traffic police officers, the article presents problems with their implementation into the police training and professional development system.

The first conclusion following the research is positive and concerns the construction of police trainers as expected in formation. This type of approach requires significant financial outlays, but Poland has found a way to implement it. A program dedicated to the ministry in charge of internal affairs was created, under which the above-mentioned scientific undertakings are financed. Another conclusion is related to the central authorities' perception of the training needs of Police functionaries, especially traffic police officers. Simulators are being developed as expected. Unfortunately, the last conclusion is not optimistic since the built police trainers are not always used for training needs - they are implemented in the police training system and professional development. The goal assumed in the introduction was achieved, however, the indicated competence problems preventing the adaptation of the simulators built in the training programs should constitute a contribution to further research and presentation of the problem in subsequent scientific studies.

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Conflict of interests

The author declared no conflict of interests.

Author contributions

The author contributed to the interpretation of results and writing of the paper. The author read and approved the final manuscript.

Ethical statement

The research complies with all national and international ethical requirements.

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Biographical note

Mariusz Nepelski – habilitated doctor of security sciences, professor at the Main School of Fire Service. Graduate of the War Studies University and the Police Academy in Szczytno. Retired Police Chief Officer; he served in executive and managerial positions in the preventive and criminal division. He focuses his research and scientific interests around the issues of internal security, especially public security (safety and public order) and general security (crisis management), including new technologies in security. He is an active participant in research and development projects. Author, co-author, and scientific editor of many publications devoted to the indicated subjects, published in Poland and around the world.

Policyjne systemy symulacyjne w procesie kształcenia policjantów ruchu drogowego

STRESZCZENIE Technologie wspomagające proces kształcenia kadr Policji obecnie stały się niezbędnym elementem infrastruktury policyjnych szkół. Głównym źródłem finansowania budowanych technologii jest Narodowe Centrum Badań i Rozwoju. Instytucja ta w porozumieniu z Ministrem Obrony Narodowej i Ministrem właściwym do spraw wewnętrznych prowadzi działania związane z badaniami na rzecz bezpieczeństwa i obronności państwa. W konkursach na konkretnie sprecyzowane tematy badawcze finansowane są przedsięwzięcia, które w największym stopniu rokują rzeczywiste zwiększenie bezpieczeństwa narodowego. Celem realizowanych programów i projektów jest nie tylko zwiększenie potencjału polskich podmiotów naukowych i przemysłowych, ale także dążenie do niezależności technologicznej poprzez tworzenie polskiego „know-how" w zakresie krytycznych technologii z obszaru bezpieczeństwa i obronności państwa. W artykule zostaną przedstawione technologie wspomagające proces szkolenia funkcjonariuszy ruchu drogowego, które zostały wytworzone przez polskie konsorcja naukowo-przemysłowe. Pierwszym prezentowanym trenażerem jest Symulator wspomagający szkolenie policjantów w realizacji czynności na miejscu zdarzenia drogowego (projekt nr DOB-BIO9/06/01/2018). Natomiast drugim rozwiązaniem szkoleniowym przedstawionym w artykule jest Symulator kierowania pojazdami uprzywilejowanymi podczas działań typowych i ekstremalnych (projekt nr OROB 001101/ID/11/1). Wskazane projekty były współfinansowane przez Narodowe Centrum Badań i Rozwoju w ramach konkursu na wykonanie i finansowanie projektów w zakresie badań naukowych lub prac rozwojowych na rzecz obronności i bezpieczeństwa państwa.

SŁOWA KLUCZOWE bezpieczeństwo, Policja, nowe technologie, systemy symulacyjne, szkolenie, projekt

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