THE METHODOLOGY TO EVALUATE A RESCUE AND TRAINING PHANTOM FOR THE ROAD RESCUING ORGANIZED BY POLICE OFFICERS AS EXEMPLIFIED BY CRASH KELLY

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Resume

The paper presents a methodology to evaluate a rescue and training phantom for road rescuing organized by Police officers. The methodology is exemplified by the Crash Kelly phantom, static and dynamic functionalities of which seem to be more frequently implemented in the road safety training processes. It stems from a morphological analysis, focusing on the quality of rescue activities, emergency resources' adequacy and the training levels. In addition, experts' evaluation allows to examine phantoms using 6 practically determined criteria, expressing their strengths and weaknesses in analysed context.

The results introduce Crash Kelly as a reference training equipment for Police officers dedicated to rescue victims after the road accidents. Basing on the research results, practical training guidelines are formulated.

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1 Introduction

According to the World Health Organisation (WHO), approximately 1.35 million people die in road accidents on a yearly basis, while the relevant economic effects of such ones, in the case of the majority of states, consume as much as 3% of their Gross Domestic Products (GDP) [1]. The Sustainable Development Goals (SDGs), set forth by the United Nations Organisation (UN), address the aforementioned factors as they refer, among others, to the provision of life in health and the promotion of prosperity (SDG3), the erection of resistant infrastructure, promotion of common and sustainable industrialization and development of innovations (SDG9), as well as making the cities accessible, safe, resistant and developed in a sustainable manner (SDG11) [2-3]. Their interpretation remains under the influence of progressive enhancement of transportation in developing countries [4].

One of the practical measures to reduce the risk of road accidents (the risk understood as a road safety level factor [5-7] and an indirect implementation of the SDGs) includes educational activities - directed towards the commonly enhanced awareness of the rules of conduct in the case of road accidents (including the first aid), as well as training actions dedicated to such services, which professionally handle adverse events.

While focusing on the latter case, it should be underlined that the said trainings include predominantly emergency response teams and the units of the fire service (in Poland, such ones being included into the State Firefighting Rescue System - SFRS). They are undoubtedly associated with providing medical assistance in the case of road accidents. Bearing in mind the following context, training activities dedicated towards Police officers, a subsequent link (apart from the emergency response teams and the fire service units) to complement the question of the so-called first responders, constitutes a theoretical and practical gap. The said groups of entities react as first when human lives and health are jeopardised. The importance of the previously mentioned gap has been underlined by the implementation of the project financed by the National Centre for Research and Development in Poland, entitled "A simulator to support the training for Police officers in performing the actions at the scene of a road accident (No DOB-BIO9/06/01/2018 [8-9]). The main objective of the project included development of a simulator, which would make it possible to obtain practical skills to carry out the actions at the scene of a road accident. It has been assumed that the simulator in question ought to support the training process for Traffic Police officers with regards to typical and non-typical situations (e.g. mass events, supporting the emergency units) and combine virtual and real worlds. The key element of the said combination was to implement the rescue and training phantoms into the

training process dedicated to Police officers.

The following article presents partial outcomes of the designing works described as the products of the project no I.2 *The Technical and operational requirements for the module responsible for the implementation of 3 rescue and training phantoms into the didactic process* [10] as well as number III.6 entitled: *The Report on the examinations over the module responsible for the implementation of 3 rescue and training phantoms into the didactic process* [11]. They refer to the methodology used to evaluate the rescue and training phantoms for the road rescuing organized by Police officers.

Due to the practicality of its application in the course of the training process, with an intention to maximize its realism, the methodology has been realized with the rescue and training phantom of Crash Kelly type as an example. The examinations were carried out within the period between February-June 2020 by the experts team from the Main School of Fire Service in Warsaw (Poland) (MSFS).

The findings obtained throw light on capabilities and implementation range for the evaluated phantom with regards to the training process intended for Police officers worldwide, based on the commonly available training equipment and reference scenarios of road accidents.

2 Methodology

2.1 Formulation of the examination scenarios

Formulation of the examination scenarios constitute the first stage in implementation of the methodology for evaluation of the rescue and training phantom within the analysed context. As assumed, they will allow to present idealized fragments of the reality, which could serve as the background in the training processes for Police officers devoted to providing the first aid under the circumstances of road accidents. The scenarios themselves can come in great numbers [12]. Close links to the real conditions of the state of emergency, corresponding to formal requirements, are desirable from a practical perspective [13] and allow to limit the scenario quantity and their variants to the optimal level.

Basically, the examination scenarios ought to be formulated based on the regulations, which impose the norms over the issue of medical assistance provision by Police officers in road incidents. Hence, they must include the wording of the following documents:

1. The Act dated 24th August 1991 on fire protection (i.e. the Journal of Laws from the year 2020, item. 961).
2. The Act dated 8th September 2006 on the State Medical Rescue Service (i.e. the Journal of Laws from the year 2020, item. 882).
3. Enactment of the Minister of Internal Affairs dated 3rd July 2017 on the detailed organization of the State Firefighting Rescue System (Journal of Laws from the year 2017, item 1319)
4. Ruling no 36 of the Police Commander in Chief dated 14th November 2017 regarding the tasks to be carried out by the Police in emergency situations (Journal of Laws of the Police Headquarters from the year 2017, item 73)
5. Decision no 168 of the Police Commander in Chief dated 22nd May 2019 on the basic vocational training programme (Journal of Laws of the Police Headquarters from the year 219, item 83)
6. Decision no 472 of the Police Commander in Chief dated 18th November 2013 regarding the traffic specialist course programme - general part (Journal of Laws of the Police Headquarters, item 95, from the year 2014, item 61 and from the year 2017, item 83)
7. Decision no 229 of the Police Commander in Chief dated 27th July 2016 regarding the syllabus for the specialist course on the provision of the first aid (Journal of Laws from the year 2016, item 35)
8. The principles for the organization for medical rescuing within the national rescue and fire system. Headquarters of State Fire System, Warsaw 2013.

The outcomes of the analysis, with regards to the aforementioned normative documents, make it possible to get acquainted with the permissible, proper circumstances, the range and manners of operations. They additionally ameliorate to define the factors, which determine the formulation of examination scenarios, while respecting the quality of actions taken with regards to medical assistance, the level of trainings received by Police officers, as well as the adequacy of resources at disposal for the said formation at the scene of an incident. Figure 1 demonstrates their morphological recognition.

One of the factor groups seems to have the strongest impact over the formulation of scenarios under the examined context in quantitative approach. This includes the degree of adequacy for Police resources, which arrive at the scene of an event. Taking such one into account makes us consider three predominant variants of scenarios:

1. Single event variant - during which one person being a participant of the event was injured.
2. Numerous event variant - when more than one injured person was registered, however the total number of casualties does not exceed capabilities of resources from safety entities being on site (including the Police).
3. Mass event variant - if more than one injured person was registered and the total number of casualties exceeds capabilities of resources from the safety entities being on site (including the Police).

2.2 Analysis of the phantom functionality

The formulation of examination scenarios shall determine the general frameworks for examinations

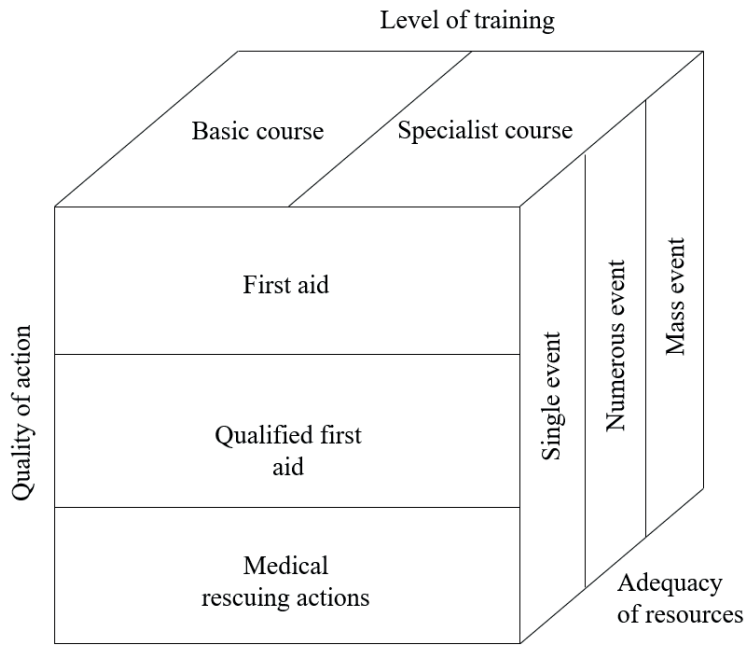

Figure 1 *Morphological recognition of factors that determine the formulation of examination scenarios*

of the rescue and training phantom. It has been assumed to be relatively detailed as far as its wording is concerned. Its adjustment to the real conditions remains indispensable, bearing in mind the operationalization of the training process for the Police officers. Hence, the analysis of the rescue and training phantom functionality ought to constitute a consecutive step in the methodology. It will provide a detailed description of the technical constraints for the training process.

Based on the peculiarities of the training process in the first aid, the functionalities of the rescue and raining phantom may be divided into the following categories:

1) Static functionalities,
2) Dynamic functionalities.

The static functionalities are related to an invariant character of the equipment location and position during the implementation of the didactic process. They refer to modifications in the phantom design and the degree to which a body position of an injured person has been represented. They are demonstrated by a system of joints and soft parts of the rescue and training phantom, which determine the mobility ranges for the head and limbs.

On the other hand, the dynamic functionalities are related to the range within which the location and position of equipment during the didactic process can be altered. They refer to a possibility of simulation for emergency response evacuation, as well as placing and sitting the phantom in an optimal position due to rescuing actions to be performed.

Both of the types determine practical capabilities for using the training equipment. They may limit the original number of examination scenarios only to such ones, which will be technically viable.

2.3 Evaluation methods for the phantom functionalities

Bearing in mind the authors' experience in rescuing operations, as well as the outcomes of the hitherto completed designing works, it has been stated that functionalities of the rescue and training phantom should be considered from the perspective of its static and dynamic equivalents. As it has been mentioned already, the first case includes the questions related to an invariant character of the equipment location and position, while implementing the training process in contrast to the latter group of functionalities.

Due to the peculiarities in the training for Police officers, regarding the first aid provided in road incidents, static functionalities include:

1) S1: the degree to which an injury is represented;
2) S2: the degree to which a body position of an injured person is represented.

The degree of an injury representation means the phantom's potential to realistically visualize the effects of a road incident over an injured person - the effects conditioned by a precise examination scenario and determining the necessity to take up the relevant rescuing actions. The degree to which an injury is represented may be evaluated in line with a check list, considering the levels of an injury representation degree set forth by Table 1.

The degree to which a body position of an injured person is represented means the compliance of the road incident effect translating into the said person's position found - the position in which the phantom should be placed when the rescuing actions are commenced (directly after the Police officers have appeared at the scene of a road incident).

Table 1 *The levels for evaluation of an injury representation degree*

criterion level	description of meanings for an evaluation criteria having been met
1	The lack of realism in the injury representation with reference to given conditions of an examination scenario. Phantom's usage ought to be limited to being a teaching aid of the situational background.
2	The phantom represents an injury with reference to given conditions of an examination scenario to a degree that allows for it to be used as a teaching aid with noticeable support from an instructor (real aid in performing the recuing actions).
3	The phantom represents an injury with reference to given conditions of an examination scenario to a degree that allows for it to be used as a main teaching aid with the minimum support from an instructor (coordination of the rescuing actions performance)
4	The phantom represents an injury fully with reference to given conditions of an examination scenario. It may be used to perform full simulation of the sequencing for the rescuing action required under given circumstances.

Table 2 *The levels for evaluation of a body position of an injured person representation*

criterion level	description of meanings for an evaluation criteria having been met
1	The lack of realism in representation of a body position for an injured person with reference to given conditions of an examination scenario. Phantom's usage ought to be limited to being a teaching aid of the situational background.
2	The phantom represents a body position of an injured person with reference to given conditions of an examination scenario to a degree that allows for it to be used as a teaching aid with noticeable support from an instructor (real aid in performing the recuing actions)
3	The phantom represents a body position of an injured person with reference to given conditions of an examination scenario to a degree that allows for it to be used as a main teaching aid with the minimum support from an instructor (coordination of the rescuing actions performance only)
4	The phantom represents fully a body position of an injured person with reference to given conditions of an examination scenario.

Table 3 *The evaluation levels for representation of the possibility to transfer from a danger zone to a safe zone*

criterion level	description of meanings for the evaluation criterion having been met
1	The lack of possibility to transfer the phantom from a danger zone to a safe zone.
2	A possibility to transfer the phantom from a danger zone to a safe zone with the lack of possibility to continue the rescuing actions within a simulation.
3	A possibility to transfer the phantom from a danger zone to a safe zone while the continuation of rescuing actions is secured once the phantom has been prepared for the simulation again.
4	A possibility to transfer the phantom from a danger zone to a safe zone while the continuation of rescuing actions is secured without further delay.

The degree to which a body position of an injured person represented may be evaluated in line with a check list, considering the levels of a body position of an injured person representation degree set forth by Table 2.

Due to peculiarities in the training for Police officers, regarding the first aid provided in road incidents, dynamic functionalities include:

1) D1: the degree to represent the possibility to transfer from a danger zone to a safe zone (as understood by emergency response evacuation)
2) D2: the degree to represent the possibility to place in the position suitable to provide the first aid
3) D3: the degree to represent the realism of rescuing actions execution
4) D4: the degree to represent the possibility to alter the phantom's position while providing the first aid.

The degree to represent the possibility to transfer from a danger zone to a safe zone ought to be analysed, while bearing in mind the necessity to carry out the emergency response evacuation for an injured person from the place where they have been found within a danger zone due to the life-threatening circumstances having been detected. This implies the promptness of evacuation activities including the transfer of the phantom from one place (associated with the danger zone) to another spot (understood as the location of the safe zone or a place within such one). The evaluation of the representation degree may be performed by means of a check-list, taking into consideration the degrees of the relevant representation set forth by Table 3.

The degree to represent the possibility to place in the position suitable to provide the first aid ought to be associated with the potential to represent the commonly applied rescue positions (e.g. recovery position, supine position) and the position in which an injured person has been found. In any case, the necessity to stabilize the injured person's cervical spine must be assumed.

Table 4 *The evaluation levels for the representation degree of the possibility to place in the position suitable to provide the first aid*

criterion level	description of meanings for the evaluation criterion having been met
1	The lack of a possibility to place the phantom in the position suitable to provide the first aid.
2	A possibility to place the phantom in the position suitable to provide the first aid without a possibility to transfer the phantom from a danger zone to a safe zone, even having previously prepared it for transportation.
3	A possibility to place the phantom in the position suitable to provide the first aid with a possibility to transfer the phantom from a danger zone to a safe zone having prepared it for transportation beforehand.
4	A possibility to place the phantom in the position suitable to provide the first aid and a possibility to transfer the phantom from a danger zone to a safe zone.

Table 5 *The evaluation levels for the representation degree of the realism to perform rescuing actions*

criterion level	description of meanings for the evaluation criterion having been met
1	Rescuing actions are performed arbitrarily only.
2	Rescuing actions are performed in a simplified manner resembling its real counterpart only functionally.
3	Rescuing actions are performed in line with the procedures and are represented in a quasi-real manner.
4	Rescuing actions are performed in line with the procedures and represented in a real manner.

Table 6 *The evaluation levels for the representation degree of a possibility to alter the phantom's position while performing the first aid*

criterion level	description of meanings for the evaluation criterion having been met
1	The lack of a possibility to alter the phantom's position while providing the first aid.
2	A possibility to alter the phantom's position while providing the first aid and the lack of possibility to continue the performance of rescue actions within a simulation.
3	A possibility to alter the phantom's position while providing the first aid with the continuation of recue action performance having prepared the phantom for the simulation again.
4	A possibility to alter the phantom's position while providing the first aid with immediate continuation of rescue action performance.

Evaluation of the representation degree for the possibility to place in the position suitable to provide the first aid may be performed by means of a check-list, taking into consideration degrees of the relevant representation set forth by Table 4.

The degree to represent the realism of rescuing action execution constitutes one of the most important evaluation parameters as it impacts directly the effectiveness of the entire didactic process including the first aid implemented by Police officers. The said realism should be demonstrated by the required compression force of the chest and respiratory resistance during the CPR, the inertia of individual phantom components during its transposition, characteristics of various injuries, application of various types of dressing and stabilizations, as well as by other questions that could contribute to the realism of the simulation with the use of the phantom. The evaluation of the representation degree for the realism of rescuing action execution may be performed by means of a checklist, taking into consideration the degrees of the relevant representation set forth by Table 5.

Altering the phantom's position while providing the first aid may be determined by the necessity to perform the preliminary examination, to place it in the position suitable to provide the first aid, to introduce a temporary change in the assumptions for the didactic process scenarios as well as the necessity to retake the rescue actions or the sequences of such ones. In any of the said cases, the phantom ought to keep injury simulations in place together with dedicated dressings and stabilizations. Evaluation of the representation degree for a possibility to alter the phantom's position while providing the first aid may be performed by means of a check-list, taking into consideration the degrees of the relevant representation set forth by Table 6.

3 Examination outcomes

3.1 Examination scenarios

The relevant scenarios remain the background for the examinations as they represent the reference circumstances during which the Police officers provide medical assistance in the road accidents. They have been formulated based on the analysis of the normative documents, based on the circumstances set forth therein, the range and the manner of action, respecting the requirements regarding the quality of actions in medical

aid imposed by such ones and the level of training received by the Police officers, as well as the adequacy of Police resources at the scene of an event [10-11]. Combined with the operational experience demonstrated by the MSFS staff, the following examination scenarios have been formulated:

1) Scenario 1 - while driving a car within an urban area, a vehicle driver sustained a heart attack, during which he pulled down on a pavement located directly at the street along which he was driving. Some passers-by of different ages (children and adults) were at the pavement. There was one passenger (an adult) in a car, apart from the driver.

a) Variant 1.1. - Police officers are the witnesses of the road incident. There are no victims among the passer-bys (the passenger and the people on the pavement). The injured person (the driver) - an adult person, unconscious, breathing maintained, cardiac arrest. A single road incident, served by one Police patrol, without any support from other safety entities.

b) Variant 1.2. - Police officers are the first representatives of the safety units at the scene of a road incident. Except for an emergency call, the witnesses have not provided any assistance to the injured persons. The first of them, the driver, is an adult, unconscious, cardiac arrest, respiratory arrest. The other injured person (the only pedestrian being present at the scene of the event, hit by a vehicle while stopping), an adult, conscious, broken lower limb, contused wounds of the lower and upper limbs. A numerous road incident, served by one Police patrol, without any support from others safety entities.

c) Variant 1.3. - Police officers are the first representatives of the safety entities at the scene of a road incident. The first injured person (the driver) is an adult, unconscious, respiratory and cardiac arrest. The other injured person (a pedestrian hit by a vehicle driven by the incident perpetrator), a child, conscious, broken lower limb, contuse wounds of the lower and upper limbs. The third injured person (a passenger), an adult, conscious, injuries of the chest and broken nose (nose bleeding due to hitting a dashboard with the head as he had his seatbelts unfastened), cognitive shock. A mass road incident served by one Police patrol, without any support from other safety entities.

2) Scenario 2 - while going by a 5-seat car outside the urban area (national road), there were 6 persons inside the vehicle (the driver and 5 passengers). The passengers aged 16-19 years old, under the strong influence of alcohol and turned aggressive towards one another. Uncontrolled movements from the passengers made the driver lose control over the vehicle.

a) Variant 2.1. - Police officers are the witnesses of the road incident including the vehicle skidding. While attempting to control the skid by the driver, one of the rear door opened and one person fell out of the vehicle. There are no victims among the passer-bys. The injured person (a passenger) is an adult, unconscious, breathing and blood circulation maintained, limb scratches. A single road incident served by two Police patrols, without any support from other safety entities.

b) Variant 2.2. - Police officers are the first representatives of the safety entities at the scene of a road incident including vehicle's going off the road and bumping into a tree located at the hard shoulder. The first injured person (the driver) is an adult, unconscious, respiratory and cardiac arrest, open fracture of the lower limb. Another injured person (the passenger taking the front seat), an adult, unconscious, breathing and blood circulation maintained, penetrating injury of the chest. Two injured persons (passengers), under-aged, in cognitive shock. Numerous road incident, served by two Police patrols, without any support from other safety entities.

c) Variant 2.3. - Police officers are the first representatives of the safety entities at the scene of the road accident - a head-on collision of a car with six passengers with another car approaching from the opposite direction, having 4 passengers on-board (two adults and two children). The first injured person (the driver of the vehicle with 6 passengers), an adult, unconscious, respiratory and cardiac arrest, another injured person (the driver of the vehicle with 4 passengers), an adult, unconscious, open fracture of the lower limb, cardiac and respiratory arrest. Other participants in the incident in a cognitive shock. Mass road incident, served by two Police patrols, without any support from other safety entities.

3) Scenario 3 (variant 3.0.) - While riding a two-wheeled vehicle (a motorcycle) outside the urban area (a provincial road through the forest), the driver and the passenger sustained a health impairment due to a collision with a deer running across the road. Police officers are dispatched to support an emergency response team. There are no victims among the passer-bys or outsiders. The first injured person (the driver) is an adult, conscious, breathing and blood circulation maintained, fractures of the lower limbs, contused wounds. The other injured person (the passenger), an adult, unconscious, cardiac and respiratory arrest, open fracture of the upper limp, contused wounds of the upper and lower limbs.

4) Scenario 4 (Variant 4.0.) - Difficult external conditions (mist, wet roadway, night) contributed to a multiple crash on the national road involving 4 cars. One of the vehicles caught fire due to the crash and fuel line breaching. Consequently, an emergency response team, 2 units of the NEFS and

Figure 2 *Preview image of the Crash Kelly-type phantom (courtesy of ETC-PZL Aerospace Industries Co. Ltd.)*

2 Police patrols were dispatched to the scene as the first rescue line. Police officers are dispatched to support the emergency response team and two NEFS units. There are no victims among the passer-bys. The first injured person (the driver of the car in fire) is an adult, unconscious, cardiac and respiratory arrest, the second-degree burns of the upper limbs. The second injured person (a passenger of the car in fire), an adult, unconscious, the second-degree burns of the face, cardiac and respiratory arrest. Additionally, 4 injured persons - participants of the incident (drivers and passengers of the other vehicles) are adults, conscious, with contused wounds, as well as one injured person, a child, unconscious, cardiac and respiratory arrest.

3.2 Functionalities of the Crash Kelly phantom

The Crash Kelly-type phantom constitutes a very common didactic aid due to the physical representation of human body - the representation reaching the degree to meet the didactic requirements regarding the first aid, qualified first aid and medical rescuing actions to be performed under the circumstances of a road incident, to name just a few its features. In comparison to other types of phantoms, its fitness for the purpose results from the offered possibilities to simulate a wide spectrum of scenarios, including, both, cardiac pulmonary resuscitation (CPR) and also related to repositioning of an injured person, as well as the performance of other rescue actions.

Figure 2 shows an image of the Crash Kelly -type phantom.

In line with the manufacturer's manual, the Crash Kelly-type phantom is intended to acquire skills regarding oral intubation, nasal intubation, finger intubation, EOA/PTL intubation, intubation by Combitube® breathing tube, intubation of the right main bronchus, insertion of the oropharyngeal tube, "ambu bag - valve-mask" ventilation, suctioning techniques, sensing the carotid pulse, extracting the injured person as well as basic principles for patient's transportation [14].

Based on the training performed, the following static functionalities of the Crash Kelly phantom have been identified:

1. Within the modification of the phantom construction:
a) non-injectable thigh pads (right and left) allowing to simulate open fracture of the femur, as well as a foreign matter in the thigh,
b) replaceable foot module with visualization of a crush wound with traumatic amputation of the little toe,
c) foot attachment with visualization of toes' crush wound,
d) replaceable crus module with the visualization of a tibia contused wound,
e) non-injectable forearm pad allowing to simulate an open fracture,
f) replaceable palm module with the visualization of a finger and metacarpus crushing,
g) replaceable palm and forearm module with visualisation of the I, II and III degree burns,
h) rubber attachment for a forearm and palm with visualisation of the I, II, III degree burns,
i) rubber attachment for a torso with the visualization of the marks after safety belts,
j) rubber attachment for a torso with visualisation of the wound dehiscence marks,
k) rubber attachment for the head with visualisation of a foreign matter intrusion,
l) a possibility of wound staging,
2. with reference to a simulated body positions of an injured person:
a) a possibility to be placed at the driver's seat with the head tilted forward,
b) a possibility to be placed at the driver's eat with the head tilted backward slightly,
c) a possibility to be placed on the floor in an upright position,
d) a possibility to be placed on the floor in a rear support position,
e) a possibility to be placed on the floor in a front-

supported position,

f) a possibility to be placed on the floor in a non-physiological position.

In the course of the training completed, the following dynamic functionalities of the Crash Kelly phantom have been identified:

1. a possibility to apply Rautek's grip in its version with partial head stabilisation,
2. a possibility to apply Rautek's grip in its version without the head stabilisation,
3. a possibility to simulate the stabilisation of cervical spine with the sitting position of an injured person (e.g. inside the car), without the need to reposition an injured person outside the vehicle involved in a road incident,
4. a possibility to tilt the head back in order to clear the upper respiratory tract and to simulate the protection of the said section against additional injuries by the manual stabilization of the injured person's head,
5. a possibility to push the lower mandible upwards,
6. a possibility to perform simplified CRP with organoleptic verification of the ventilation effectiveness,
7. a possibility to alter the phantom's position while providing the first aid (the system of joints and the limbs),
8. dimensions and weight necessitating the performance of selected medical assistance actions by more than one person.

All the static and dynamic functionalities directly influence the adequacy of the Crash Kelly-type phantom with regards to the training expectations.

3.3 Outcomes of the functional evaluation

Bearing in mind the extents to which Police officers perform rescue actions and the conditions corresponding to individual examination scenarios, the following phantom's functionalities have been defined, required with reference to such scenarios:

1) Within scenario 1:
a) for Variant 1.1.:
- W1.1.-U1: Stabilisation of the cervical spine of an injured person remaining inside a car.
- W1.1.-U2: Preliminary examination of an injured person remaining inside a car.
- W1.1.-U3: Physical repositioning of an injured person remaining inside a car from the vehicle (or its mock-up) to the final destination, where the first aid will be provided.
- W1.1.-U4: Stabilisation of the cervical spine of an injured person, as well as the CPR.
- W1.1.-U5: Moving an injured person to a spine board.

b) for Variant 1.2.:
- W1.2.-U1: Stabilisation of the cervical spine of an injured person remaining inside a car.
- W1.2.-U2: Preliminary examination of an injured person remaining inside a car.
- W1.2.-U3: Physical repositioning of an injured person remaining inside a car from the vehicle (or its mock-up) to the final destination, where the first aid will be provided.
- W1.2.-U4: Stabilisation of the cervical spine of an injured person as, well as the CPR W1.2.-U5: Stabilisation of a broken limb.
- W1.2.-U6: Dressing the wounds.
- W1.2.-U7: Moving an injured person to a spine board.

c) for Variant 1.3.:
- W1.3.-U1: Stabilisation of the cervical spine of an injured person remaining inside a car.
- W1.3.-U2: Preliminary examination of an injured person remaining inside a car.
- W1.3.-U3: Physical repositioning of an injured person remaining inside a car from the vehicle (or its mock-up) to the final destination, where the first aid will be provided.
- W1.3.-U4: CPR.
- W1.3.-U5: Stopping the haemorrhage.
- W1.3.-U6: Moving an injured person to a spine board.

2) Within Scenario 2:
a) for variant 2.1.:
- W2.1.-U1: Stabilisation of the cervical spine.
- W2.1.-U2: Preliminary examination of an injured person.
- W2.1.-U3: Dressing the wounds.
- W2.1.-U4: Placing in a supine position in order to secure thermal comfort.
- W2.1.-U5: Periodical evaluation of the injured person's state.
- W2.1.-U6: Moving an injured person to a spine board.

b) for Variant 2.2.:
- W2.2.-U1: Stabilisation of the cervical spine.
- W2.2.-U2: Preliminary examination of an injured person.
- W2.2.-U3: Stabilisation of cervical spine and CPR.
- W2.2.-U4: Stabilisation of a broken limb with simultaneous stabilization of the driver's cervical spine.
- W2.2.-U5: Dressing the wounds (open fracture of the lower limb) and monitoring of the injured driver's state.
- W2.2.-U6: Monitoring of the injured driver's state.
- W2.2.-U7: Moving the injured driver to a spine board.

c) for Variant 2.3.:
- W2.3.-U1: Preliminary examination of the injured driver.
- W2.3.-U2: Physical repositioning from the vehicle (or its mock-up) to the final destination, where the first aid will be provided.

Table 7 *Outcomes of examinations for scenario elements*

	S1	S2	D1	D2	D3	D4
W1.1.-U1	4	4	4	3	4	4
W1.1.-U2	3	3	4	3	2	4
W1.1.-U3	4	4	4	4	3	3
W1.1.-U4	3	3	4	3	3	4
W1.1.-U5	4	4	4	4	3	4
W1.2.-U1	4	4	4	3	4	4
W1.2.-U2	3	3	4	3	2	4
W1.2.-U3	4	4	4	4	3	3
W1.2.-U4	3	4	4	3	3	4
W1.2.-U5	3	2	3	3	3	4
W1.2.-U6	4	3	3	3	3	3
W1.2.-U7	4	4	4	4	3	4
W1.3.-U1	4	4	4	3	4	4
W1.3.-U2	3	3	4	3	3	4
W1.3.-U3	4	4	4	4	3	3
W1.3.-U4	3	3	3	3	3	3
W1.3.-U5	4	4	3	3	3	3
W1.3.-U6	4	4	4	4	3	4
W2.1.-U1	4	4	4	3	4	4
W2.1.-U2	3	3	4	3	3	4
W2.1.-U3	4	4	3	3	3	3
W2.1.-U4	4	4	3	4	3	4
W2.1.-U5	2	4	4	4	2	4
W2.1.-U6	4	4	4	4	3	4
W2.2.-U1	4	4	4	3	4	4
W2.2.-U2	3	3	4	3	3	4
W2.2.-U3	3	3	3	3	3	3
W2.2.-U4	2	3	3	3	3	3
W2.2.-U5	2	4	4	3	3	3
W2.2.-U6	2	4	4	3	2	4
W2.2.-U7	4	4	4	4	3	4
W2.3.-U1	3	3	4	3	3	4
W2.3.-U2	4	4	4	4	3	3
W2.3.-U3	3	3	3	3	3	3
W2.3.-U4	4	4	4	4	3	4
W3.0.-U1	4	4	4	3	4	4
W3.0.-U2	3	4	3	3	3	3
W3.0.-U3	2	4	4	3	2	4
W3.0.-U4	4	4	4	4	3	4
W4.0.-U1	3	4	3	3	3	4
W4.0.-U2	3	4	3	3	3	3

- W2.3.-U3: CPR.
- W2.3.-U4: Moving the injured driver to a spine board.

3) Within Scenario 3 (for Variant 3.1.):

- W3.0.-U1: Stabilisation of the cervical spine.
- W3.0.-U2: Dressing the wounds.
- W3.0.-U3: Current monitoring of the injured driver's state.
- W3.0.-U4: Moving the injured driver to a spine board.

4) Within Scenario 4 (for Variant 3.1.):

- W4.0.-U1: Dressing the burns.

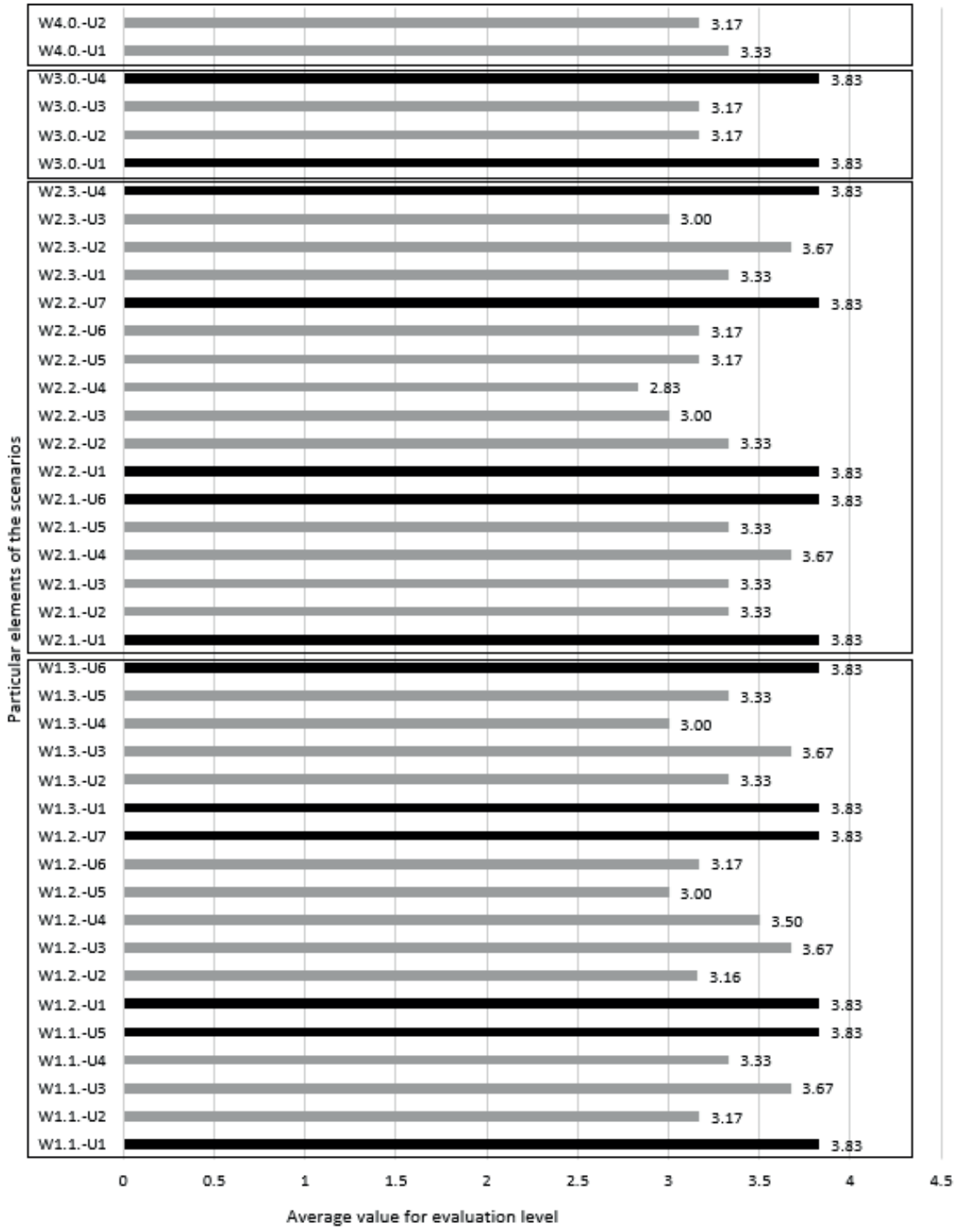

Figure 3 *Average values of evaluation level for particular elements of scenario, considering all the static and dynamic functionalities*

- W4.0.-U2: Dressing the wounds.

Subsequently, individually defined phantom's functionalities, required with reference to individual examination scenarios, have been seen in relation to individual reference functionalities. This allowed to achieve the Crash Kelly phantom functionality evaluation matrix within the context subjected to analysis. The evaluation has been performed in the course of two training sessions. Table 7 demonstrates their outcomes.

The phantom capabilities and the implementation range in the context of particular scenarios elements can be expressed by arithmetic averages of evaluation levels for particular scenario elements, considering all the static and dynamic functionalities. The values are presented in Figure 3.

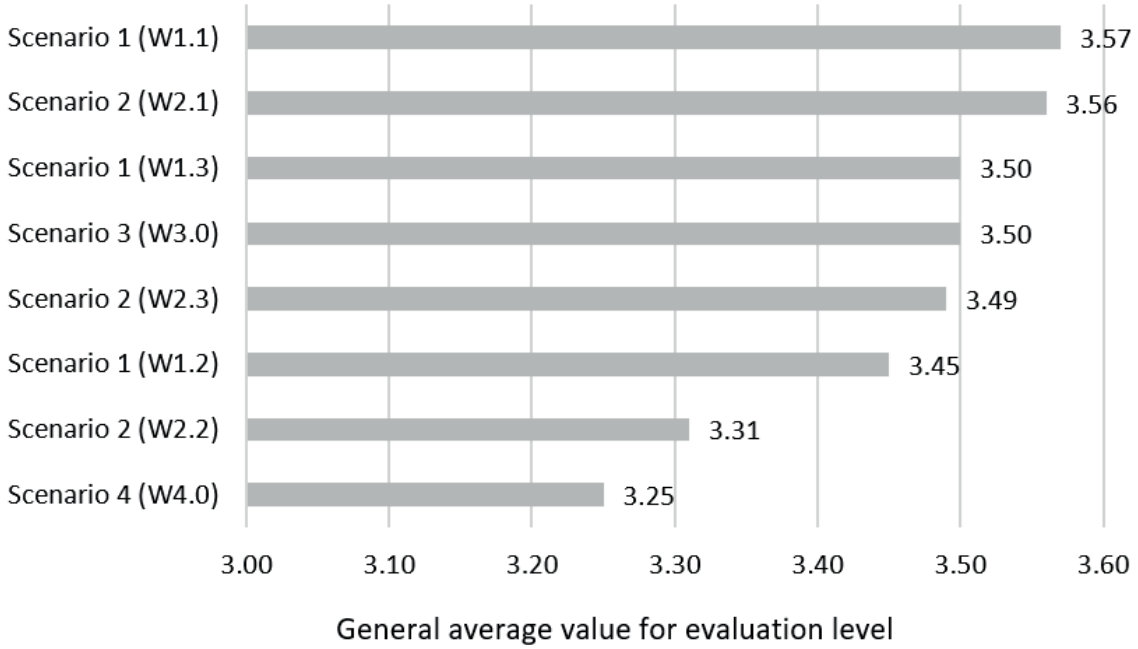

Figure 4 *General average values of evaluation level for particular variants of scenarios, considering all the static and dynamic functionalities*

The brackets indicate elements ascribed to particular scenarios. The black columns mean the highest calculated average values of evaluation levels for the scenario elements.

One can notice the highest usability of the phantom for activities, which begin and finalize the rescue procedure. There are stabilisation of the injured driver (also inside the car) and moving him/her from the danger zone with use of the spine board. This reflects the phantom elements (head, torso, legs and arms) and its general specification (weight, size, movement possibilities). In addition, in these cases the phantom is desirable as an independent didactic mean.

The lowest usability is observed in the case of stabilisation of a broken limb, stabilization of the driver's cervical spine and CPR. The first two are consequences of the phantom functional movement limitations in elbows and neck. The third one stems from the Crash Kelly's only general adaptation to CPR. In these cases, the phantom cannot be the only one didactic mean during road safety trainings. One may even consider eliminating it from the training support at these rescue procedure steps.

Other values express relatively balanced implementation ranges for particular scenarios elements, which are understood as the rescue procedure steps. They show the steps when the phantom should or could be supported by other didactic means and manners as well as directly by the trainer.

Taking into account all the outcomes of the examinations allows to present a general arithmetic averages of evaluation levels for particular scenarios variants, considering all the static and dynamic functionalities. They are presented in Figure 4.

Three groups of scenarios can be enumerated. The first one is characterised by the highest general average values of evaluation level and regard W1.1. and W2.1. The second group is comprised by W1.3., W3.0., W2.3. and W1.2. They present the lower values for evaluation levels. W2.2. and W4.0 constitute the last group, with the lowest values. Nevertheless, there are small differences in values inside and between the groups. This indicates that phantoms can be implemented in all of the scenarios. Detailed implementation manners should correspond to the previously described results for particular scenarios elements (see Figure 3).

4 Conclusions and training recommendations

The high degree of usefulness in the didactic process, regarding the provision of the first aid by Police officer in the case of road incidents, has been reported for the Crash Kelly phantom. The said equipment can be applied in all the examination scenarios. Its usefulness refers to all the variants within the aforementioned scenarios. The Crash Kelly phantom bears a great value when being implemented with reference to such rescue actions like stabilization of an injured person's cervical spine, physical repositioning of an injured person remaining inside a car away from the vehicle (or its mock-up) to the final destination where the first aid will be provided, moving an injured person to a spine board and dressing the wounds characteristic for the road incidents. However, the implementation values related to dressing the wounds and stabilizing the limbs, characteristic for the road incidents, lose their significance when a sudden change in the training scenario assumptions must be

introduced, for they may lose adhesion (together with the relevant dressings and stabilizers) to the material, which the phantom has been made of.

Phantom's "rigidness" and the aforementioned limited adhesion restrict the possibility to place it in every position (especially non-physiological position). Hence, it is recommended to limit changes in the didactic process to the ones regarding the sudden emergency evacuation (without the continuation of the originally specified rescue actions), placing the phantom in the position suitable for the CPR and on a spine board. In the case when the spectrum of rescue actions has been quite limited, the Crash Kelly phantom may be applied to train various techniques of emergency evacuation, involving one or two trainees. A periodical evaluation of an injured person's state ought to be limited to the most evident injuries only. The phantom's design makes it impossible to identify all symptoms of internal injuries (e.g. filling up the abdomen cavity or a thigh with blood, capillary refill). The phantom's design does not allow to place it in a safe position. Hence, the necessity to include injured person's monitoring into the scenarios and provide the paramedics with oropharyngeal tubes and other elements allowing for clearing the upper respiratory tract. Stabilisation of the broken limbs should be regarded as one of the last rescue actions to be taken and emergency evacuation should not be introduced afterwards accompanied by additional rescue actions due to an unacceptable risk of wound dressing loosening and limb stabilization removal.

The Crash Kelly phantom allows for the use of a self-inflating bag, an oropharyngeal tube, a laryngeal tube, a laryngeal mask of i-gel type as well as other elements intended for more advance rescue actions than just first aid. Therefore, it is useful in the course of the simulations involving the cooperation between various safety entities, especially from the so-called rescue triangle (Police, entities of NEFS and the entities of the State Medical Rescue system).

It is possible to provide additionally a staging set to improve the realism of the injuries. The degree of injury representation remains at its peak when the phantom does not change its position in the course of the scenario.

The degree to represent the body position of an injured person bears the greatest importance in the case of an analysis regarding the bodily position found by Police officers at the very beginning of the simulation. The degree to represent a possibility to transfer from a danger zone to a safe zone is related to emergency evacuation. The degree to represent the position suitable for providing first aid is to a great extent related to the first rescue actions to be performed (direct dependence).

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