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Improvement of the Inspection of the Scene in the Examination of the Emergency Situation Associated with the Explosion and Fire

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ABSTRACT

The article proposes to improve the inspection of the scene during technical inspections of emergency situations, to increase the efficiency of the work of experts through the use of unmanned aerial vehicles during the inspection.

KEYWORDS: *emergency, expert, examination, civil servants, algorithm, mathematical model, efficiency, unmanned aerial vehicles.*

Technical expertise is a particularly intricate procedure that calls for both theoretical and practical knowledge as well as a thorough understanding of not only the technical and building domains but also the legal ones. The reason is that it's important to remember that an expert's judgment may have an impact on a person's fate. Below, we'll go through how an expert examination is conducted: The expert has the power to ascertain the technical and organizational causes of the emergency situation. After locating the emergency's center or centers, the cause of the emergency should be ascertained. It is hard to determine the precise source of the emergency scenario if the expert cannot locate its focal point. The tests run by the examination units of the Ministry of Emergency Situations contain the following steps, in a new order. The examination and drafting of an expert opinion can be symbolically depicted as follows at stage C's starting stage:

$$S_{\text{эхтж}} \in \left(S_x^1, S_x^2, S_x^3 \dots S_x^i\ S_y^1, S_y^2 S_y^3 \dots S_y^j S_z^1\ S_z^2 S_z^3 \dots S_z^k\right) (1)$$

here: $S_{\text{эхтж}}$ – preparation of an expert opinion; S_x^1, S_x^2, S_x^3 – conditions for the sequential execution of operations, which are known to the expert in advance and cannot be changed; $S_y^1, S_y^2 S_y^3$ – the solutions to be determined by the expert (the time of the beginning of the situation, the location of the epicenter, the mechanism of the emergence of the emergency situation, the conditions that led to it, the consequences, etc.); $S_z^1\ S_z^2 S_z^3$ – conditions or factors unknown to the expert in advance (correlation of the dynamics of the development of the emergency situation with certain conditions and situations, the focus (epicenter), the reason), the right questions were asked to the expert to determine them, the samples for the study were correctly selected, the research was conducted, etc. . it became known that it depends on . Reduction of the time of identification and examination of the epicenter of the emergency situation and $S_y^1, S_y^2 S_y^3$ – by reducing the time in partial execution, the experts considered the improvement of the quality of work efficiency as follows.

$$\tau_{\text{фвэ}} = \tau_{\text{ууа}} + \tau_{\text{вкм}} + \tau_{\text{ома}} + \tau_{\text{мқи}} (2)$$

here: $\tau_{\text{ууа}}$ – time spent acquiring images by unmanned aerial vehicles; $\tau_{вкм}$ – the time spent taking photos and videos through a video surveillance device installed in the rapid fire technical laboratory; $\tau_{ома}$ – time spent on online information sharing with operational management staff; $\tau_{мқи}$ – time spent on data processing. Unmanned aerial vehicles are thought to be useful in operating in the heart of an explosion or fire and keeping military troops in a secure area. Drones are operated remotely, thus

there is no need for employees to put their lives in danger by traveling to the disaster's epicenter. Unmanned aerial vehicles with thermal imaging capabilities can find things or persons that the human eye cannot see. In order to make nighttime operation easier, drones can also be fitted with specialized lighting equipment. The drone is a strong instrument that can be applied in various industries thanks to the thermal imaging camera that is embedded inside it. This not only ensures the safety of an expert or group of experts conducting an examination or research at the scene of emergencies, but also improves the efficiency and quality of their work, enables them to prepare a primary expert opinion by evaluating the situation at the scene, and allows them to submit this work to the state fire control inspector. The ability to get reliable information about it will be available. Figure 1 below depicts a significant aircraft, unmanned aerial vehicle, and human survey of the location, along with data collecting. fields of waves and stationary (magnetic photography, aerial photography).

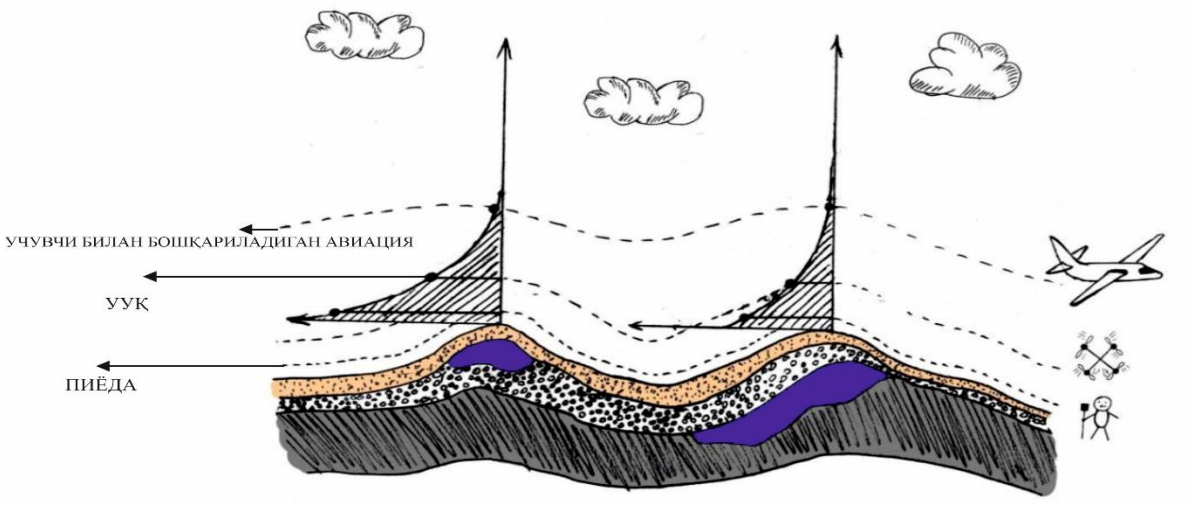

Figure 1. Photo-video recording of the emergency situation in different ways

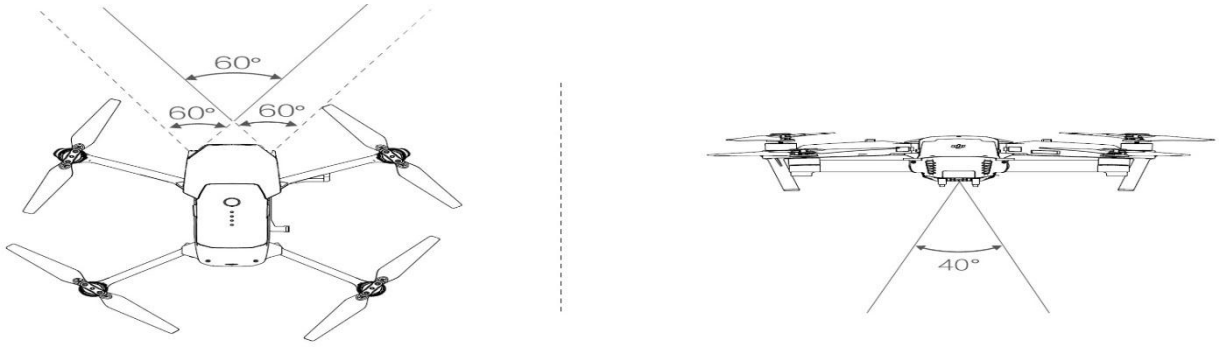

Figure 2. MavicPro unmanned aerial vehicle optics field of view

Aerial photography: the source emits the field. Images of sources are automatically captured by the camera. The capabilities of aerial photo-video imaging using ground-based photo-video imaging, unmanned aerial vehicles, and massive aircraft were compared throughout the course of the work (Table 1).

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Table 1 Comparison of imaging process

Dimensions	Shooting from the ground	unmanned aerial vehicle	Big aviation
Maximum working volume	less	medium-high	high
Minimum work volume	as desired	less	high
Service costs	Expensive	medium	very expensive
Clarity	surface flatness, surfaces with various obstacles	high	pomex medium difficulty, various obstacles
Speed of work	very low	medium-high	upper-middle
Preparation for work	difficult	upper-middle	difficult, expensive

A drone was discovered to be the most practical tool for gathering data from the area, shooting images and movies, according to Figure 1 and Table 1. The time taken by a citizen on foot, the time taken by an expert from the Ministry of Emergency Situations' expertise units on foot at the scene of an emergency, and the time saved when an expert uses drones in these works are all given in Table 2 below along with the coefficient of efficiency (CE) that was obtained from the research.

Table 2 Efficiency coefficient calculation table

No	without a unmanned aerial vehicle	weighted average for experts		with a unmanned aerial vehicle		Comments
	(man)	(an expert or specialist)	*SK*	(УУА)	*SK*	SK_2- SK_1
1	L_o^1=47260	$L_э^2$=45544	1,29	L_{yya}^3=27520	1,65	
Time taken by the expert for the total distance covered						
2	t_o^1=21,30 min	$t_э^2$=10,12 min	2,10	t_{yya}^3=2,10 min	4,81	*
	The time spent by the expert to determine the emergency					
3	t^1=21,04 min	t^2=15,45 min	2,49	t^3=6,15 min	2,51	*
Time spent communicating online						
4	t_1^1=23,37 min	t_1^2=12,0 min	1,94	t_1^3=7,53 min	1,59	*
5	t_2^1=21,31 min	t_2^2=16,04 min	1,32	t_2^3=5,45 min	2,94	*
6	t_3^1=22,40 min	t_3^2=15,32 min	1,46	t_3^3=6,24 min	2,45	*
Average k_{s1}^i			1,57	Average SK	2,32	Time saved
7	L_Δ^1=16 km	L_Δ^2=18,6 km	0,86	L_Δ^3=8km	2,32	Road crossing of the Autotrans port
8	Q_1= 4 l	Q_2 =5,32 l	0,75	Q_3=2,8	1,9	Gasoline consumption

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		$k_{s1}^{i} = \sum 1_{o} / \sum 2_{э}$	$k_{s2}^{i} = \sum 2_{э} / \sum 3_{yya}$	

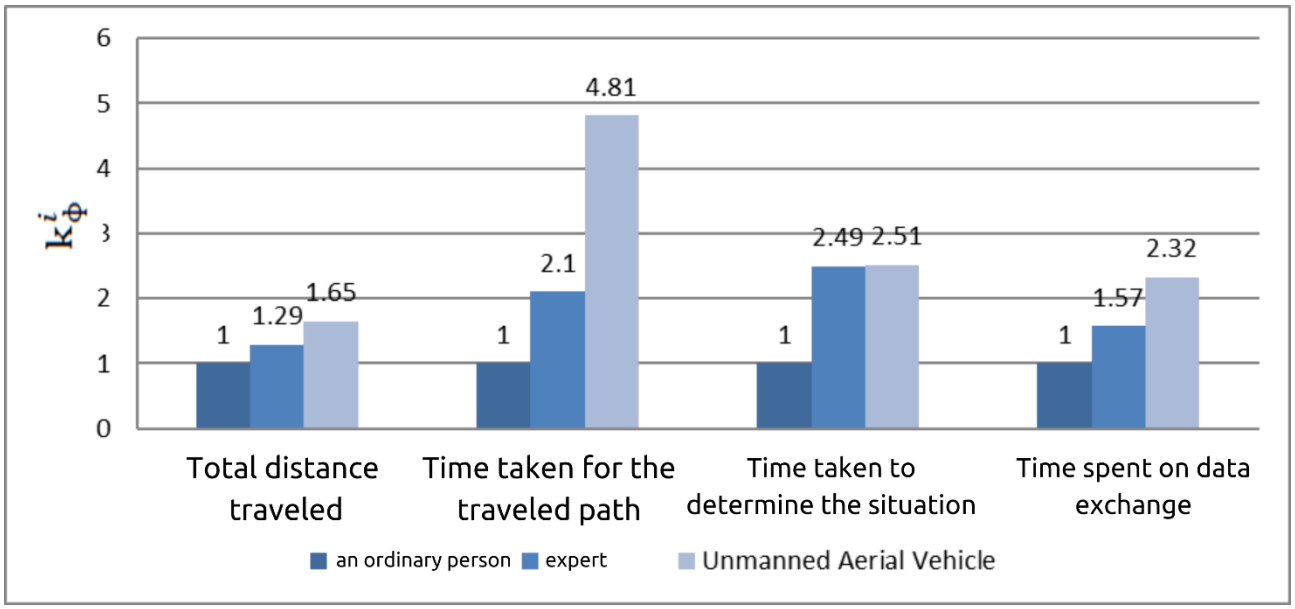

Figure 3. The analysis of the results of the educational-practical research conducted in field conditions is presented in the form of a histogram

The gap between a regular person and an expert rises by k_{s1}^{i}-1.29 times, as seen in the table above. However, it will decrease k_{s2}^{i}-1.65 times if the same expert arranges an expert examination employing drones. Additionally, the calculation of the average usable work coefficient was completed while taking into consideration the distance to be traveled, the ratio of times, the amount of fuel spent, and other factors. In conclusion, it can be stated that the use of drones in explosion and fire emergency zones will, in addition to saving the lives and health of experts, result in a 1.65-fold increase in the useful work efficiency of those experts in terms of data collection and transmission, while simultaneously lowering the costs of large aviation. It was established how many reductions may be made in addition to an up to 13 percent gain in job efficiency.

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