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## ECONOMIC ASSESSMENT OF PERSONNEL TRAINING CONTRIBUTION TO ENSURING CIVIL DEFENCE OF UKRAINE

***The article provides the economic assessment of contribution of educational institutions of civil defence profile to ensuring people's security, basing on the statistic data on the number of fires, saved property cost and the volume of damages. The interpretation of the 'saved property cost' definition and the method of its calculation are suggested. The minimal period of mandatory service in the units of State Emergency Service of Ukraine after obtaining professional education financed from public funds is economically substantiated.***

***Keywords:*** *emergencies; professional education; cost of saved property; damages; civil defence.*

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## ЕКОНОМІЧНЕ ОЦІНЮВАННЯ ВНЕСКУ ПІДГОТОВКИ КАДРІВ У ЗАБЕЗПЕЧЕННЯ ЦИВІЛЬНОГО ЗАХИСТУ УКРАЇНИ

***У статті надано економічну оцінку внеску навчальних закладів цивільного захисту у забезпечення безпеки населення, ґрунтуючись на статистичних даних щодо кількості пожеж, вартості врятованого майна, розміру збитків. Запропоновано визначення «вартості врятованого майна» та методу його обрахунку. Економічно обґрунтовано мінімальний термін служби в органах та підрозділах Державної служби України з надзвичайних ситуацій після отримання професійної освіти за державні кошти.***

***Ключові слова:*** *надзвичайні ситуації; професійна освіта; вартість врятованого майна; збитки; цивільний захист.*

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## ЭКОНОМИЧЕСКАЯ ОЦЕНКА ВКЛАДА ПОДГОТОВКИ КАДРОВ В ОБЕСПЕЧЕНИЕ ГРАЖДАНСКОЙ ЗАЩИТЫ УКРАИНЫ

***В статье представлена экономическая оценка вклада учебных заведений гражданской защиты в обеспечение безопасности населения, основанная на статистических данных о числе пожаров, стоимости спасенного имущества, размера убытков. Предложены определение «стоимости спасенного имущества» и метод его расчета. Экономически обоснован минимальный срок службы в органах и подразделениях Государственной службы Украины по чрезвычайным ситуациям после получения профессионального образования за государственные средства.***

***Ключевые слова:*** *чрезвычайные ситуации; профессиональное образование; стоимость спасенного имущества; убытки; гражданская защита.*

**Problem statement.** According to the human capital concept the results of educational activities (knowledge) materialize in the value through the work of higher quality and efficiency, performed by a professional. The impact of education and qualification of work on economics was studied by S. Strumilin (1982: 11), a prominent economist of the early 20th century. His main work is focused on the effectiveness of school education, in particular it was shown that school education provides economic benefits, which is 27.6 times higher than cost of its implementation.

At the same time it was found that increasing the level of education reduces its economic profitability, however, higher education also makes a significant economic impact. It should be noted that the method of research used by S. Strumilin is based

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on expert assessments of a worker's supervisors – namely, awarding an employee an appropriate category.

Contemporary methods of such contribution estimation are based on the increase of output by raising the level of education and skills of workers (Kalenyuk, 2005: 252). Thus, according to (Vanieva, 2008: 8) for each 1 UAH directed to finance education, Ukraine receives UAH 2.34 increase in gross value added. This approach is to a greater extent justified for the production sector specialists. However, civil protection experts work on preventing and reducing losses and damages, so the direct use of the existing methods for evaluating the contribution is impossible. Moreover, it is necessary not only to state the fact of importance of training as a factor of economic development, but also to determine the level of this contribution with certain accuracy. There are no methods of evaluating the contribution of training to ensuring civil protection, that is why the topic of this research is important.

**Recent publications analysis.** The following studies of such leading foreign and domestic scientists seem to be a substantial contribution in the research area. Here we should mention the works by L. Antoshkina (2005), N. Bahautdynovoyi (2003), T. Boholib (2004), O. Galayda (2008), B. Danylyshyn (2005), I. Kalenyuk (2005), T. Rodenkova and V. Slepov (2009), N. Verkhoglyadova et al. (2005) and others. However, a number of questions on the impact of professional education to ensuring national security and its certain aspects remain poorly studied.

**The purpose** of this work is to provide economic assessment of the contribution of educational institutions to improving productivity of civil protection experts and ensuring public safety.

**Key research findings.** Professional education in the system of civil protection makes its contribution to public safety and to the economy of the state, reducing losses from emergencies, fires and other natural disasters. Thus, the volunteer fire suppression engages usually 20 people, while 13 trained professionals are needed to liquidate the fire (www.twirpx.com), professional firefighters liquidate fires more quickly and effectively due to trainings and equipment and their actions are less dangerous to their lives. Thanks to professionalism, losses from fires reduce, the amount of remaining property increases. Thus, professional training for civil defense makes a special contribution to the security of the state and its people from emergencies.

In the system of civil protection the result of educational activities is fully reflected in improving performance indicators of the service, which can be seen in the amount of remaining property, values, human life during an emergency. In (Abolontsev, 1985; Akimov, 2004; Baranin, 2004; Kozmenko, 1997) determination of the effectiveness of civil protection is suggested through the concept of damages and losses that were prevented, and there is no definition of "remaining property" in them. A. Mikyeyev (1994) uses the concept of "remaining property" to determine the profitability of a fire department, but there is no definition of what kind of property is considered to be saved.

In this study the author suggests using the concept of "saved property" because the notion of "damages, which were prevented" can be used only at a particular object of national economy. It should be noted that the term "saved property" is rather complicated, if there are no questions about the concept of the number of people rescued by civil protection service, the notion of "saved property" has certain characteristics.

It should be mentioned that it is the value of property, which could be destroyed by a fire or by another emergency, but was not spoiled because of professional actions of rescue units.

However, this definition reflects only operational and rescue side of civil protection service because undamaged property may also be included to the saved property because the emergency did not take place due to preventive and precautionary actions of civil protection service. Thus, to determine the contribution of personnel training to providing civil protection the author proposes to consider "saved property" as the property, which was not destroyed by an emergency (fire) due to professional actions of personnel of State Service of Emergencies of Ukraine. It is impossible to evaluate the impact of an event that did not occur due to its stochastic nature.

Comparative analysis of the contribution of civil protection service personnel with professional education and without it can be done on the basis of the relationship between such categories of staff and statistics on the number of fires and other emergencies in Ukraine and the average value of property saved in different years.

It is known that personnel contribution to increasing the cost of production is determined by productivity. But civil protection personnel does not produce new products instead of saved property that has certain value. Thus, saying "productivity" we mean the amount of saved property per year per employee. We denote the average productivity of civil protection service personnel with professional education by $x$, and without it – by $y$ (ths UAH/(person x year)). As general economic characteristics including gross domestic product (GDP) change over time, we assume that the ratio of performance to GDP remains unchanged, as it is seen in the economy with a constant number of employees.

A number of employees of civil protection service with professional education is denoted as $m_o$, and people who do not have it – $m_p$. Then we obtain a system of equations linking $x$ and $y$:

$$\begin{cases} m'_o \dfrac{x}{GDP'} + m'_p \dfrac{y}{GDP'} = \dfrac{S'_p}{GDP'} \\ m''_o \dfrac{x''}{GDP''} + m''_p \dfrac{y''}{GDP''} = \dfrac{S''_p}{GDP''} \end{cases}, \tag{1}$$

where the coefficients with $'$ and $''$ refer to different years; $S_p$ – the cost of saved property.

Changing $x'$ for $\dfrac{x \times GDP''}{GDP'}$ and $y''$ for $\dfrac{y \times GDP''}{GDP'}$ we get:

$$\begin{cases} m'_o x + m'_p y = S'_p \\ m''_o \dfrac{x''}{GDP''} + m''_p \dfrac{y''}{GDP''} = \dfrac{S''_p}{GDP''} \\ or \;\; m''_o x + m''_p y = \dfrac{S''_p \times GDP'}{GDP''} \end{cases}. \tag{2}$$

On the other hand, the cost of saved property according to the definition above is the difference between possible ($P_l$) and actual losses ($L$):

$$S_p = P_l - L. \tag{3}$$

It is difficult to calculate potential losses as the cost of saved property, because emergency development has the nature of probability. It depends on many factors: the direction and the speed of development, the existing period, weather conditions etc. A group of experts from various fields, including experienced professionals of civil protection service, economists, experts in aerodynamics and building structures are needed for evaluation. There is a need of an emergency simulation using computer technologies. Therefore, the assessment of potential losses and cost of saved property is conducted only in individual cases.

Based on the assumption that potential losses are proportional to GDP and the number of fires and other emergencies we can state that

$$S_p = \frac{GDP \times n}{k} - L, \tag{4}$$

where $n$ – the number emergencies; $k$ – coefficient of proportionality.

Therefore, for the estimation of saved property for each emergency situation the expert method is used. However, for quality evaluation experts from various fields should be involved: fire safety (to assess the area of the fire in the absence of eliminating action) and economics (to estimate the property cost in this area), that's why expert assessment of saved property from fires is incomplete. But having the sampled data for evaluation of saved property by an expert group we can determine an average statistical proportionality coefficient, which can be found as an average for each emergency, for which the cost of saved property was determined:

$$k_1 = \frac{GSP \times n}{\sum_{i=1}^{n}(S_p + L)}, \tag{5}$$

where $n$ – the number of fires/emergencies for which the cost of saved property is estimated.

According to state statisticals in 2013 there were 61000 fires. Analyzing 1000 fires, for which the evaluation of remaining property and direct damage was conducted we can estimate the coefficient $k$.

$$k = \frac{1454931000 \times 1000}{(15+4)+(20+2)+(100+750)+\ldots\ldots+(20+1)} = 1.11 \times 10^6.$$

According to the data for 2011 and 2013 GDP was 1.3166 bln UAH and 1454931 bln UAH respectively. The number of personnel in those years was 58781 and 60857 people, 6224 and 5585 people among them had professional education – and the direct losses amounted to 802.85 mln UAH and 710.86 mln UAH. Calculation (3) makes it possible to estimate the cost of remaining property during these years:

$$S_p^{2011} = \frac{1316600 \times 60790}{1.11 \times 10^6} - 802.85 = 6378.74 \text{ mln UAH};$$

$$S_p^{2013} = \frac{1454931 \times 61114}{1.11 \times 10^6} - 710.86 = 7267.57 \text{ mln UAH}.$$

where 60790 and 61114 – the number of fires in 2011 and 2013 (www.mns.gov.ua).

Now we can determine the coefficients of the equation system ($x$ and y).

$$\begin{cases} S_p^{2011} = 6224 \times x + 52557 \times y = 6378740; \\ S_p^{2013} = 5585 \times x + 55272 \times y = 7267570. \end{cases}$$

where 52557 and 55272 – the number of personnel without professional higher education.

Solving the equation we obtain:

$x \approx 1371000$ UAH/(person x year);

$y \approx 1051000$ UAH./(person x year).

Therefore, we can determine the ratio $x / y$:

$$\frac{x}{y} = \frac{137.1}{105.7} 1 = 1.3.$$

It should be noted that according to the definition and the initial data $x$ and $y$ contain labor productivity only partially because, first – only the data on fires, but not on all other emergencies (there was expert evaluation of the remaining property for them) is accounted, and secondly – the activities on emergencies prevention are not excluded. But we can assume that the ratio of productivity of Civil Protection Service during carrying out these functions is the same. This means that the productivity of civil protection service personell with professional education is on average 1.3 times higher than the productivity of personell who do not have it.

The difference in monetary allowance was about 8500 UAH / year per employee while the productivity $(x - y)$ is equal to 32000 UAH. The cost of training of a specialist in fire safety in the year 2013 was 37050 UAH. Thus, 185250 UAH (5 years of studying) invested in professional education should be paid off in 7.5 years (Figure 1). This term also substantiates minimally required valid time of service needed to be worked out by an employee after receiving professional education.

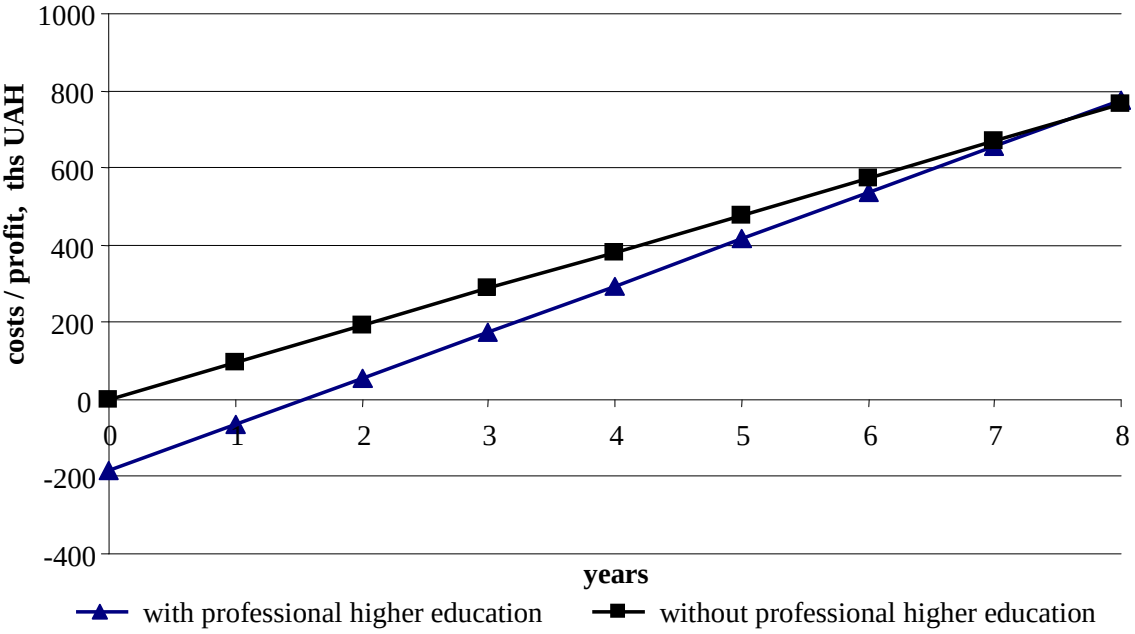


*Figure 1.* **Payback period of expenses for training personnel in the system of civil protection,** *constructed by the author on the basis of calculations*

Besides increasing productivity of graduates of the educational institutions of civil protection have also made its contribution to improving safety from emergencies and protection of civilians by functioning of a training firefighting station. Fires, as well as other emergencies have stochastic, unpredictable nature and sometimes may occur

with a certain interval, and sometimes simultaneously, besides the scales of emergencies are different too. Maintenance of additional reserve for such isolated cases requiring certain expenses. Therefore, firefighting educational institutions of Civil Protection Service which have specialized engineering tools for training, are able to be a reserve for municipal Civil Protection Service units. At the same time participation of cadets of senior courses in fire suppression is a widely spread practice in the world.

**Conclusions.** The article suggests the method for calculating primary contribution of educational institutions of civil protection in public safety, based on statistical data on the number of fires, the cost of saved property, the amount of damages etc. The definition of the "cost of saved property" concept was provided and the method for its calculation is proposed. The minimal period of mandatory service of graduates of civil protection higher educational institutions is grounded.

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