Scientific Journal of Riga Technical University
Safety of Technogenic Environment
2011
Volume 1

Usage of Robots for the Increasing the Effectiveness of the Fire Protection

Roman Zinko, *Lviv Polytechnic National University Institute of Engineering Mechanics and Transport,* Vladimirs Jemeljanovs[1], Jelena Sulojeva[2], [1-2]*Riga Technical University,*

Abstract. **One should conclude that the role, possibilities and significance of disaster and rescue services in life protection and ensuring of populated areas in town and in the country are little examined. In fact, this process begins only now.**

The service area of fire protection brigade is of great importance. In Riga these areas are larger than in other towns. It can be clearly seen in Table 4, where the density of Riga fire-fighting brigades stations in comparison with other world cities is given [2-4].

Keywords: operative service zone, the economic effectiveness, automatic fire-extinguishing.

I. INTRODUCTION

Raising the level of fire protection is an indisputable necessity dictated by significant moraland material loss that fires incur to society. In the system of raising fire protection of populated areas and state objects the economic substantiation of fire protection ensuring methods is of great importance. Additionally, it is very important to prove scientifically the interconnection between fire protection expenses and possible loss caused by fire. In its turn it is closely connected with resource limitations for further fire protection development, including its most important element – fire protection systems.

Methods of defining the economic effectiveness of fire protection system in general and its separate elements, substantiated by innovative approach to these complicated and significant problems, help to solve this problem.

Economic theory studies social production in general, forms of expression of economy laws and their operation mechanisms in national economy.

General feature of any theory studying national economy is examination of economic processes and material wealth, its exchange, consumption and distribution appeared in the process of production. However, the economic theory does not particulary study the specific forms of the expression of laws of general economy in several spheres of national economy. This is the subject of research of sectoral economic disciplines – industrial economics, agricultural economics, transport economics, etc.

Fire protection economics can be in the same way referable to the category of sectoral economic disciplines. Sectoral economics and fire protection economics as well studies the action and forms of the expression of economic laws in the mentioned sphere of sectoral economics, special economic regularities characteristic for the sphere mentioned, study conditions and factors under which influence the laws can operate with greater effectiveness.

Thereby, fire protection economics is economic relationships that appear in the process of fire protection ensuring system formation, introduction and expluatation, the peculiarities of expression in the sphere of objective economic laws functioning, in the system of fire protection ensuring in general and methods of effectiveness rising of its separate elements.

Fire protection economics is closely connected with particular economic disciplines that study the methods of analysis and calculation of economic activity, economic effectiveness, evaluation methods of economic substantiation of different organisational and technical activities (with statistical, managerial economics disciplines, national economics sectoral economics disciplines, etc.).

In its turn fire protection economics directly cooperates with special technical disciplines - fire-fighting equipment, automatic fire-extinguishing, fire-extinguishing water supply, fire-fighting preventive disciplines, fire-fighting tactics, bases of management of state fire-fighting and rescue service. It is known, that the equipment used in enterprises strongly affects all the spheres of fire protection economics.

Simultaneously, economics defines technical progress, evaluates new equipment taking into account its ability to ensure the rise in labour productivity – the most important ratio of social productivity effectiveness.

Today one can declare with certainty that in economically developed countries the expenses on fire protection system maintenance, engineering activities and direct loss caused by fire make about 1% from yearly gross domestic product. If one takes into account indirect loss caused by fire, social and environmental damage, then social expences become at least twice as great. This is why it becomes obvious that fire protection has turned into independent and very important sphere of economics.

Appropriation of financial resources to ensuring fire protection on the one hand and the necessity of their economic evaluation on the other hand determine the necessity to elaborate the methods for definition of economic effectiveness of fire protection system ensuring and the methods of thair optimisation.

One should conclude that fires, especially those that develop into emergency situations and disasters, principally influence the implementation of state development topical programs, economic conditions, ecology and society.

TABLE 1

DENSITY OF RIGA FIRE-FIGHTING BRIGADES STATIONS IN COMPARISON WITH OTHER WORLD CITIES, YEARS 2009-2010

City	Number of inhabitants, thousands	Space, m^2	Number of fire stations	Average space of service area, źm 2	Average number of inhabitants for one station, thousands
Riga	830	307	11	27,9	92,22
Kopenhagen	460	90	9	10	51
London	7000	1600	114	14	34
New York	7300	790	217	3,6	34
Tokio	10000	720	229	3,1	44

Therefore, there appears the necessity to improve the fire protection system in which great meaning is applied to the subsystem of loss caused by fire volume reduction – fire protection, which can be considered a system as well.

The results summarised for year 2010 show that in Latvia fire-fighting brigades arrived at fire locations at an average in 7.3 minutes in urban and in 25 minutes in rural areas. The analysis of fires shows that the critical values of factors dangerous for people is achieved in 5-10 minutes time from fire starting moment, destruction of metallic constructions begins in 10-15 minutes, but effective work of fire-fighters begins only in 19 minutes (including 11 minutes spent on the way).

II. GENERAL REGULATIONS

Analysing the data provided by International Association of Fire-Fighting and Rescue Services (further in the text ISFRS) from 2006 till 2010, the number of fires in the most developed European Union and world countries is great. It is reflected in the Table 2.

During this period, there started at an average 184,628 fires a year in Germany, which makes 2.24 fires for 1000 inhabitants, in France - 359,126 fires, 5.64 fires for 1000 inhabitants, in Italy – 224,717, 3.86 for 1000 inhabitants; but in Sweden – 27,374, which at an average makes 3.03.fires for 1000 inhabitants a year, in Englang it is 462,868 fires, which makes 7.62 fires for 1000 inhabitants, in its turn, in the USA - 1,587,400, which makes 5.27 fires for every thousand of state

TABLE 2

ISFRS DATA FOR YEARS 2006-2010

Country	average annual number of fires	number of fires PER 1000 inhabitants
Germany	184628	2,24
France	359126	5,56
Italy	224717	3,86
Sweden	27374	3,03
England	462868	7,62
USA	1587400	5,27
Russia	227058	1,61
Latvia	11537	5,1
Lithuania	18066	5,05
Estonia	12127	9,04

TABLE 3

ISFRS DATA FOR YEARS 2006 - 2010

Country	average annual number of DEAD	number of dead per 1000 inhabitants
Germany	461	0,56
France	434	0,68
Italy	101	0,17
Sweden	97	1,07
England	512	0,84
USA	3635	1,21
Russia	17974	12,21
Latvia	227	10,04
Lithuania	277	7,76
Estonia	140	10,45

inhabitants. In Russia there are 227,058 fires, 1.61 fire for 1000 inhabitants. Baltic States do not get behind the most developed world countries in these figures. In five years time, from 2006 till 2010, there started at an average 11,537 fires a year in Latvia, which makes 5.1 fire for 1000 inhabitants, in Lithuania it was 18,066 fires, which makes 5.05 fires for 1000 inhabitants, but in Estonia it was 12,127 fires, which makes the biggest number of fires for 1000 inhabitants in Baltic states – 9.04

The number of people lost in fires during this period of time, from 2005 till 2009, is very big in the above mentioned countries. In Germany 461 people died in fires

, which makes 0.56 people for 1000 thousand inhabitants, in France this number is equal to 434 people, 0.68 for 100 thousand inhabitants, in Italy 101 people died, which makes 0.17 people for 100 thousand inhabitants, in its turn, in Sweden 97 people were lost died, which makes at an average 1.07 people a year for 100 thousand inhabitants. In England it is 512 people, 0.84 for 100 thousand inhabitants, in its turn, in the USA it is 3635 fires, which makes 1.21 person for every 100 thousand state inhabitants. In Russia there are 17,974 lost people, which makes 12,21 people for 100 thousand inhabitants. In Baltic states during the period of five years, from 2006 till 2010, there is great proportion of people lost in fires. In Latvia there are 227 people lost in fires, which is 10.04 people for 100 thousand inhabitants, in Lithuania it is 277 people, 7.76 for every 100 thousand inhabitants, in its turs, in Estonia it is 140 people, 10.45 people lost in fires for 100 thousand inhabitants. Thus, in different countries great loss can be observed as a result of fires.

The aim of the research was chosen taking into account the main Euripean Union directives in the sphere of fire protection, as well as taking into account resources and other kinds of supply data of State Fire Protection and Rescue Service, as one of the most important subsystems of Latvia national wealth fire protection, as well as using other data connected with ensuring technical safety in the state.

The analysis of foreign scientific sources showed, that the problem of ensuring fire protection, as well as technical safety in general, is of an explicit international character and it causes serious agitation in the world.

The analysis of statistical data performed shows that there still are reserves in raising the effectiveness of fire-fighting brigades' activities

Statistical data about fires testify that the activities performed, norms accepted and safety requirements existing in the country do not ensure the reduction of loss caused by fire. In standing normative documents fire prevention requirements are particularly formulated, but there are no normative documents providing ways and methods of solving these problems.

Analyzing the experience of foreign countries, one should note that in conditions of market economy every state tries to solve the problem of fire protection of objects not with the help of extensive methods, which require additional material and human resources, but with the help of intensive methods based on scientifically technical progress and involving voluntary brigades (VFB) into operative service of fire-extinguishing.

The D part of objects being in operative service zone can be defined by using regressive equation acquired by the method of smaller squares:

$$D = 7{,}82.10\text{ -4}.\ N + 1{,}57.10\text{ -3}, \quad (1)$$

where N – number of fire-fighting stations.

At the objects where fire-fighting service cannot provide aid in case of emergency, it is offered to place autonomous fire-extinguishing systems. In gardening societies that are situated 20-30 km away from the fire-fighting stations, local extinguishing systems placed have already proved their effectiveness and perspective.

To evaluate the economic effectiveness of using automatic fire-extinguishing it is necessary to solve two problems. Firstly, the expedience of use of AFE at national economyobjects should be economically substantiated if there are other fire protection systems (hereinafter - FPS), secondly, the most rational variant of the use of automatic fire-extinguishing equipment should be chosen.

At an object where there is no automatic fire-extinguishing system but there are other protection means of fire security system, the economic expedience of using automatic fire-extinguishing system can be defined by comparing the volume of loss reduction possibility if there is automatic fire-extinguishing equipment with present value of investments.

Calculation of present value of reduced expenses for automatic fire-extinguishing system construction (capital and operating expenses) usually does not cause special difficulty.

Using sufficiently precise statistical data about loss caused by fire at an object, one can define annual material loss caused by fire according to the following formula:

$$Zie.m.z = (Zt + Zn + Z\ b.t. + Z\ eco.)P, \quad (2)$$

where Zt – average direct loss from one fire, Ls;

Zn – average indirect loss from one fire, Ls;

Zb.t. – loss from people's death and injuries, Ls;

Zeco – ecological loss, Ls;

P – probability of fire starting.

If there is no statistical data for evaluation of possible volume of loss caused by fire, then a mathematic model should be elaborated. The area of fire should be calculated and the part of material values destroyed should be defined according to this calculation. On the basis of statistical materials, the part of material loss destroyed in a fire can be defined according to different types of objects if the object is or is not equipped with FPE, taking into account the frequency of fires. The numbers of calculation are reflected in the Table 4. The value of object in FFRS station service zone and its area are known quantities for each object, so possible material loss caused by fire could be calculated according to the following formula:

$$Z_{ie.m.z.} = Co \cdot (C_1 + K_{net}) \cdot f, \quad (3)$$

where Co – average rate of the area protected 1 m^2, Ls;

f – frequency of fires, a year (see.table 6);

C_1 – destroyed part of material values of an object (see Table 6);

K_{net} – ratio of indirect loss caused by fire ($K_{b.t.} + K_{eco}$).

Taking into account that new coefficients K b.t. and K eco. are first introduced in the paper, it is necessary to evaluate them quantitatively.

As $K_{b.t.}$ we accept the correlation between human loss, injuries and direct loss from fire, i.e.

$$K_{b.t} = \frac{Z_{b.t}}{Z_t} \quad (4)$$

where $Z_{b.t.}$ – loss from peoples' death and injuries in one fire, Ls

Z_t – average direct (basic) loss in one fire, Ls;

As K_{eco} isaccepted the correlation between ecological loss and direct material loss from fire, i.e.

$$K_{eco} = \frac{Z_{eco}}{Z_t} \quad (5)$$

where Z_{eco}- ecological loss caused by fire, Ls.

In the research devoted to the category of social and economic effectiveness, the emphasis is on the unity of social and economic results. Under the notion of 'social results', one should understand the characteristics reflecting the achievement of the aims put forward by society as a consumer and changes they make in a person. Under the notion of 'economic results' one should understand the achievement of aims put forward by society as the owner of production means and which show as profit.

TABLE 4

PART OF MATERIAL LOSS DESTROYED IN A FIRE AT DIFFERENT TYPES OF OBJECTS

Kind of object	Destroyed part of material values of an object C[1]		Frequency of fires, a yearf
	Not equipped with FPE (are other FPS means)	Eguipped with FPE	
Warehouses:			
Timber and woodwork	0,316	0,006	0,0394
Leather and leatherwork	0,235	0,004	0,0123
Technical rubberwork	0,314	0,006	0,0123
Fabrics	0,098	0,002	0,0104
Technical property	0,114	0,002	0,0094
Cellulose and paper products	0,204	0,004	0,0125
Chemical products	0,139	0,003	0,0123
Other products	0,206	0,004	0,0094
Production shops:			
Synthetic rubber and synthetic fibre processing	0,030	0,001	0,0265
Casting and melting	0,072	0,002	0,0189
Machine-shops	0,139	0,003	0,0060
toolshops	0,054	0,001	0,0060
meat and fish products processing	0,100	0,002	0,0153
hot metal rolling shop	0,065	0,002	0,0189
textile industry	0,060	0,001	0,0153
Electric power stations	0,314	0,006	0,0224
Commercial objects:			
Trade centres, department stores, stores	0,073	0,002	0,0097
public catering enterprises	0,035	0,001	0,0097

Timely arrival of fire-fighting brigades on fire reduces time of free fire extension. And by other conditions being equal it will lead to the reduction of level of direct (basic) and indirect (secondary) damage of property, as well as number of dying and injured people.

One of the main indicators, which has influence on qualitative and successful fire extinguishing, is time of arrival of firefighting brigades to the fire location. It depends on:

1. Duration of free fire extension, as well as untrained population, so people simply do not know what to do in case of fire.

2. Fixed significance of local time, at the moment of registering arrival of firefighting brigade to the fire location.

3. Period of time, which a firefighting brigade needs to get from the permanent firefighting brigade station to the fire location.

1. Main reasons of a rather long time of free fire extension are absence of automatic fire alarm, autonomous fire-extinguishing system, basic means of fire extinguishing, as well as population lack of information concerning proper actions in case of fire.

2. Time of firefighting brigade arrival to the fire location depends on how quick, exact and correct firefighting controller takes and works up message about fire.

3. Fire fighter truck has to drive in a shortest route, with an ultimate possible, providing safety speed.

Time of driving depends on the choice of route and dynamic properties of firefighting truck. As all firefighting trucks are created on the bases of series – produced chassis (series retractable landing gear) of lorries with known dynamic features, which can be carried out only in specific road conditions. So, for the reduction of time of driving one should chose optimal route.

There are several factors that influence time of fire-fighters arrival to the fire location, when a small hotbed of fire grows into conflagration. This time can be critical because of the following factors: current state of roads, traffic jams, great remoteness of population centres from the dislocation of firefighting stations.

Normative time of the first brigade of fire fighters arrival in urban areas is 10min. Additional help can arrive even later, depending on the station dislocation. If in Riga regions fire-fighter brigades arrive on fire location in 5min from starting point, than the maximum time of arrival can be up to 30min [5]. As a rule, for this time fire can grow to such a size, that it is impossible to rescue even part of property. If looking at the map of Latvia from the point of view of scopes of operation of fire-fighting stations, it can turn out that there are dead areas. For getting to these areas, fire-fighters need to cover about 40-50km, it takes them not less than hour of driving.

The importance of level of fire protection is often underestimated. As a lot of people mistakenly think that fires occur rarely. However, statistic date prove reverse. Thus,

62207 fires were registered only in Ukraine during 2010 year. As the result almost 3000 people died, 1500 are seriously injured. Besides, damage of property was more than two and a half million hryvnas. So we can understand the situation considering these figures. They make us think about the importance of fire protection system on enterprises, storehouses, terminal stations. Installation of fire alarm allows us to search fires in time and decrease damage of property. Fire protection of buildings and constructions provides carrying out control for the fire situation by means of fire automatic machinery (installation of the fire alarm and/or fire-extinguishing systems).

Such typical properties as smoke and optical emission of fire allow detecting the hotbed of fire at its starting point. Installations of fire alarms (IFA) with the smoke and light fire announcers considerably decrease time of searching fire (particularly by the sizeable areas and volumes of the protected places) in comparison with sprinkler automatic installations of fire-extinguishing (AIF), which react on thermal factor. Ability of searching fire at the starting point makes these installations master links in the system of warning people and people evacuation in the extreme conditions of fire. Installations of fire alarms are effective only with the timely arrival of the fire-fighter brigades.

Nowadays it is not always possible to make this demand in the densely populated towns, because of overload of traffics. That's why, the effect of the searching fire at its starting point is not so significant in comparison with the using of more inertial sprinkler AIF. However, in fact, if by the actuation of IFA sprinkler AIF bring into action at the same time, it will allow to extinguish fire or considerably decrease area of burning by arrival of firefighting brigade.

Aiming at minimization of the damage from fire, one very often uses installations of fire alarm and installation of fire extinguishing, sprinkler in particular, together in the overcrowded areas, or at objects where the property and cultural values are kept. These systems work separately, without making any influence on each other, but functioning properly and supplementing each other.

Ability of combining the installations of fire automatic machinery and fire alarm in one system is realized in the drencher installations of fire extinguishing, which are brought into action by IFA. However, such cooperation has considerable drawbacks, connected with water delivery to the sizeable protected area. As a result, a lot of water is delivered and damage of equipment or property values is quite possible. Partitioning of the protected areas into more bounded areas, results in considerable rise in price of fire automatic machinery. It happened because of increase of quantity of control units and length of supplying and separating pipelines, complication of installation works, as well as technique maintenance and exploitation of AIF. Their functions can be reasonably combined with the security system of enterprise.

The use of mobile fire robots can serve as an alternative to the AIF. Their functions can be reasonably combined with security system of enterprise. It will decrease financial expenses on exploitation, as well as to use elaborated algorithms of operating. On the first stage of operating of such robots, its main function can be exploring and monitoring of territory in the area where emergency situation happened. In perspective – these systems will also warn people of fires and ensure their easier evacuation. There is scheme of reduction of time of searching and beginning of fire extinguishing by using mobile fire robots on Figure 1. In the given case only function of exploring of fire is taken into consideration. Cases when the enterprise is connected to the panel of central observation are examined. The controller announces the signal to the firefighting brigade and local brigade of fire extinguishing.

The case with using mobile robot reduces time, before starting fire extinguishing. Besides, information awareness of behaviour of fire is considerably improved because of usage of measuring mechanisms of the robot.

In Lviv National Polytecnic University experimental prototype of fire robot was created (fig.2). While robot projecting operational and constructive unification of robot on the bases of its modular construction was taken into consideration. Structure of system: transport platform with remote control; on board viewing system; system of control and data transfer; panel of the operator with means of control, gathering, saving and processing of the video data.

Driving of the robot is provided by caterpillar engine. Gear on the right and left caterpillar is independent. It consists of three-stage reduction gear and direct current motor. The gear supply is made up of automobile accumulator battery. Gear rollers are set at front of the platform, while strain rollers from behind. Such a construction of gear with not a big weigh of the platform (36kilos) provide rather high speed characteristics (speed of driving is up to 1,5 m/s). Basic elements of the transmission are interchangeable. The next step is the elaboration of range of basic elements of the same type.

There is one more characteristic feature in creation of fire robot prototypes – concordance (agreement) of robots characteristics with conditions in which they will work, including technical equipment (channels of communication, transfer of video image).

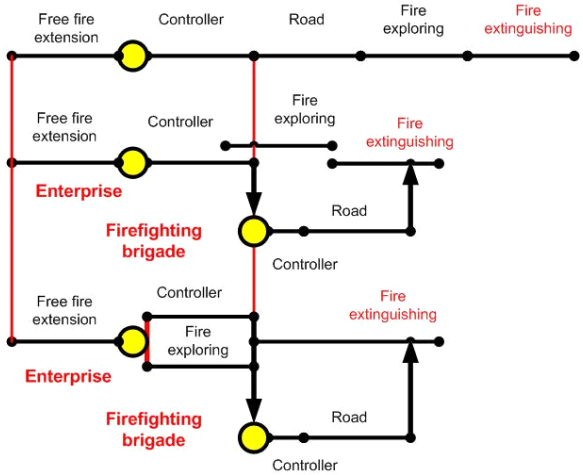

Fig. 1. Reduce of time of fire searching and beginning of fire extinguishing by the use of mobile fire robots.

Fig. 2. Experimental prototype of fire robot.

On the prototype of the fire robot the color-video camera (1/3"; 3,6 mm; 0.5 lux), is set. It transfers data with the help of in-built radio channel. Received video signal is digitized with the help of device USB CAP 100. Received data is processed on the personal computer (in the capacity of which handheld notebook is reasonably used). Control of fire robot is performed on the separate commanding radio channel, radius of action – up to 40m. New software platform of the company "Electronic systems" – HUNTER –M, is used for the data entry and data processing, as well as for the robot control. The main purpose of which is integration of intellectual means of video surveillance [7].

Algorithms of control with the help of video processing are realized in the system – automatic stop before obstacle; setting of the direction of the platform driving with the help of laser marker.

III. CONCLUSIONS

1. SFRB to use methods of defining the economic effectiveness for basic elements of fire protection of objects and populated areas (automatic fire detection and extinguishing systems, reducing the time of free development of fire, as well as the necessary number of fire stations as basic factors of reducing social and material loss caused by fire).

2. The elaborated methods of defining averted economic loss caused by fire and defined structure of this loss are recommended for SFRB use.

3. Justifying the new approach to ensuring fire protection in such Latvian rural territory objects that are situated outside service area of fire-fighting brigades and really cannot be reached in time defined in the standards, to equip such objects with local automatic fire detection and fire extinystems to reduce possible loss caused by fire.

4. Usage of mobile robots for protection and monitoring of fire situation on the object will considerably decrease free fire extension of the emergent fire and allow decreasing economic damage of it.

REFERENCES:

[1] Sulojeva J. *Methods of Evaluation of Fire-Fighting Economic Effectiveness in Latvia. Summary of the doctorate paper.* – R.: RTU, 2010. 40p.
[2] The Technical Scientific Advisory Council of the German Fire Protection Association, (vfdb;GFPA), Stuttgart: GFPA Data, August 2002, 10 p.
[3] GIS Technology and Applications for the Fire Service. New York:An ESRI® White Paper, March 2006, 32 p.
[4] South Wales Fire Brigades.Annual Report 2001/02 Sydney NSW, 132 p.
[5] The cold weather – firefighters wait for new dead bodies. http://unity.lv/ru/news/147681.
[6] Combined use of installations of fire alarm and fire extinguishing: abilities and benefits http://www.techportal.ru/articles/detail.php?ID=151253.
[7] Sharov B.G., Makoveychuk A.N., Korovyanko A.G. Main distinctive features of the videosurveillance "HUNTER"// Business and security. – 2006.–¹5.–Ñ.41-43.
[8] Ēku un būvju ugunsgrēku radīto materiālo zaudējumu aprēķināšanas metodika. Zinātniski pētnieciskais darbs. - Rīga: RTU, 2002. – 71zlpp.
[9] LR Iekšlietu ministrijas Valsts ugunsdzēsības un glābšanas dienests. 2000., 2001., 2002., 2003., 2004., 2005., 2006., 2007., 2008. gada pārskati.
[10] Sulojeva J. Ugunsdrošības paaugstināšanas ekonomiskā efektivitāte. Maģistra darbs. – Rīga: RTU, 1999. – 80 lpp.
[11] VUGD efektīvai darbībai nepieciešamā materiāli tehniskā un finansiālā nodrošinājuma zinātniskais pamatojums. Zinātniski pētnieciskais darbs. - Rīga: RTU, 2008. – 79 lpp
[12] Thomas R.L. Modern Econometrics. - Addison–Wesley Publishing, 1997. – 535 p.

Jeļena Sulojeva, is the assistant manager for study process at the Institute of Occupational Safety and Civil Defence and the lecturer at Riga TechnicalUniversity. In 2011 she received a Degree of Doctor in Economics (Dr.oec.) from Riga Technical University. She was member of the board at SVD Group, Ltd. (2010-2011), the assistant professor and head of business department at LBK Latvijas Biznesa koledža (2008-2010).
Address: 1/7 - 114 Meza Street, Riga, LV-1048,
e-mail: Jelena.Sulojeva@rtu.lv

Vladimirs Jemeļjanovs, is a Professor of the Institute of Labour Safety and Civil Defence at Riga Technical University, Faculty of Engineering Economics and Management. In 1997 he received a Degree of Doctor of Engineering Sciences (Dr. Sc.ing.) from Riga Technical University. He delivers lectures in civil defence and fire fighting. He specialises in work safety, improvement of civil protection, fire prevention systems efficiency and fire fighting efficiency.
Address: 1/7 - 123 Meza Street, Riga, LV-1048,
e-mail: Vladimirs.Jemeljanovs@rtu.lv

Roman Zinko, Candidate of Dr.sc.ing., ass.prof., Lviv Polytechnic National University, Institute of Engineering Mechanics and Transport, Department of Mechanics and Automatization of Engineering.
Address: apt.32 LPNU Bandera street, Lviv, Ukraine
e-mail: rzinko@gmail.com

Romans Zinko, Vladimirs Jemeļjanovs, Jeļena Sulojeva. Robotu izmantošana ugunsdrošības sistēmas efektivitātes palielināšanai
Darbā tiek piedāvāts izmantot ekonomiskās efektivitātes noteikšanas metodes objektu un apdzīvoto vietu ugunsaizsardzības pamatelementiem (automātiskās ugunsgrēka atklāšanas un dzēšanas sistēmas, mobilie roboti – kas saīsinās ugunsgrēka brīvās izplatīšanās laiku, kā arī samazinās ugunsdzēsības depo skaitu uz ugunsgrēka radīto ekonomisko un materiālo zaudējumu samazināšanās pamata). Ir izstrādātas ugunsgrēka izraisīto ekonomisko un ekoloģisko zaudējumu noteikšanas metodes un ir noteikta šo zaudējumu struktūra; ir pamatota jauna pieeja ugunsdrošības uzlabošanai lauku objektos un objektos, kas atrodas ārpus ugunsdzēsēju komandu apkalpošanas zonas. Šī pieeja ir sekojoša: laukos izmantot apmācīto brīvprātīgo komandas, bet attālos objektos – ugunsgrēka atklāšanas sistēmas vai mobilos robotus. Mobilo robotu izmantošana objekta ugunsdrošības situācijas apsardzei un monitoringam būtiski saīsinās ugunsgrēka brīvas degšanas laiku un ļaus samazināt tā izraisītos ekonomiskos un ekoloģiskos zaudējumus. Jāatgādina, ka piedāvāto inovatīvo tehnoloģiju izmantošana dos pozitīvu ekonomisko efektu ne tikai konkrētā objektā, bet arī tautsaimniecībai kopumā.