

## **FIRE AND RESCUE SERVICE IN THE WORLD: STATUS AND NEW CHALLENGES**

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### **ABSTRACT**

Analysis of statistical data in the work supports the fact that the fire and rescue services developed and equipped, particularly following the development of cities, population increase and the general progress of science and technology. Constant self-examination, together with the recognition of acceptable industry standards allow fire and rescue services to set targets, measure the extent of their achievements and, if necessary, to achieve the goals of the institution program in phases. The next generation of leaders in fire and rescue services will need to use more scientific methods of forecasting operational planning engagement during emergencies and disasters because they will face with new challenges, which are caused by phenomena about which they do not have enough experience (for example, use of weapons of mass destruction, etc.).

**Key words:** fire and emergency services, statistics, fires, accidents, explosions.

### **1 INTRODUCTION**

The first data on organized forms of firefighting come from the ancient Romans. Emperor Augustus in the capital, Rome, which at that time was about two million inhabitants, has organized seven units (squads) guards who, apart from providing perform tasks related to fire protection. With industrialization, the construction of high and complex business, public facilities became necessary to establish a professional fire service. Their main jurisdiction was the fire, and in most cities were founded in the 19th century (Paris, 1800, St. Petersburg 1803, Moscow 1804, Berlin 1851, New York 1865, Vienna 1886th year). In late 20th and early 21st century, tasks of fire brigades and rescue services in general are greatly changing.

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Today it is the organization that can prevent and respond to all types of emergencies, in order to save human lives, property and environment.

In the late 70's, the United Nations established a world center of fire statistics, which restricted its activities to the study of economic aspects of fighting the fires. A number of countries (mostly European) sent to the center of reports about damage caused by fire, as well as information on how Fire and Rescue (hereinafter referred to as FAR) in these countries spend financial resources for its functioning. International Technical Committee for the prevention and firefighting (CTIF Comité Technique International De Prevention Et Du Feu D'Extinction), trying to collect and process data fire statistics. Integrating and analyzing data from fire statistics to create images of the state fire safety activities and FAR.

The main problem in the work CTIF the fact that many countries do not send the necessary statistical data on fires, and data that are sent vary in content and character.

## 2 CURRENT STATE OF THE FIREFIGHTING SERVICES OF SOME OF THE COUNTRIES AND BIG CITIES

In recent years (based on 2008 data) in the World, in analyzed countries with a total of about 3.5 billion people, about 4.5 million fires were registered, of which about 1.45 million were in U.S.A. In these fires, about 60,000 people lost lives, of which 15,279 in Russia, and USA 3500. If we take the fact that today Earth has more than seven billion people alive, it is certain that the number of fires is much higher.

Table 1 Data on total population, fires and killed in the (28-52) countries for the period from year 1993 to 2008<sup>4</sup>

Year	Number of countries	Total population (billions)	Total number of fire outbreaks (millions)	Total number killed (thousands)	Average number of fires on every 1000 people	Average number killed	
						on 100 fires	on 100000 people
1993	39	2,4	3.9	30.2	1.6	0.8	1,3
1995	40	1,2	4.5	32.5	3.8	0.7	2,7
1997	43	2,8	3.7	57,7	4.1	0.9	2,1
1999	48	3,1	3.9	51,8	3.6	0.8	1,7
2000	52	3,3	4.5	56,2	3.7	0.9	1,7
2001	41	3,5	3.8	61,9	1.4	1.1	1,8
2002	31	3,5	4.3	62,3	1.6	0.9	1,8
2003	31	3,5	4.5	61,1	3.6	0.9	1,7
2004	33	3,5	4.1	60,1	3.2	0.9	1,7
2005	45	3.5	4.3	57.4	1.2	1.3	1,6
2006	37	3.6	4.1	52.2	1.1	1.3	1,5
2007	39	3.6	4.0	52.5	1.1	1.3	1,5
2008	28	0.9	3.2	26.8	3.6	0.8	3,1

<sup>4</sup> Bruschlinsky N., Sokolov S., Vagner P.: World Fire Statistics, № 15, CTIF, Paris. Vydavatel'stvo -CTIF, Paris- Center of Fire Statistics , 2010. tabela 3-17., 9-20 s.

The main causes of fires all over the world are the same: the careless handling of open flame, neglect when smoking and technical deficiencies in electrical equipment and installations. Statistics also show that a large part includes fires in residential buildings. In the majority of interventions (80-90%) need a university fire truck with crew.

The organizational structure of bachelor degrees in most countries is similar, with more or less specific. In all major cities there is more or less developed network of fire and rescue stations that include firefighting and other intervention vehicles. Basic data about the environment and structure of the university of individual countries for 2008. are given in the table below (*Table. 2*).

*Table. 2<sup>5</sup>. Data on the structure of the university environment and individual countries for 2008. year*

Country	Number of citizens (thousands)	Number of fires (thousands)	Number of fire stations	Vehicles		Firemen		Number killed	
				Assault and other	Ladders and platforms	Profess.	Volunteer	Citizens	Fireman
<b>China</b>	1,321,852	-	-	-	-	130,00	7,500,000	-	-
<b>USA</b>	305,000	1451,5	51,450	67,800	6,500	323,350	825,450	3200	103
<b>Russia</b>	141,378	20,17	5,300	17,100	1,600	280,00	145,000	15279	12
<b>Japan</b>	128,000	-	1,687	8,147	1,282	154,02	944,134	-	-
<b>Germany</b>	82,218	-	37,717	43,343	2,107	40,918	1,039,737	-	-
<b>France</b>	63,714	31,21	8,196	-	997	38,800	199,200	402	-
<b>Great Britain</b>	60,776	32,75	2,053	2,900	235	40,100	1,400	453	-
<b>Poland</b>	38,135	16,1	17310	7,212	564	30,491	497.600	0	0
<b>Romania</b>	21,517	1,55	275	410	101	31,294	158,201	1	1
<b>Belgium</b>	10,667	27,095	252	1,680	270	5,519	52,683	3	3
<b>Serbia</b>	10,150	6.673	194	422	37	3,222	17,749	-	-
<b>Hunagary</b>	10,045	19,828	610	710	99	9,032	88,384	0	0
<b>Austria</b>	8,305	36,031	5,067	9,005	282	2,419	254,721	-	-
<b>Slovakia</b>	5,412	11,267	114	325	113	4,096	39,771	-	-

<sup>5</sup>Bruschlinsky N., Sokolov S., Vagner P.: World Fire Statistics, № 15, CTIF, Paris. Vydavatel'stvo -CTIF, Paris- Center of Fire Statistics , 2010. tabela 3-17., 9-20 s.

Financial expenses for the maintenance and development of the university in the world are extremely high (3-5% of city budget), of which 95% goes to fund salaries (wages). In a greater or lesser extent, in all countries of the world developed the organization of voluntary fire brigade. Particularly good results and the organization have volunteer fire organizations in Germany, Austria, Switzerland, Japan and others. In the overall university activities, particularly in increased activities: addressing technical assistance, assistance in various emergency situations, providing first aid, transport of injured and environmental protection. Tables 1, 2 and 3 presents data for a number of states and populous cities (10-parameter indicator). They characterize the size of the state and city (population, area), the scope of tasks and FAR (no intervention), the degree of real fire hazard in the city (the number of fires and the number of deaths) and the possibility – capability FAR [number of fire stations, fire trucks, fire extinguisher Fire ladders and platforms, vehicles for intervention and firemen-rescuers (professional and voluntary)].

Table 3<sup>6</sup>. Basic characteristics of some of the World major cities

N	City	Popula-tion (thousa-nds inh.)	Area sq (km)	Number of calls	Numbe r of fires	Num-ber of fire death s	Num-ber of fire Injur-ies	Average number per 1000 inh.:		Averag e numbe r of fire deaths per: 100000 inh.	Averag e numbe r of fire injurie s per: 100000 inh.
								calls	fire s		
1	Tokyo	12,222		-	5,762	128	-	-	0.5	1.0	-
2	Moscow	10,500	1,078	58,228	9,718	309	420	5.5	0.9	2.9	4.0
3	London	8,300	1,589	93,491	29,589	38	1,718	11.3	3.6	0.5	20.7
4	New York	8,141	790	473,395	44,054	86	-	58.1	5.4	1.1	-
7	Paris	6,508	759	479,618	17,778	58	-	73.7	2.7	0.9	-
9	Athens	3,762	3,808	12,174	10,158	1	18	-	2.7	0.0	0.5
13	Roma	2,750	1,285	56,474	12,404	9	12	20.5	4.5	0.3	0.4
15	Warsaw	1,710	517	15,427	5,578	28	136	9.0	3.3	1.6	8.0
16	Budapest	1,702	525	11,668	2,784	8	72	6.9	1.6	0.5	4.2
19	Prague	1,212	496	-	2,493	-	-	-	2.1	-	-
21	Brussels	1,048	161	-	2,659	11	204	-	2.5	1.0	19.5
27	Genova	700	243	15,495	1,870	4	5	22.1	2.7	0.6	0.7
30	Copen-hagen	500	89	5,581	2,573	5	-	11.2	5.1	1.0	-
31	Bratisla-va	429	368	2,742	1,246	3	29	6.4	2.9	0.7	6.8
35	Belgrade	1,700	3,600	5,539	4296	85	32	-	-	-	-

<sup>6</sup> Bruschlinsky N., Sokolov S., Vagner P.: World Fire Statistics., № 15, CTIF, Paris. Vydavatel'stvo -CTIF, Paris- Center of Fire Statistics , 2010. tabela 3-17., 9-20 s.

On the basis of data from tables 1, 2 and 3 (referring to a population of 2.7 billion people) we can conclude the following: *a*) there are 2.8 fires per year on every 1,000 people, *b*) 100,000 people have two deaths in a year resulting from fires, that is, on average, 0.93 deaths per 100 citizens, *c*) fires kill 0.35 firemen-rescuers on every 10000 fires. Basic features of individual cities and structure interventions in 2008. year are in the following table.

In developing and grouping of statistical data in tables 1, 2 and 3 there are many problems and inaccuracies. The table data is interpreted differently on the total number of vehicles for intervention in different cities. In doing this parameter is not very reliable. Also, from this table it can be concluded that in many cases, for the same or a similar set of interventions have different names (incidents and technical interventions). Also, the problem is the logging of connection and cooperation of professional and voluntary fire brigades, and in particular the intervention. Furthermore, the problem is the fact that different cities include territories of different sizes. In the end, in many countries is not possible to get all the parameters and data. When analyzing data from tables 1, 2 and 3 should take into account all the difficulties and needs to have enough critical approach to evaluating this information. All this, makes the analysis of statistical data for 30 states and 26 cities in the world is very complex.

As can be seen from Table 3, are very numerous interventions university of Tokyo (653,260 emergency medical intervention), Hong Kong (703 509 interventions), New York (473 395 interventions) and Paris (479 618 interventions, in which the university to intervene in cases of emergency).

From table 3 and we can conclude that in most of the engagements in major cities share a fire in the total number of reasons for intervention relatively small (Tokyo, Hong Kong, New York, Paris and London) and the university have tasks to perform and a significant percentage tasks of the medical or technical assistance. On the other side of the city of Athens, Sofia and Belgrade with a much smaller number of attempts Fire and rescue units to the intervention, but the number of attempts to fire the still very large. It should be noted that the firemen-rescuers in these cities the most important task is still fighting fires. Assistance in natural disasters and other emergencies, in these and other cities are increasingly being awarded university. If we analyze the joint statistics service for emergency medical rescue, a variety of technical interventions and fire, then get the data from several hundred thousand intervention. Therefore, this analysis gets a similar picture as in the case of large cities in western countries and their fire brigades which were compared in tables

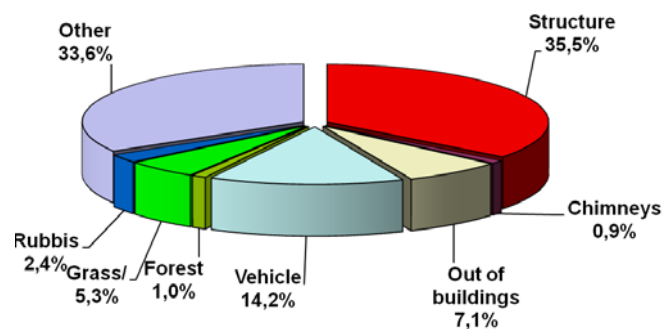
Analysis of indicators in these tables and graphs allows drafting decisions on the organization of university. In the cities of the United States and Canada there is a high fire hazard and the resulting fire. Therefore in them is a high degree of density of fire stations with modern equipment. It is similar to other North American cities, as well as cities in Japan. Number of fires in the cities of Africa is much smaller.

The scope of the research university engagement in these cities will be constantly expanded. In doing so, we need very much support national and international organizations (international fire and rescue association), for unification (standardization) of observed data. For example, there is still no uniform statistics for

fire and rescue service, no matter what is in that direction in some countries it operates. There are many questions: which indicators should be collected, processed and presented to the evaluation? To what end and purpose of this data should be considered? It is important to emphasize that all specialist services should have a common position for establishing a unified but flexible methodology, whose results will be suitable for practical application. It should be noted that the volume of data for most cities apply only to the urban area without suburbs. Especially it has to be seen the degree of development of surface.

Statistics show that interventions FAR is built and populated areas of greatest concentration of events (fires, car accidents and various interventions which need help). Infrastructure of cities is changing, and therefore the structure of the population (overpopulation of urban centers, population growth in the outer parts of the city and suburbs). In this respect, Figure 1 must be interpreted with caution, often because of significant differences in reporting [eg]., some countries (mostly European) chimney fires appear separately, while others (including the U.S.) are shown as fires in buildings, then some countries (including Belarus and Russia) are not recorded most of the fires that affect certain parts of grass, while some other countries (including Cyprus and Romania), kind of fire so chose. other categories].

Figure 1 Distribution of fires by fire origin (2008)



To conclude this part of the work can be done several significant conclusions. On the basis of population data in millions of cities, certainly can be done most of them, which can be made normative: "The 100,000 people there should be one fire station, and the 1,000 people there should be a fireman."

### 3 NEW CHALLENGES FIRE AND RESCUE SERVICE IN THE 21<sup>ST</sup> AGES

Fire and rescue service in the 21 century expect many significant problems, for which the experts have to provide appropriate solutions. In addition, experts must provide answers to the questions of the organization, management, improvement of fire protection and rescue, where one must take into account the natural indicators and practical experiences.

Predictions (with aspects of the way and the outcome) vary from country to country. In the Russian Federation and the United States designed a mathematical simulation models of forecasting events, their location, involvement of the Fire and

rescue teams on interventions, and other busy times. Of course, predictions are clearer when analyzed at the beginning events of the past. The old saying goes that if you study the history – we will be forced to repeat it. There is another, which says: “If you do not know where you’re going, you will never lose” The growing concerns regarding the use of weapons of mass destruction (WMD), or facilities in which these funds produced and stored, or the funds to be transported, and preparedness for terrorist attacks, they say, in addition to other services and the university, to stimulate the planning process for expanding the role of high expertise in the safety of society.

According to experts, chemical and biological agents whose use is most likely during the performance of acts of terrorism are: toxic herbicides and insecticides, hazardous chemicals: chlorine, phosgene, hydrocyanic acid and others; toxic substances: sarin, soman, mustard gas, lewisite, psychogenic substances and drugs, causes severe infections of black pimple, smallpox, tularemia and other, natural toxins and poisons: strychnine, ricin, botulotoksin et al. Among the major threats of a terrorist nuclear accident or other acts (for example, an earthquake in Japan that caused the tsunami, which was then damaged the appropriate systems that have resulted in general average, fire ii highlight radioactive materials in nuclear power Fukushima) are: average or deliberate sabotage, explosions and destruction of nuclear reactors.

Fire and rescue services around the world looking for more specific answers to some crucial questions: What type and level of forces required for adequate safety of different types of local and community groups (?) What strengths and resources necessary to provide basic fire and rescue services to the community (?) What are the indicators and characteristics are adequate or better FAR (?) Can a professional and volunteer firefighters composition-rescuers, working together organized and productive (?); What to emergency services (eg medical assistance) better performing individual tasks and tasks of high expertise (?) What should be the source of funds for financing local FAR (?) What role and responsibility should have a national university and other national service, whose work has focused on wildfires and rescue (?) In response to these questions, we can say that it is safe to FAR and rescue service in the future, the priority in the work have a resolution of the following questions:

1. The broadest and most important challenge that will face the future leaders of the university is constantly changing the number and types of jobs and tasks (services) to fire-rescue units to provide the community (fire fighting, fire prevention: participation in the resolution and remediation of chemical and biological accidents and radioactive materials, participation in addressing and repairing damages to oil and oil pipelines; help drowned and Water Rescue, emergency medical services and transportation of patients and of victims, assistance with industrial accidents, natural disasters, aid, technical rescue of people, animals or property; indication of technical assistance and services, joint action with the service order, (the police).

2. The trend of increasing surface area of cities and population in them ( 35 mil.)

3. In all the university will be increased attention to the identification of all types of hazards and risk assessment, which corresponds to the change of priorities in public policy almost all countries in the field of population and territory against the dangers and threats, different types – instead of a “culture of reaction” to emergencies, in the first place there must be “culture of prevention “.

4. Defining the relationship between the university and the Emergency Department in terms of their future possible mergers and growing into a service.

5. Environmental protection is becoming increasingly a priority in the plans of all countries, and training and engagement of FAR for all major environmental interventions.

6. Standardization and accreditation procedures in the university (eg, standard coverage of the territory, standard operating procedures for fire fighting, rescue, etc.), as in all other areas in the interest of improving the safety of citizens and society, and further increases the security and status of fire-rescue workers to higher quality of VS units.

7. Prediction in emergency planning and disaster (earthquake, flood, technical / technological accidents, etc.), because the university faced a new challenge – the answer to the problems that rarely occur and which do not have much prior experience and to engage significant power and resources. The bottom line is in transition from development plans and preparations for events with high probability to events with low probability.

8. Favoring by the FAR historical concept of “worst case scenario” (present from ancient Greece and in the writings of the philosopher Seneca), in relation to the concept of estimated risk.

9. Wind in the creation of new specialist services and teams [currently FAR takes precedence over the primary response teams and urban search and rescue (USAR)] to respond to new challenges will greatly complicate regulation of their responsibilities and competencies. Going forward, the university will increasingly operate in a wider area of joint actions, sharing responsibilities and resources from emergency and other services. It is possible that first responders will not have the most important role in certain major BRNC incidents and emergencies. There is an increasing need for multidisciplinary teams for response (composed of medical doctors, engineers, radiologists, meteorologists, lawyers, environmental experts etc.). Integrated systems and command operative centers will be the framework for managing crisis response in major emergencies.

10. Possible problems during the civil unrest and demonstrations, when the university could become the target of attacks by citizens, so that members of the university must pay attention to their safety.

11. The terrorists know that by causing secondary explosions and other adverse effects, can cause death in relation to fire-rescue workers, police officers and members of other departments.

12. It is possible, that some powers and responsibilities related to emergency and rescue will be translated into some specialized services of police and military.

13. Further increasing the number of Fire and Rescue Station (closer to their places of origin on bases of possible emergency events).

14. The transition from large to small and slow and faster cars fire engines, which will in conditions of high traffic congestion roads faster progress towards the place of intervention, providing ladder and platforms “telescope” type with a height within reach, commands from the ground, construction vehicles and building “container” type of future directions in the modernization of equipment FAR. Also, it is the development of special equipment to perform the task of searching (search) and



rescue in the rubble, water surfaces and all other areas, especially to perform special tasks, when radiological, chemical and biological emergencies.

15. Training and use easier and more functional personal protective equipment (apparatus, helmets, protective suits, clothing and footwear), in order to create conditions for efficient work on interventions, with a care that much protection can reduce the basic instinct of self-protection firefighters – rescuers. Further computerization of [Global Positioning System (GPS) and geographic information systems (GIS)] as well as improved communication systems at university.

17. Application of the new modern means for extinguishing fires, increase the efficiency of operation of existing assets and reduction of damage caused by shutting down

18. Building a modern center for training firemen-rescuers, upgrading training, to model “real-fire” and virtual models, a further specialization of firemen-rescuers for certain types of businesses and executives to higher levels of management.

19. In a number of cities, a large number of firemen-rescuers and commanders will retire, which means that they VS units that have a high percentage of older workers. This will result in the recruitment and training of new fire-rescue workers and managerial staff in a very short period.

20. Improvement of legislation in the field of fire, flood, earthquake, etc., which will improve, above all, safety measures in buildings.

21. The scale of the dangers and threats in the twenty-first century makes the need for strengthening the role of international institutions and international cooperation in countering these threats, in which the university has a special role.

22. Further construction of housing facilities or production in areas prone to natural disasters (earthquake and its consequences, floods, hurricanes, etc.) require the creation of massive training programs where the university will have a significant role.

## **4 CONCLUSION**

Identification of the situation and new challenges to fire-rescue services in the world was in the function of defining strategies for their future development. The way to will achieve this is the collection, processing and using data on the state university in the world, especially in big cities of most developed countries, which are reasonably believed to represent the standard (minimum quality) and firefighting. However, these data were not considered reliable enough due to lack of uniform methodology for processing and use. Nevertheless, there were a certain levels of data reliability on the basis of which' to define the specific cause-effect relationships and expectations in the field of firefighting, some of which are listed in the main part of the paper. However, given that the data were sufficient, if possible, the optimum (maximum) level of confidence, it is necessary to develop, implement and promote a unique methodology for collecting, processing and using data on the state university in the world. The challenges of fire and rescue services in the world as a professional contradictions, should be harmonized, and to the said subjects of security optimal engaged in the performance of official duties and special-purpose tasks. So far on this subject are known and proven (scientific) knowledge, as well as many famous and not proven (and therefore unscientific) knowledge, experience and even more uncertain. The

hypothetical views on the identification of current challenges and possible fire and rescue services in the world, many of which are listed in the main part of this work, a solid basis design, organization and implementation of macro, mezo and micro projects in the field of fire and rescue services in the world.

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