

ORGANIZING FOR EMERGENCIES – ISSUES IN WILDFIRE FIGHTING IN CROATIA

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ABSTRACT

Croatia's accession to the European Union implies inevitable changes in the national emergency management system. New requirements for adjustment in accordance with the EU standards and practices also apply to the fire-services organization. Harmonious functioning of a large number of relatively autonomous organizations related to the National Protection and Rescue Directorate necessitates clear decision-making authority and coordination mechanisms as well as a high level of interoperability and core competencies development. This paper gives an overview of the Croatian fire protection organization along with its accompanying legislation, followed by an analysis of identified problems, especially those concerning fighting of wildfire. In our research a survey questionnaire comprised of Likert-scale items was used to assess the attitudes and experiences of trained fire department members. The respondents reported a relatively low evaluation of effectiveness and appropriateness of the following key fire service attributes: organizational structure, legislation and firefighting logistics support. From the obtained results guidelines can be drawn for possible redesign of the emergency management organization, especially those concerning the fire protection service.

KEY WORDS

coordination and interoperability, emergency management, firefighting, organizational changes, survey

CLASSIFICATION

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INTRODUCTION

Due to climatic influences and its geomorphological and biological specificities, the Republic of Croatia is particularly exposed to open space fires (or wildfires), especially in the coastal areas. Such a fire can have characteristics of a large fire, which requires the involvement of all the material, technical and organizational resources of associated agencies and the wider community, which can consequently disturb the functioning of certain segments of society. In that respect, the role of firefighting is particularly notable in the improvement of public safety in Croatia.

In the United States, the purpose of Firefighting as Emergency Support Function is defined as providing “Federal support for the detection and suppression of wild-land, rural, and urban fires resulting from, or occurring coincidentally with, an all hazard incident requiring a coordinated national response for assistance” [1]. Emergency management generally needs to ensure an efficient emergency response as a process of gathering resources and acting upon the problems immediately after the incident that may result in damage to property or harm to people occurs [2]. Sylves [3] claims that emergency management can be defined as the process of developing and implementing distinct policies concerned with mitigation, preparedness, response and recovery. The definition of emergency management by Wilson and Oyola-Yemaiel [4] includes coordination of all emergency functions in order to prevent the occurrence of damage and minimize its extent.

In Australia, emergency evacuations generally occur in the face of natural disasters, most commonly in case of wildfires, floods and, occasionally, cyclones [5]. In the European Union, according to Zulean and Prelipcean [6; p.515], the most important factors regarding emergency preparedness and strategic planning include the concerns of a majority of citizens regarding man-made disasters, natural disasters, terrorist attacks and armed conflicts. In the European Union, the firm attitude prevails that activities in the civil protection should be coordinated across the member countries. According to Turoff et al. [7], in a study [8] conducted among the majority of Romanian emergency system managers, large-scale forest fires were identified as a second ranking threat, after earthquakes.

In Croatia, efforts in creating an effective organization that would enable successful *emergency management* led to the establishment of the National Protection and Rescue Directorate (NPRD) in 2005. The European emergency number 112 has been attached to the NPRD [9], which can be used for notifications on situations requiring urgent medical aid, or interventions by firefighters, police, mountain rescue service or other NPRD services.

Upon the establishment of the NPRD in Croatia, certain organizational discrepancies regarding firefighting emerged between that new central institution and the existing Croatian Firefighting Association under the Ministry of Interior. While in some fire emergency situations the system functions properly on the whole, relative redundancy and inconsistency regarding the regulation, management and supervision is generally evident in its functioning. Finally, oscillations can be observed in the organization at the local level, especially in fighting wildfires.

Modern organizational design in emergency systems, including firefighting, is mainly concerned with issues of legislation, institutions, coordination and communication of organizational entities and resource allocation [2, 10-13]. Due to the multi-dimensional character of the issue, a detailed overview will first be presented.

The main objective of this paper is to examine firefighting in Croatia, the accompanying legislation, efficiency of the operational functioning of the organization in emergency response



Figure 1. Geographical position of Croatia as a relevant factor in the context of coastal firefighting.

activities as well as potential causes of inefficiency. The availability of human resources with experience in participating in emergency response scenarios enabled us to conduct research (Section 5) into observations and opinions related to operational functioning of firefighting in crisis situations. The results of our research are aimed to indicate possible directions and recommended organizational changes, taking into consideration identified shortcomings.

THE FIREFIGHTING SERVICE IN CROATIA

Organization of the fire service, with a large number of different and relatively autonomous actors, is demanding in terms of both management and coordination. Territorial organizations have a great influence on distribution and delivery of vital resources. In bigger crisis situations, the tasks of planning of operations, deployment and redeployment are particularly challenging. In the context of complex firefighting actions, the term ‘organization’ is of key importance. According to some authors, e.g. [14], it can generally refer to the activity (organizing) or the condition arising from organizing (that is – order, design, system structure). Consequently, the firefighting system must be transformed from its state of readiness into the operational state in a short time, depending on the necessity for an emergency response. The success of this transformation is crucial for the outcome of firefighting actions.

At the beginning of every year, the chief firefighting commander of the Republic of Croatia makes a decision on the establishment of the Croatian Fire Brigade Headquarters, Coastal Firefighting Headquarters, Continental Firefighting Headquarters, County Firefighting Headquarters, and appoints their commanders. The holder of the preparatory activities for the fire service is the NPRD. For the purpose of firefighting actions in two or more counties additional forces can be engaged, such as the firefighting air force and members of national intervention units. In such cases the intervention is managed and coordinated by the Continental Firefighting Headquarters. With regards to emergency management, large fires are recognized as a permanent security risk for the Republic of Croatia in the Security Strategy as a cornerstone document of Croatian security [15]. Wildfires are also defined as a particular threat to lives of citizens and their property in the Regulation on Internal Organization of the NPRD [16].

THE LEGAL FRAMEWORK FOR FIREFIGHTING

Article 135 of the Constitution of the Republic of Croatia stipulates that local authorities perform the activities of local jurisdiction that directly address the needs of citizens, such as firefighting and human protection. The Law on Protection and Rescue, as a cornerstone

document for protection and rescue [17], regulates the system of protection and rescue of people, material and other resources in disasters and catastrophic accidents. Before the Fire Protection Law issued in 2010 [18], legal solutions had been outdated and inconsistent with the current legislation in the Republic of Croatia and the EU law acquires. Specific areas, such as conformity assessment, placing on the market, availability and control of fire protection products, had not been arranged at all. The Law on Protection and Rescue [17], with its sub-regulations and corresponding acts related to this law, almost entirely meet the criteria set in accordance with the EU accession guidelines. The emphasis in the EU regulations is on the decentralization of the firefighting service, an issue which still poses certain challenges in Croatia.

The Fire Protection Law [18] regulates the fire protection system, which includes planning for fire protection, prescribing measures for fire protection of buildings, setting up entities for fire protection, fire protection enforcement, fire protection funding and training as well as accreditation for performing fire protection. The Law on Firefighting [19] primarily defines firefighting activities and bodies involved therein, namely: firefighting units, volunteer firefighting units and firefighting associations. The establishment of firefighting units is the responsibility of representative bodies of the local self-government, in accordance with firefighting protection plans. In addition, volunteer firefighting departments can be established at the local level.

The firefighting system is also additionally regulated by the Occupational Health and Safety Act, in accordance with the National Fire Protection Strategy (Draft) [20]. New laws, sub-regulations and directives for firefighting are issued almost on annual basis, or at least amended in order to comply with the existing legislation and enable proper organizational functioning.

INTERNAL ORGANIZATION OF THE NATIONAL PROTECTION AND RESCUE DIRECTORATE

In Chapter 2 of the US Federal Emergency Management Agency's doctrine document [10] its roles and missions—ranging from preparedness to recovery—are described and explained. Similarly, in Croatia policies related to a whole spectrum of emergency management sub-processes at the national level are defined by the NPRD, while the implementation of activities takes place at the county and local government levels. The NPRD provides the assistance, support and leadership to help the state, county and local governments build operational capabilities needed to successfully implement preparedness strategies. In the selected representative excerpt it is stated that the mission of the NPRD is "... to establish and maintain a modern system of protection and rescue in Croatia that, using all available resources, will be able to respond to needs for the protection of people, property and the environment ..." [21].

An organizational structure is generally a formal system of tasks and relations of authority that serves to exert control of coordination of human activities and the use of resources to achieve organizational goals [22]. The main purpose of the implementation of the management structure is organizational control [23]. According to the government's Regulation on Internal Organization of the NPRD [16], the Headquarters is set up in the capital, with regional (county) offices established for the protection and rescue of a particular county's area. The Headquarters staff is organized in the following units: Office of the Director, Department of International Relations, Internal Audit Department, Civil Protection Service, Firefighting Service, 112 System Service, College of Firefighting and Rescue, and Shared Services. The NPRD mission is defined by the Law on Protection and Rescue and the Law on the Structure of State Administration [24].

The NPRD is an independent professional and administrative organization in charge of preparation, planning, management and coordination of operational forces. The Chief Firefighting Commander, who is also the Assistant Director of the NPRD, is responsible for the organization, training and preparedness of the Croatian firefighting forces. The National operational forces in the structure of the NPRD are the State Firefighting Intervention Unit and the State Civil Protection Intervention Unit. Those operational units are responsible for conducting emergency operations as well as for planning and preparedness. According to several documents e.g. [25], there are three levels in the organization of Civil Protection in Croatia. Fire brigades pertain to Level 3 (that is, town or municipality mayors), while the central authority can exclusively intervene and move units from one area to another.

CROATIAN FIREFIGHTING ASSOCIATION

The Croatian Firefighting Association (CFA) is a professional, humanitarian and non-political association whose declared mission is to “... act as one of the pillars of public safety with the primary task of ensuring the security of people and property in order to strengthen the national security system through the implementation of firefighting activity” [26]. To achieve such a mission an advanced human resources development system is needed which relies on the education and development of competencies required to perform complex jobs. Therefore, for each particular position general and specific skills requirements are defined in [19] in Article 21.

The head of the CFA is one of the Assistant Chief Firefighting Commander of Croatia. The CFA bodies include the CFA Assembly, Presidency, Operational and Technical Staff and Supervisory Board, among others. The Law on Firefighting [19] defines the bodies responsible for firefighting activities, that is, professional firefighting units, volunteer firefighting units and firefighting associations. Fire intervention units, which are under the direct jurisdiction of the NPRD, are not included in the organizational structure of the CFA. In Croatia there are 20 county firefighting associations together with the Firefighting Association of the City of Zagreb (Table 1), all of which constitute the CFA. The Association receives funding through the state budget, whereas volunteer firefighting associations and other fire-fighting societies are funded by counties and municipalities (with up to 5% of their own revenue).

Table 1 shows that a large ratio of human resources is generally not allocated in the coastal areas, where most severe wildfires tend to occur. Out of the total size of the firefighting force,

Table 1. Existing firefighting forces in the Republic of Croatia by counties [27].

| County | Coastal area | Number of firefighters | | County | Coastal area | Number of firefighters | |
|------------------------|--------------|------------------------|-----------|-----------------------|--------------|------------------------|---------------|
| | | professional | volunteer | | | professional | volunteer |
| Bjelovarsko-Bilogorska | no | 97 | 1 870 | Primorsko-Goranska | yes | 226 | 1 300 |
| Brodsko-Posavska | no | 52 | 893 | Sisačko-Moslavačka | no | 103 | 1 720 |
| Dubrovačko-Neretvanska | yes | 150 | 1 056 | Splitsko-Dalmatinska | yes | 136 | 1 510 |
| Istarska | no | 226 | 1 001 | Šibensko-Kninska | yes | 119 | 410 |
| Karlovačka | no | 72 | 7 000 | Varaždinska | no | 69 | 1 721 |
| Koprivničko-Križevačka | no | 109 | 2 382 | Virovitičko-Podravska | no | 39 | 2 400 |
| Krapinsko-Zagorska | no | 74 | 2 980 | Vukovarsko-Srijemska | no | 83 | 1 354 |
| Ličko-Senjska | no | 50 | 472 | Zadarska | yes | 164 | 1 106 |
| Međimurska | no | 37 | 1 020 | Zagrebačka | no | 120 | 4 594 |
| Osječko-Baranjska | no | 126 | 1 940 | City of Zagreb | no | 337 | 6 772 |
| Požeško-Slavonska | no | 40 | 2 761 | TOTAL | | 2 429 | 46 262 |

professional and volunteer, respectively (2 429 + 46 242), a fairly small portion (795 + 5 382) is situated in the Croatian coastal counties.

FIGHTING WILDFIRES: THE CASE OF CROATIA

The Mediterranean region is exposed to wildfire threats that have negative impacts on people and property, and also destroy biodiversity, increase desertification and decrease air quality, among others [28]. Wildfire management can be defined as an activity aimed for protection and rescue of citizens and property from harmful effects [29]. The common and most important task in managing the fighting of wildfire is to adequately and accurately select and mobilize the necessary forces and material resources to successfully combat fire. The major factor that influences the movement dynamics of wildfire is fast-flowing wind [30, 31]. Such wind can create conditions for skip fire, which causes fire to spread across longer distances. In fighting wildfire in Croatia local firefighting units in municipalities on the territory of which the fire occurs are primarily involved. Depending on the degree of vulnerability, which is often defined on a 1-5 scale, additional forces can be engaged.

In Table 2 it is evident that material damage caused by fire in the coastal areas periodically exceeds the damage in the continental areas four times, wherein oscillations in the damage tend to occur more frequently in the coastal areas. The discrepancy between the size of the available firefighting forces (Table 1) and the data presented above is notable. Namely, expert assessment of fire severity and vulnerability indicates a high level of vulnerability in a large part of the coastal areas, with a minor risk level in the continental areas. Some other countries facing similar problems are even starting to consider the inclusion of the tourism industry in the structure of protection and rescue, as reported in [33].

ORGANIZING WILDFIRE OPERATIONAL ACTIVITIES

According to fire protection plans, in the period from 1 June to 30 September additional troops are engaged in coastal firefighting forces, for which planning of training and equipment is also required.

The Croatian government enacted the Program of activities in the implementation of specific fire protection measures of interest to the Republic of Croatia in 2013 [34]. Based on that program the Plan for dislocation of firefighting forces was developed. Wildfire in a particular area (e.g., a county) commonly requires alarming several firefighting units. In that case the County firefighting commander takes command with the support of the County Firefighting Headquarters in coordination and management of activities. For the purpose of rapid reaction in fighting wildfire, considering the coastal area exposure, State Intervention Firefighting Units Department were founded to which the Air Firefighting Unit of the Ministry of Defense also belongs (Fig. 2). Such a complex organization encompassing different units requires good coordination and communication. The aforementioned challenges in wildfire firefighting

Table 2. Material damage in open space areas caused by fire [32].

| DAMAGE | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---------|---------|-------|-------|--------|--------|--------|--------|--------|
| MATERIAL DAMAGE OF OPEN SPACE – CONTINENTAL AREA (1000 HRK) | | | | | | | | | |
| | 124516 | 20219 | 31829 | 44606 | 238477 | 115814 | 38319 | 10128 | 91805 |
| MATERIAL DAMAGE OF OPEN SPACE – COASTAL AREA (1000 HRK) | | | | | | | | | |
| | 1604044 | 47217 | 34543 | 40711 | 634049 | 209847 | 63551 | 51374 | 486670 |
| SUM | | 1728560 | 67436 | 66372 | 85317 | 872526 | 325661 | 101870 | 61502 |

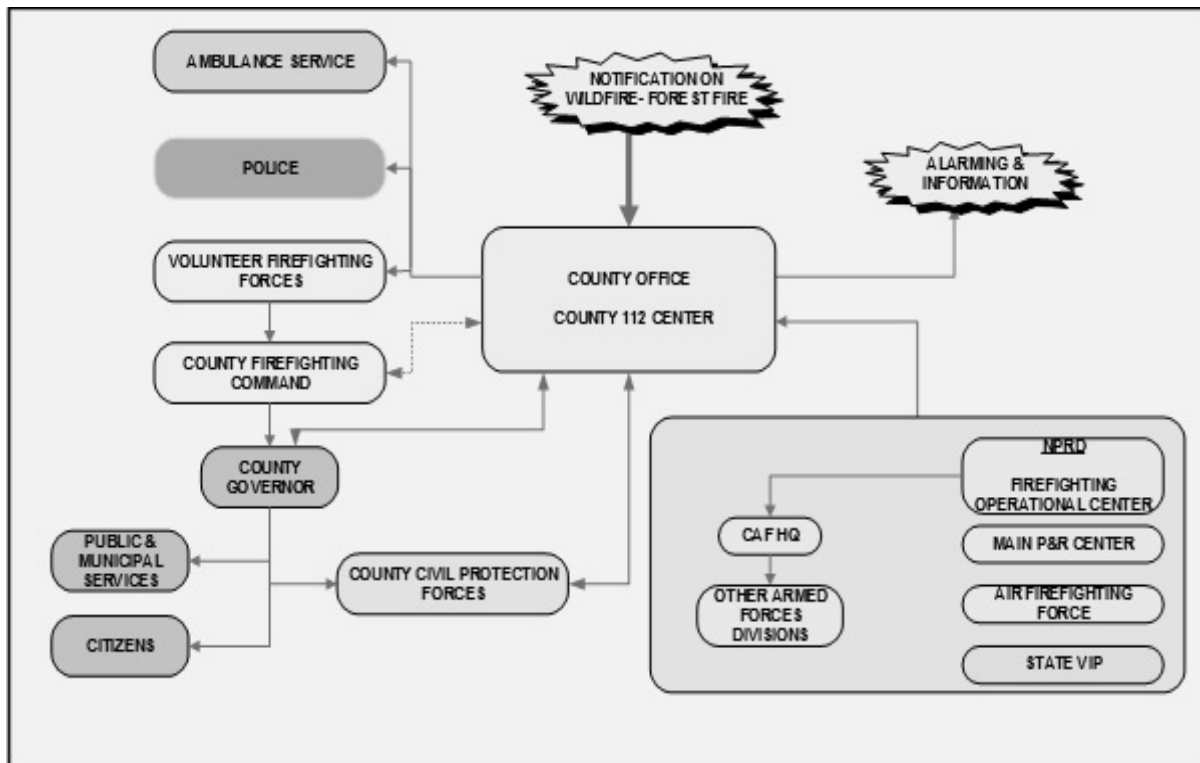


Figure 2. Schematic representation of coordination of all forces at the county level during forest fire [27].

also indicate the requirements for effective application of a special form of firefighting logistics.

FIREFIGHTING LOGISTICS AND LOGISTICS MANAGEMENT

As a science, logistics is a collection of multidisciplinary and interdisciplinary knowledge related to exploring and applying laws of planning, organizing, managing and controlling the flow of materials, people, energy and information through organizational systems. In accordance with this definition, the process of logistics management [35] is defined. Recently some authors [36] have suggested that firefighting logistics should be considered as a subsystem of the so-called ‘quintary-logistics system’ of specialized logistics (also including public administration, army, judiciary, etc.). Firefighting logistics as a science and firefighting logistics as an activity refer to the totality of resources, potential, measures for the protection of natural resources, people and their property from fire, especially large fires which cause extreme material damage [37].

Owing to its central role in the emergency response system, the NPDR activity is of key importance for ensuring coordination during major firefighting actions as well as in the strategic planning and procurement of equipment for fire service tasks. Consequently, NPDR is actually responsible for proper firefighting logistics support, which includes: optimal performance of firefighting actions; operational readiness and reliability, compliance with the requirements and needs of the community and achievement of minimum cost and maximum safety of firefighting participants. However, in the recent draft of the Strategy it is stated that it is “... necessary to create a proposal of a new organizational model of firefighting, whereby relations in the firefighting system at the town (municipality), county and state level would be precisely defined. As a matter of fact, over the past decade certain deficiencies or inaccuracies in the existing legislation have been observed ...” [20].

OBSTACLES TO THE ACHIEVEMENT OF THE MISSION AND OBJECTIVES OF FIREFIGHTING IN CROATIA – THEORETICAL CONSIDERATIONS

Since 2000 the number of professional firefighters and professional units in Croatia has increased by about 20 % due to the introduction of new legislation ensuing from the adoption of the EU acquis, as well as the expansion of protection criteria. In spite of that, in circumstances of the economic crisis, local and regional governments are operating within the same or, in most cases, reduced budgets, which is inevitably also reflected in the funding of firefighting services. Another issue is the legislative struggle over a body that would be responsible for firefighting, with public authority. Although, according to the Law on Protection and Rescue, NPDR is a central government body in charge of the Fire Service, the Law of Firefighting defines all firefighting entities/units as belonging to CAF.

Therefore, the operational power of the Fire Service is based in a single entity (CAF), whereas the commanding function is also partly executed by that entity and partly by a state body (NPDR). Furthermore, the firefighting activity is under the jurisdiction of the state body also responsible for its management, while the local self-government is responsible for its financing. As a result, in firefighting practice certain patterns of inefficiency and insufficient cost-effectiveness and imprudence tend to emerge. This particularly applies to emergency situations related to fighting wildfire.

In the theory of modern organization the aforementioned problems are described as typical of large, horizontally differentiated structures and joint organizational action forms. In that respect, the identified problems are mainly associated with categories of interoperability and coordination, as well as the development of a consistent model of governance and decision-making. According to Lawrence and Lorsch [38], an appropriate organizational structure that regulates internal relations represents significant support for every organization in effectively responding to coordination and motivation issues. Although the emergence of information technologies has generally resulted in changes in the way of organizing over the last two decades, the selection of an adequate organizational structure remains an important issue. Different coordination mechanisms are used for coordination of individuals and organizational units in their effort to achieve common (organizational) goals. Coordination is also necessary in joint actions of several organizations [39]. Hartnett and Campbell [40] identify obstacles to coordination that often occur in the process of inter-organizational (-agency) and similar associations, including: organizational sovereignty, complex missions with great uncertainty, large differences between agencies in terms of force and resources; differences in programs, approaches and timelines between agencies; different cultures and communication systems; vertical bureaucratic barriers within agencies and coordinating policies. According to Chen et al. [41], effective coordination is an essential component of emergency response management. However, coordination of emergency response can be demanding because of high uncertainty and necessity for rapid decision-making and response on the one side and resource constraints on the other.

The question of interoperability has been gaining significance with the increasing number of organizations participating in joint operations, projects, missions and activities such as firefighting. According to the UK's National Policing Improvement Agency [42] interoperability in the context of multi-agency co-operation is the ability of an organization or individual parts of an organization to exchange operational information and use it for successful decision-making. Kubicek and Cimander [43] propose the following four levels of interoperability with related objects: technical (signals), syntax (data), semantic (information)

and organizational (processes). Interoperability between the command structure of firefighting and rescue includes the following [13]:

- compatible communications systems, equipment and control,
- joint agreements regarding command, control and coordination,
- effective information, notification and data sharing,
- compatible operating procedures and governance relying on familiar, common terminology, and
- compatible individual and collective training, and others.

According to Sutton [44], failure to achieve interoperability is the inability of the network to meet specified levels of interoperability, conditions and requirements, such as the minimum acceptable rate of data transfer, quality of service and the maximum allowable time of reaction. Firefighting performance is largely dependent on the average response time and response [45], for the improvement of which specific training strategies can be used [46]. Owing to their characteristics, some modern logistics systems can be classified as complex [47, 48]. Such systems are challenging to manage, because supporting mental or computational models that reduce complexity by omitting seemingly unimportant parts can lead to erroneous conclusions regarding the expected outcomes of the behavior of the organizational system.

The design of information systems for logistics, or for the purpose of fire protection, is of great importance. With the intent of better communication, coordination and resource management in crisis situations appropriate solutions are used, such as Critical Software PRIMFIRE [49], in addition to new ways of improving information-sharing and decision-making that are being considered [50, 51]. Below, after a theoretical interpretation of the fire service specificities, we shall focus on a more detailed description of the current situation, i.e. detection and formulation of problems in the Croatian firefighting system. For this purpose, we conducted a survey on the experience and attitudes of competent members of this service.

RESEARCH ON EMERGENCY RESPONSE IN THE FIREFIGHTING SYSTEM – WILDFIRE FIGHTING EFFICIENCY

Emergency response for wildfire crises includes numerous factors which increase the complexity of such situations, including surprise, speed of development, spatial extension, number of involved stakeholders, uncertainty, lack of flexibility in decision-making, lack of available resources and reduced ability to communicate, among others [52]. Our research was designed and focused in a way to explore whether the indicated problems related to fighting wildfires concerning the accompanying logistics, organizational structure and legislation are recognized among the population of skilled firefighters. Generally speaking, research into the current state of an organization is one of the stages in the process of organizational redesign [53]. In other words, the aim of the research to obtain insiders' judgments regarding the organizational design issues that can be applied to subsequent systematic efforts in developing possible scenarios of emergency organization redesign.

SURVEY ON THE STATE OF FIREFIGHTING

The sample of respondents in the survey was comprised of professional firefighters who had participated in fighting wildfire on several occasions as well as firefighting commanders. The sample can be characterized as a random sample drawn from the basic set of trained and experienced firefighters. It needs to be noted that they mostly belong to forces from the continental part of Croatia. The survey was conducted at the end of 2012. A total of 72 firefighters received the questionnaire by email or in courses and seminars, while it was

personally delivered to operational firefighters—members of the Intervention Firefighting Units of Croatia. From the administered questionnaires, 45 (62,5 %) were properly completed and returned. The questionnaire consisted of three sheets containing 11, 12 and 7 items, respectively. For the purpose of this study the first and the third sheet were used, with a total of 18 questions. The respondents' attitudes were tested using the 5-degree Likert scale. The questions are included in Table 3, in which the frequencies of individual responses are also shown. The items were formulated with regards to the research goals aimed at determining potential weaknesses in the operational functioning of firefighting and determining possible causes in the sphere of its internal and external organizational environment. Although it is evident that the sample of firefighters that participated in our study generally does not dispose of formal expertise regarding legislation, finances and logistics, it can be assumed that they base their own opinion about those issues on their own professional experience, and have formed attitudes or assumptions regarding the causes of inefficiency in the firefighting practice. Therefore, this observation is of particular importance in case of items 1, 7, 11, 15, 17 and 18.

RESULTS

In accordance with the standards of research data processing, the required consistency of answers was first established in the data on respondents' attitudes collected by a questionnaire containing Likert-scale items. The Cronbach's alpha coefficient was 0,7915, which implies satisfactory reliability (see: Gliem and Gliem [54]).

In Table 3, the left-hand column contains the items and their numbering as well as information about inversely oriented items (marked INV, which denotes that a high degree of agreement with the statement indicates a negative attitude about the current state of the subject/topic in that item). The number of responses for each degree of agreement (*n*) is expressed in percentages. In subsequent quantitative analysis of responses, values of inverse items were reversed using the simple model (1 → 5, ..., 5 → 1). Next we divided the total set of items by four topics (Table 4). For three groups of items mostly negative attitudes of respondents were identified, with the average score slightly above the response 'mostly disagree' (score 2).

The basic sample of subjects in this study is comprised of competent and well-trained staff with experience in wildfire firefighting. It is assumed that there are approximately 3 000 (or slightly more) such members of the firefighting force in the firefighting system. That number is accounted for by the fact that every year 3 000 firefighters¹ (if all aggregated categories are considered) undergo necessary training, wherein instances of duplicated training and lack of experience with participating in firefighting are also included. A sample of 45 respondents is considered representative. By computing the mean estimate [55], and taking into consideration the aforementioned data, assuming that the standard deviation equals 0,6, we found that the mean of the basic set is determined by the arithmetic mean of the sample with the ± 0,17 interval range, with 95 % reliability. It is clear that the obtained (low) scores shown in Table 4 are not significantly shifted by this ambiguity.

Table 3. Responses to questionnaire items (continued on p.102).

| QUESTIONNAIRE: PART 1 | | | | | | | | | | |
|--|---------------------|------|-------------------|------|-----------------------|-----|----------------|------|------------------|-----|
| STATEMENTS | I entirely disagree | | I mainly disagree | | neutral or no opinion | | I mainly agree | | I entirely agree | |
| | <i>n</i> | % | <i>n</i> | % | <i>n</i> | % | <i>n</i> | % | <i>n</i> | % |
| P1. Laws and regulations that govern firefighting facilitate optimum firefighting. | 6 | 13.3 | 10 | 22.2 | 4 | 8.9 | 22 | 48.9 | 3 | 6.7 |
| P2. The organizational firefighting structure fully enables an optimal course of action in fighting wildfires. | 10 | 22.2 | 14 | 31.1 | 3 | 6.7 | 14 | 31.1 | 4 | 8.9 |

Table 3. Responses to questionnaire items (continuation from p.101).

| | | | | | | | | | | |
|--|---|----------|----|----------|---|----------|----|----------|----|----------|
| P3. Participants in fighting wildfires are fully trained to perform these tasks. | 5 | 11.1 | 15 | 33.3 | 0 | 0.0 | 20 | 44.4 | 5 | 11.1 |
| P4. Alarmed forces for fighting wildfires regularly require additional logistical support. INV | 1 | 2.2 | 3 | 6.7 | 0 | 0.0 | 15 | 33.3 | 26 | 57.8 |
| P5. Supplying firefighting material and equipment at the fire site is timely and sufficient. | 3 | 6.7 | 19 | 42.2 | 3 | 6.7 | 14 | 31.1 | 6 | 13.3 |
| P6. In each major wildfire fighting action (regulated by existing laws) flaws in the logistics supply were manifested. INV | 0 | 0.0 | 6 | 13.3 | 5 | 11.1 | 16 | 35.6 | 18 | 40.0 |
| P7. Dislocated firefighting forces from other parts of Croatia completely fulfill the purpose of forces reinforcement. | 9 | 20.0 | 10 | 22.2 | 2 | 4.4 | 14 | 31.1 | 10 | 22.2 |
| P8. Logistical support to firefighters in the form of food and accommodation in extended firefighting actions is timely and sufficient. | 7 | 15.6 | 26 | 57.8 | 4 | 8.9 | 8 | 17.8 | 0 | 0.0 |
| P9. Basic and special occupational safety rules are fully observed in practice. | 8 | 17.8 | 16 | 35.6 | 4 | 8.9 | 14 | 31.1 | 3 | 6.7 |
| P10. Mutual communication between firefighting forces and 112 Center is optimal and ensures optimal forwarding of information. | 7 | 15.6 | 22 | 48.9 | 8 | 17.8 | 6 | 13.3 | 2 | 4.4 |
| P11. Local self-government units (city, municipality, companies) are regularly involved in actions of fighting wildfires. | 3 | 6.7 | 27 | 60.0 | 4 | 8.9 | 8 | 17.8 | 3 | 6.7 |
| QUESTIONNAIRE: PART 2 | | | | | | | | | | |
| P12. The basic prerequisite for effective wildfire fighting is to create a new legal framework. INV | 1 | 2.2 | 2 | 4.4 | 6 | 13.3 | 21 | 46.7 | 15 | 33.3 |
| P13. A key factor in enhancing the firefighters' capability (particularly that of operational forces) is permanent education of employees, especially commanders. | 0 | 0.0 | 9 | 20.0 | 2 | 4.4 | 15 | 33.3 | 19 | 42.2 |
| P14. For funding operational firefighting it is necessary to create a new model of funding firefighting at the state level. INV | 0 | 0.0 | 0 | 0.0 | 6 | 13.3 | 11 | 24.4 | 28 | 62.2 |
| P15. Compliance with tactical rules of wildfire fighting and occupational safety rules at work requires subordinate legislation in the form of new regulations governing firefighting. INV | 0 | 0.0 | 2 | 4.4 | 4 | 8.9 | 24 | 53.3 | 15 | 33.3 |
| P16. For force planning and resource allocation to be appropriately executed, new threat assessment and plans for fire protection are needed in addition to territorial vulnerability distribution. INV | 0 | 0.0 | 3 | 6.7 | 4 | 8.9 | 13 | 28.9 | 25 | 55.6 |
| P17. To consolidate all firefighting entities it is necessary to establish a central government firefighting body. INV | 2 | 4.4 | 2 | 4.4 | 3 | 6.7 | 20 | 44.4 | 18 | 40.0 |
| P18. In order to combat fire in coastal areas during fire season, it is necessary to employ a larger number of seasonal firefighters trained for wildfire fighting instead of dislocation from the continental part. INV | 1 | 2.2 | 2 | 4.4 | 2 | 4.4 | 30 | 66.7 | 10 | 22.2 |
| SCORE | | 1 | | 2 | | 3 | | 4 | | 5 |

Table 4. Items structured by topics.

| Group of items | Attached questions | Mean ± St. dev. |
|--|---------------------------------|-----------------|
| Legal framework and firefighting funding model | P1, P12, P14, P15 | 2,13 ± 0,61 |
| Organizational structure and governance | P2, P7, P10, P11, P16, P17, P18 | 2,34 ± 0,56 |
| Competence and education of firefighters | P3, P9, P13 | 3,28 ± 1,00 |
| Logistics support in firefighting actions | P4, P5, P6, P8 | 2,23 ± 0,59 |

Based on the data on the surveyed employees, we examined the relationship between the subjects' assessment and their characteristics with regards to: (a) their workplace and education level (linear combination labelled *position*), and (b) experience. The *Statistica* software package (version 12) was used for that purpose. We set the threshold for a medium correlation with the observed variables at $r > 0,45$. In Table 5, R. stands for 'respondent'. For the sample of respondents in our study, the values obtained for *R. position* are in the 1,00 – 3,67 interval, while those obtained for *R. experience* are within the 1,00 – 5,00 boundary interval. The correlation coefficients indicate that the respondents in commanding positions reported less favorable attitudes regarding organizational structure and logistics compared to other respondents.

On the other hand, respondents with more experience seem to have less favorable attitudes regarding the level of competence and education of the firefighting force for combating wildfire in Croatia as well as regarding the organizational structure. With the aim of further structuring of firefighting and emergency response issues, factor analysis was performed.

As shown in Table 6, four eigenvalues explain 70 % of the total variance. The main results of the factor analysis are presented in Table 7, which contains the obtained determining factors (1, 2, 3 and 4). The factors were extracted after performing varimax rotation, and are characterized by respective items as variables: Factor 1 (items P1, P2, P6, P8, P9), Factor 2 (items P12, P15, P16, P17), Factor 3 (items P14 and P18) and Factor 4 (items P4, P5, P7, P13). In accordance with the questionnaire items that determine the 4 factors (Tables 3 and 7), we can provide interpretation for each of the factors. Factor 1 refers to *existing legislation and flaws in the organization of firefighting*; Factor 2 is marked by *new legislation and new protection plans*; Factor 3 is determined by *a new financing model and new local engagement and seasonal employment*; in determining Factor 4 *firefighters' qualifications*

Table 5. Correlation matrix of respondents' attributes and their attitudes (scores).

| Variables | Correlation values between variables | | | | | |
|----------------|--------------------------------------|---------------|-----------------|----------------|--------------|--------------|
| | R. position | R. experience | Legal framework | Org. structure | Competence | Logistics |
| R. position | 1,00 | 0,46 | -0,22 | -0,51 | -0,44 | -0,50 |
| R. experience | 0,46 | 1,00 | -0,08 | -0,47 | -0,54 | -0,45 |
| Legal | -0,22 | -0,08 | 1,00 | 0,55 | 0,18 | 0,46 |
| Org. structure | -0,51 | -0,47 | 0,55 | 1,00 | 0,71 | 0,68 |
| Competence | -0,44 | -0,54 | 0,18 | 0,71 | 1,00 | 0,65 |
| Logistics | -0,50 | -0,45 | 0,46 | 0,68 | 0,65 | 1,00 |

Table 6. Factor analysis – eigenvalues# 1 . #percentages of factor variance.

| Component | Principal components and Eigenvalues | | | |
|-----------|--------------------------------------|-------------|--------------|-----------------|
| | Eigenvalue | Variance, % | Cumulatively | Cumulatively, % |
| 1 | 6,362909 | 35,34950 | 6,36291 | 35,34950 |
| 2 | 3,584541 | 19,91412 | 9,94745 | 55,26361 |
| 3 | 1,585348 | 8,80749 | 11,53280 | 64,07110 |
| 4 | 1,214363 | 6,74646 | 12,74716 | 70,81756 |

Table 7. Loadings of variables in factors. Factors bigger than 0,60 are marked.

| Variable (question) | Factors (<i>Varimax rotation</i>) | | | |
|------------------------|-------------------------------------|-----------------|------------------|------------------|
| | Factor 1 | Factor 2 | Factor 3 | Factor 4 |
| p1 | 0,763551 | 0,284733 | -0,092096 | -0,089775 |
| p2 | 0,630893 | -0,185926 | 0,251986 | 0,526852 |
| p3 | 0,517702 | -0,396947 | -0,013465 | 0,547931 |
| p4 | 0,157088 | 0,335245 | -0,150275 | -0,681781 |
| p5 | 0,260762 | 0,235075 | 0,238493 | 0,689134 |
| p6 | 0,710259 | -0,384916 | 0,111539 | 0,233857 |
| p7 | 0,219087 | -0,145449 | -0,054738 | 0,847848 |
| p8 | 0,629502 | -0,050683 | 0,270648 | 0,388248 |
| p9 | 0,605866 | 0,272315 | 0,196920 | 0,328812 |
| p10 | 0,198062 | -0,028770 | 0,539009 | 0,555587 |
| p11 | 0,572139 | 0,147597 | 0,589425 | 0,249279 |
| p12 | 0,077669 | 0,831207 | 0,110836 | 0,026426 |
| p13 | 0,398711 | -0,227179 | 0,042411 | 0,718874 |
| p14 | 0,279946 | 0,223110 | 0,736861 | 0,216152 |
| p15 | -0,083948 | 0,797267 | 0,074119 | -0,162057 |
| p16 | 0,302322 | 0,843487 | -0,199568 | -0,075012 |
| p17 | -0,235552 | 0,710209 | -0,062042 | -0,303766 |
| p18 | 0,163874 | 0,445522 | -0,763567 | 0,153777 |

and skills together with logistics and operational functioning ability are important. By using factor analysis a large number of variables (themes, features) was thus reduced to a small number of basic factors.

CONCLUSIONS

In the organizational framework of the firefighting system it is assumed that the National Protection and Rescue Directorate is responsible for the planning, managing and coordination of the firefighting task force, while subjects such as the Croatian Firefighting Association and the local government are responsible for ensuring the readiness of forces (that is, for *sending* forces in emergency). Interoperability and coordination challenges, which undoubtedly exist, tend to lead to certain confusion in practice regarding, among others, the issues of control and command, as well as the responsibility for providing comprehensive logistical support. The situation in Croatia is by no means an exception when such challenges are concerned, as can be evidenced by other research into interorganizational communication in emergency situations on the European territory (e.g. see [7; p.1649]).

For the Republic of Croatia wildfires are an issue of utmost importance since their occurrence and extinction have been known to cause most severe and most frequent disorders in the functioning of society. In order to indicate a possible direction of organizational changes in the firefighting system, we conducted a survey on the attitudes and experiences of operational firefighting on a sample of 45 active firefighters from entire Croatia. This is a representative sample of the basic set of experienced and trained firefighters. Research into the attitudes of operational firefighters in this paper indicated certain overarching issues not limited to the effectiveness of wildfire fighting that call for the need to improve the emergency management system organization. However, conclusions arising from the evidence on the attitudes of the respondents participating in our survey should be drawn with caution and certain reservations, considering the indefinite nature of the respondents' knowledge of specific areas of concern: finances, logistics, organization as well as law.

The investigation of respondents' attitudes yielded results that can be summarized as follows:

- respondents are generally dissatisfied with the current situation and the degree of organization of logistical support in fighting wildfires as well as with the organizational structure and the legal framework,
- respondents believe that a new model of (increasing) firefighting forces in the coastal area during summer months is desirable, as well as new plans for fire protection.

Firefighters with more experience and those with a higher rank and higher level of education were more stringent in their assessment of the organizational structure, logistics and legal framework for firefighting. Using factor analysis we showed that the identified characteristics and problems can be reduced to four topics/categories: existing legislation and flaws in the organization of firefighting, new laws and new protection plan, new funding model and local hiring; training and operation of the firefighting department.

Our future research may focus on the conceptual design of new legislation, processes and organizational structure that would allow better coordination, interoperability and greater efficiency. To successfully meet these goals, however, it is necessary to gain a deeper insight into the integrated emergency management system.

REMARK

¹According to National Plan for Engagement of Firefighting Forces and Participation in Firefighting, NPRD, 2013.

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ORGANIZIRANJE ZA HITNE SITUACIJE – PROBLEMI U GAŠENJU VELIKIH POŽARA U HRVATSKOJ

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SAŽETAK

Ulaskom Republike Hrvatske u članstvo Europske unije pokrenute su neizbježne organizacijske promjene, te je i područje zaštite i spašavanja stanovništva zahvaćeno novim zahtjevima prilagodbe standardima i mjerilima Europske unije. Vatrogasna djelatnost pri tome svakako ima vanjske i unutarnje poticaje svojim promjenama. S ciljem stvaranja suvremenog ustroja koji bi raspolagao potrebnom opremom i materijalnim resursima, učinkovit sustav vatrogastva Republike Hrvatske treba oblikovati i vodeći računa o zemljopisno- klimatskom području u kojemu je smještena naša zemlja. Skladno funkcioniranje većeg broja relativno autonomnih organizacija kod upravljanja u hitnim situacijama, zahtjeva jasne nadležnosti odlučivanja, dobro razrađene mehanizme koordinacije,

visoku interoperabilnost i potrebne kompetencije u ključnim područjima. U vatrogasnoj praksi utvrđene su određene manjkavosti pri gašenju velikih požara otvorenog prostora. U ovom radu dan je prikaz ustroja vatrogasnog sustava, prikaz prateće zakonske regulative, te razmatranje uočenih problema i pitanja u vezi funkcioniranja organizacije gašenja požara. Provedeno je anketno istraživanje kao ispitivanje stavova i iskustava pripadnika vatrogasne službe, a s naglaskom na uočene probleme u izvođenju operativnih aktivnosti. Kod skupine ispitanika utvrđena je prosudba relativno niske razine zadovoljavanja vatrogasne organizacije u vezi kategorija: organizacijska struktura, zakonska regulativa, logistička potpora kod gašenja požara. Vatrogasni djelatnici s višim obrazovanjem, oni na zapovjednim funkcijama i oni s više iskustva bili su kritičniji u ocjenjivanju postojećeg stanja. Rezultati istraživanja mogu poslužiti kao smjernice za redizajn organizacije vatrogastva kao i obuhvatnijeg sustava sigurnosti u RH.

KLJUČNE RIJEČI

koordinacija i interoperabilnost, upravljanje hitnim situacijama, vatrogastvo, organizacijske promjene, anketno istraživanje