STUDY ON THE EVOLUTIONARY INFLUENCE OF THE DEGREE OF TECHNICAL ENDOWMENT ON THE EFFICIENCY OF EMERGENCY PREVENTION AND MANAGEMENT ACTIONS

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Abstract: In Romania, the *National Emergency Management System* was regulated starting in 2004. Thus, the notion of "emergency situation" was defined as representing that category of exceptional events, of a non-military nature, that threaten the life or health of the person, the environment, material, and cultural values. At a regional level, (Timiș County) *the Inspectorate for Emergency Situations* (ISU) "Banat" of Timiș County was established.Its main role of intervention is to restore normality, with the responsibility of adopting urgent measures and actions, allocating specialized resources, and applyingunitary management of the forces and means involved. Since its establishment, ISU "Banat" has constantly pursued the efficiency of the prevention and management of emergency situations, to keep the risks under control, and to ensure the state of normality and the protection of citizens' lives, property, heritage values, and environmental factors. Given that the risks are always changing, and technology progresses in all fields, a study was carried out on the evolution of the success rate of interventions, respectively the efficiency of the entire preventive measures, by increasing the technical level of the equipment used. The results of the study carried out in the period 2004-2022 are presented along with follow-ups in the evolution of the degree of the technical endowment of ISU "Banat", as well as some necessary measures resulting from continuous alignment with the evolving European standards, specifically aimed at reducing risks, both for operators and especially for the population and material goods.

Key words:emergency situations, equipment, technical means of intervention, risk management, prevention

1. INTRODUCTION

The society of the last century has experienced significant changes such that, special emergency situations, with strong effects and consequences, are sometimes difficult to anticipate. In recent decades, the number of fires remains quite high, despite the technological progress and the increase in prevention and intervention knowledge accumulated. Fires increasingly threaten people's lives and material properties [1]. In Romania, the professional emergency services were actively involved in keeping the risks under control and ensuring the normality of life in human communities [2], [3].

Emergency management is a set of activities carried out and procedures used by decision-makers, institutions and public services empowered. These activities consist inidentifying and monitoring risk-sources (natural and technological), evaluatinginformation, analyzing the situation, developing forecasts, and establishing options for action to restore the normal situation [4], [5]. The variety and difficulty of emergency situations, as well as the potential dangers to which the participating personnel are exposed, require different techniques, devices, equipment, and special intervention accessories [6].

Along with the technical-scientific evolution and following the latest innovations in the military-industrial field, the technical means of intervention in emergency situations and all their functions have experienced real progress, registering a considerable development and modernization. The Inspectorate for Emergency Situations "Banat" of Timiș County has attached great importance to this aspect, ensuring that all special vehicles have a high operational mobility, performance on the move, superior ergonomic indices, reliability in operation, possess tactical characteristics -techniques that allow their effective use in interventions of any type [3].

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The present study is part of an extensive research program on the optimization of the management of emergency prevention and management actions in Timiș County (Romania). The results were the basis of the administrative and logistical measures established in the medium term, the investments in the direction of increasing the degree of technical equipment proving extremely effective, both regarding the operativeness of the interventions, as well as the reduction of the loss of human life and material damage.

2. GENERAL RESEARCH FRAMEWORK

2.1. Statistical analysis

With the establishment of the General Inspectorate for Emergency Situations (IGSU) at the national level, the foundation of integrated action plans at the regional and county level [2] was also started. The old paradigms have been abandoned, requiring the creation of flexible and mobile logistic structures that ensure efficient logistic support at the right time and with the necessary resources. It was necessary to adapt to the exponential growth of non-military risks, against the backdrop of accelerating globalization trends, radical climate changes, the diversification of economic activities, and the production of disasters.

Within the Inspectorate for Emergency Situations “Banat” of Timis County, since 2004, there have been two major stages regarding the logistical development. The first stage, 2004-2014, was the identification of programs and funding sources with a focus on the acquisition, storage, transport, distribution, maintenance of intervention techniques, and equipment. The subsequent stage represented a continuation of the endowment with means of intervention, as well as the construction, maintenance, operation of the facilities, namely parking spaces, workspaces, storage spaces [3].

Thus, in the period between 2004-2022, several analyses of statistical data were carried out regarding the evolution of the endowments for various types of intervention means. Several deficiencies were found, especially at the beginning of the period, regarding the provision of adequate technical equipment, caused mostlyby financing problems faced by almost all public institutions in the country. However, ISU Timiș has shown a permanent interest in providing professional emergency services, seeking to capitalize with maximum efficiency of the technical and human resources in the endowment andto ensure effective responses to intervention requests. Specialized literature always brings arguments on the role of emergency response strategies, which can prevent the occurrence of "domino" effects. In case of an emergency, if the initial response is not the right one, not only does it fail to prevent the „domino” effect, but it also puts the life of the emergency personnel at risk [8].

Based on the annual reports concludedfor the period 2004-2022, the way of using equipment such as: ladders, special vehicles for firefighting, transport and intervention trucks, and pneumatic boats, respectively those made of fiber or alloys, were statistically tracked. During the analyzed 18-year period, different behaviors of the management team, respectively of the financing provided from the state budget, were observed. Until 2017, the focus was on long-term use of the equipment, with a possible development of their typology. Thus, the autoladders were replaced only after 13 years, and the boats made of fiber or aluminum alloys became available only in 2015 [3].

2.2. Research methods

The research methodology adopted was based on a systemic, hierarchical, and generic model of an action plan, with both economic connotations at the institutional level and the degree of satisfaction of the population's fair requirements. In this sense, the industrial model FIS (Fuzzy Interference System) was considered, to evaluate its effectiveness. Potential failures were considered, making predictions based on a prior analysis of the plan model and a posterior analysis of the lessons learned from the experiences gained in past interventions. Periodic evaluations of the annual plan functions were also conducted, using checklists, structured by the systemic model for each measure included in the plan. Thus, this approach has been adopted, which can be used as a set of tools both for the evaluation of existing plans and for the development of emergency plans [9], [10]. This working method has been applied more in the last 5 years, the results being more and more conclusive.

Thus, in the annually made decisions concerning the work plans, it was considered necessary to conduct a deeper analysis of the situation related to each type of equipment, in conjunction with the requirements imposed by the patternof intervention requests.

Considering the critical situations that happened during the analyzed period in Timis County, it was chosen to carry out a complex study on the evolution and the way of capitalizing on the escalators

3. COMPARATIVE STUDY CONCERING THE EFFECTS OF THE MODERNIZATION OF INTERVENTION AUTOLADDERS ON THE EFFICIENCY OF ACTIONS CARRIED OUT IN EMERGENCY SITUATIONS

Man's aspiration to celestial heights, the dream ofconquering the heights in human evolution, led to the construction of super-tall buildings, called by the architectural community „super scraper"/„skyscraper", outstanding with their fabulous dimensions that managed to„scratch the clouds". The scientific and technological progress in the development of resistance structures, made of extremely durable materials, the extensive research in the military-industrial field, the innovations in the technological field since the end of the 19th century, made it possible, in an extremely short time at historical scale, to move from buildings with a relatively low height (8-10 m), to bold superstructures, distinctive urban architectural ideas, materialized in buildings with heights of over 500 m [11].

Even if during the construction of buildings, architects, engineers, and builders sought to create very safe buildings, this does not stop the manifestation of the risks represented by fires, earthquakes, or other natural calamities, which endanger the people and the material values located in these tall buildings. Access stairs to heights have obviously evolved with the development of buildings.

In Timiș County, different models of manually operated ladders were used at the beginning, such as:

- window ladders (made of aluminum alloy equipped with hanging hook.
- folding stairs (stick) - made of laminated wood, used up to a height of 3.0 m.
- mating ladders (made of laminated wood or aluminum, composed of 3 ladder sections), with access to a usable height of 6.58 m, when folded for transport of 2.70 m and the weight of one section of 14 kg.
- sliding stairs (composed of the following parts: three ladder sections that slide (slide) on each other, with a pulley system, with access to a usable height of 10.66 m 4.36 m, the height in use 10 .66 m, when folded for transport of 4.36 m and a mass of 59 kg.

After 1900, the firefighters from the Banat area end up using a model of a ladder invented by a firefighter pioneer from Germany, Conrad Dietrich Magirus (1872), for intervention, but hypo tracted. The first mechanical escalator in the world was built in 1904 by the Magirus company.

Before 2004, the mechanical ladder trucks used by the "Banat" Fire Brigade were a collaboration between a Romanian manufacturer (ROMPRIM S.A. Bucharest) and a German one (FEUERLOSHGERATEWERK – Luchenwalde, Germany). Escalators are aimed at rescuing people from heights and ensuring the rapid penetration of firefighters to the upper parts of buildings when access routes become impassable because of fires, catastrophes, or calamities. The escalators can also be used as a crane, for pumping extinguishing substances from a height, to raise some projectors to illuminate certain areas, to save material assets [12].

The auto-ladder type Roman 8135 FA, used by ISU Timiș until 2017, was 8.9 m long, 2.5 m wide and 3.45 m high. A 135 hp engine ensured a maximum speed of 80 km/h, the maximum height of use being 30 m. Starting from 2019, a technical mean of rescue at heights, latest mechanical escalator model, auto-ladder Magirus M 42 L, was purchased. It is intended for intervention and rescue from heights of 40 m, and for technological accidents, disasters, or natural calamities as well. In 2019, the rescuers from Timisoara will receive a unique piece of equipment in the world, appreciated for its indoor performance, namely the 42-meter Escalator with an articulated arm and a single extension. M 42 L – AS, the only escalator in the world with a working height of 42 meters and an articulated arm of 4.7 m,(figure 1).

Ford 1930 *Magirus M42 L – 2022*

Figure 1 –Turntable auto-ladders for intervention at height.

Relevant information regarding the number of escalator interventions, the people and animals saved, the value of the goods saved and the average time of intervention, at the level of Timiș county, in the last 7 years, is highlighted in table 1

Table 1 –The situation of the efficiency of the use of auto-ladders in the period 2016-2022.

	2016	**2017**	**2018**	**2019**	**2020**	**2021**	**2022** (10 mouths)
No. Interventions	103	189	168	234	161	302	252
Value of salvaged goods, [million lei]	2.34	69.36	6.45	39.28	29.09	190.08	198.07
No.people saved	3	10	9	3	6	2	4
Average time, [h:min:sec]/intervention	1:17:00	00:58:14	00:58:34	00:52:54	00:50:28	1:08:00	1:43:00

The data reflects the fact that, with the introduction of high-performance escalators, there is a progressive increase in the possible number of interventions and a shortening of the average response time, which demonstrates the reliability, versatility, and current use of this type of rescue technique in emergency situations.

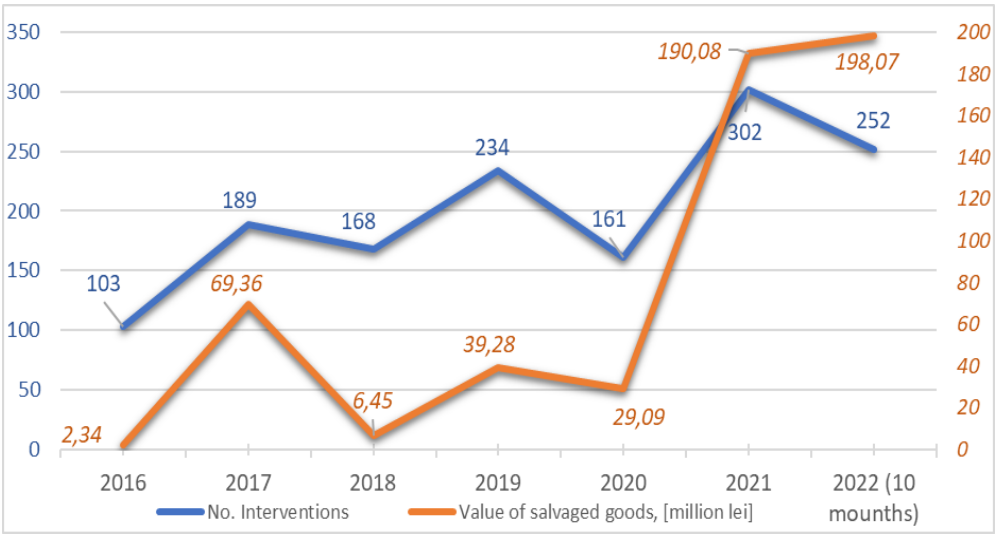

Figure 2 – Graphical representation of the evolution of the modern auto ladders efficiency.

Human life is priceless; the costs of purchasing technical means of intervention, top notch in their field, are considerable and their maintenance is carried out by highly qualified specialists, but nothing is too expensive when there is a chance to save a life. Looking at the graphical representation (figure 2), there is an increase in the number of emergency situations, in which escalators are becoming more and more requested but also more efficient, due to their functional complexity.

If up until this moment, there was no possibility to perform rescues from a height,currentlywith so many ways of using ladder trucks such as moving the top of the ladder according to needs, the ladder truck allows: the opening of an effective ventilation hole, partially or even totally uncovering the roofs, the rescue and evacuation of personnel, animals and material goods caught by fires on the upper floors or roofs, ensuring a maximum degree of security and safety for those working on the ladder sections, as well as for the aggregates in the composition.

In the same way, the truck is successfully used as a water tower, for the discharge of extinguishing substances or water, with pressure on the upper floors. The escalator is used, not infrequently, to lift projectors, to illuminate different areas or to lift weights and even as a crane. The distinctive feature of this auto ladder is the use, in certain contexts, of the arm extended horizontally, below the level of the car (under bridges or banks), for water rescues.

4. CONCLUSION

The current emergency services must be in a dynamic evolution, both in terms of the complexity imposed by the patterns of the situations that have arisen, and by the greater importance given to saving human lives and material values. It was necessary to diversify and integrate the emergency services including the Emergency Medical Service, Resuscitation and Discharge (SMURD), with its particularities and the technical and professional training needs of the work teams. During the analyzed period, at the level of Timiș county, the total number of interventions increased almost 15 times, and the response time to requests decreased a lot.

The professional emergency services of 2023 cannot exist without the logistics of 2022, and logistics cannot be efficient or evolve without continuous adaptation to new and changes, based on innovation and creative spirit. From this point of view, logistics requires continuously optimized organizational structures, automation and robotization and to an increased extent computerized means and technologies, in close relation with the concern of their humanization.

The necessary measures regarding the alignment with the evolving European standards are continued through projects with European funding, which have in mind the training of the staff, using new technical capabilities all the time, the development of methods of intervention in emergency situations through the integration of video communications, real-time data analysis , collected from autonomous flight equipment (drones) and the use of technical means in an integrated system of intervention (hydro perforation, extinguishing with water towers, extinguishing robots).

The endowment programs, through projects with European funds, have in mind the acquisition of means of rescue and protection with high degrees in reducing the risks to intervention personnel and the endowment and redevelopment of civil protection shelters in support of the population, in case of armed conflicts. At the same time, the permanent preoccupation to be equipped with effective means of extinguishing with rapid movement to the place of intervention, with a high degree of efficiency in extinguishing and removing fires, has therefore both the main mission of saving human lives and the protection of material goods, respectively the prevention of propagation.

The collaboration of all decision-makers and those responsible for the security of populations and property is imperative, to ensure the best intervention equipment and a high level of professionalism of the workers involved in the intervention in case of emergency situations, for a greater efficiency of actions. In this sense, for Timiș county, the forms of cooperation with citizens are also diversifying, to prevent and avoid the occurrence of this kind of situations.

On the basis of these researches,measures are being created to address the optimization of action management, to prevent and manage emergency situations, including the administrative and logistical measures established in the medium and long term, the investments in the direction of increasing the degree of technical endowment having priority, the correlation being proven them with increasing the effectiveness of intervention actions, but also with reducing the loss of human life and material damage.

5. REFERENCES

[1] Šupić S., Bulatović V., Pantić V., Laban M., (2022), National fire safety requirements for high-rise buildings in Republic of Serbia compared to other countries, 17-th Conference with international participation risk and safety engineering, Kopaonik, January 2022, Book of proceedings, pg 80-86.

[2] https://www.igsu.ro, last accessed in 26.11.2022.

[3] https://www.isutimis.ro, last accessed in 26.11.2022.

[4] (2004), O.G. no. 21/2004, regarding the National Emergency Management System, art.1-2, art.6-12 and art.14 published in the Official Monitor, Part I no. 361 of April 26, 2004

[5] Romanian Law no. 481/2004 on civil protection with subsequent amendments and additions.

[6] Necula, D.A., (2016), Does Romanian army need logisticians at the base of the military career? Bulletin of the "Carol I" National Defense University, March 2016, pg. 97-102,

[7] Andronic, B.; Mocanu, B.: (2003), Logistical support in multinational operations, Publishing House of the Academy of Advanced Military Studies, Bucharest, p. 44.

[8] Zhou Jianf, Reniers Genserik, Khakzad Nima. -Application of event sequence diagram to evaluate emergency response actions during fire-induced domino effects, Reliability engineering and system safety - ISSN 0951-8320 - 150(2016), p. 202-209, http://hdl.handle.net/10067/1319140151162165141

[9] Karagiannisa G-M, Piatyszeka E, Flaus J-M.(2010),Industrial emergency planning modeling: A first step toward a robustness analysis tool. Journal of Hazardous Materials 2010; 181: 324-334.

[10] Tomescu A. ș. a. (2006), The Key Concepts and the Success of the Romanian Organizations. In: Management & Marketing.

[11] Gheorghe D., Radu C.,Creac M. (2015), Features of the rescue system for working at height, Student Scientific Session, May 15-16, 2015,

[12] Olaru E., (2019), Firefighting equipment and accessories. Series of lectures, Chișinău: Tehnica-UTM.