

An Improved Conceptual Model for Occupational Safety in Rescuers' Activities

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Abstract: This article develops and substantiates an improved conceptual model for occupational safety in rescuers' activities. The model integrates five interrelated blocks: regulatory and management, personnel and competencies, risk diagnostics, operational protection, and monitoring and feedback. The study demonstrates that occupational safety for rescuers should be treated not as an isolated technical measure, but as an integrated management system combining hazard identification, risk assessment, protection organization, operational monitoring, and preventive decision-making. The model is based on the principles of preventive priority, systematicity, and operational adaptability, allowing safety measures to be continuously adjusted to rapidly changing emergency conditions.

Keywords: Rescuer, Occupational Safety, Conceptual Model, Risk Diagnostics, Operational Protection, Monitoring, Preventive Priority.

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I. INTRODUCTION

Occupational safety in rescuers' activities is directly associated with the complexity of emergency situations, the need for rapid decision-making, and high levels of physical and psychological workload. Therefore, occupational safety in this field should not be limited to protective equipment or safety instructions; rather, it should be integrated into all stages of rescue-service management as a comprehensive system. The current legal framework establishes requirements related to rescuer status, continuous training, certification, hazard identification, risk assessment, and internal control [1–5]. Integrating these elements into a unified conceptual model is important from both scientific and practical perspectives.

Rescuers perform their duties under high-risk, rapidly changing, and multifactorial working conditions. Under such conditions, organizing occupational safety solely on the basis of general safety rules is insufficient. Hazard sources must be identified in advance, assessed according to scientifically grounded criteria, prioritized, and linked to management

measures that can be revised as the operational situation changes.

The relevance of this study is determined by the fact that, under real rescue conditions, hazardous factors usually do not act independently. At a fire scene, for example, high temperature, smoke, toxic gases, reduced visibility, time pressure, physical fatigue, and psychological stress may affect personnel simultaneously. Consequently, the occupational risk profile of a rescuer should be assessed through an integrated approach that reflects the combined and changing nature of these factors.

The literature on emergency response and rescue operations addresses the organization of search-and-rescue activities, improvement of operational effectiveness, professional training, physical and psychological preparedness, and the use of technical equipment [7–15]. Recent studies also examine occupational safety methods in fire-rescue training and the adjustment of operational standards when personal respiratory protective equipment is used [16–18]. These works provide an important theoretical

and methodological basis; however, there remains a need to integrate regulatory, personnel, diagnostic, protective, and feedback mechanisms into a single management model tailored to rescuers' activities.

II. RESEARCH METHODOLOGY

The purpose of the study is to substantiate an occupational safety conceptual model adapted to the high-risk and operational nature of rescuers' activities. To achieve this purpose, the following objectives were defined: to summarize the existing regulatory framework; identify the structural blocks of the model; demonstrate the functional relationships between these blocks; and substantiate the scientific novelty and practical significance of the proposed approach.

The study employed systems analysis, regulatory and legal analysis, conceptual modeling, functional grouping, and logical generalization. The regulatory basis comprised documents governing rescue services and rescuer status, emergency-response management, personnel certification,

training requirements, and occupational safety management [1–5]. Scientific and educational sources concerning rescue operations, combat and drill training, fire safety, occupational safety, and risk-oriented preparation were used as the methodological foundation [7–18].

The model was developed according to a preventive logic: safety measures are organized not only as a response to an incident after it occurs, but primarily through advance identification, assessment, and control of hazard sources and the adoption of preventive decisions. Within this approach, occupational safety is interpreted as a management instrument that supports operational resilience rather than as a restriction on rescue-service efficiency.

III. STRUCTURE OF THE IMPROVED CONCEPTUAL MODEL

The improved conceptual model comprises five mutually connected blocks. Their content and expected management results are summarized in Table 1.

Table 1 Structural Blocks of the Improved Occupational Safety Model for Rescuers

Block	Content	Expected result
Regulatory and management block	Internal regulations, risk register, areas of responsibility, authorities, internal audit, and reporting system.	Tasks and boundaries of responsibility are clarified, and management decisions are documented.
Personnel and competencies block	Selection, certification, retraining, psychological preparedness, competence monitoring, and specialized competencies.	A rescuer's readiness for the assigned task is assessed on the basis of actual competencies.
Risk diagnostics block	Hazard identification, assessment, forecasting, prioritization, and maintenance of an occupational risk profile.	Risk factors are identified in advance, and preventive measures are clearly defined.
Operational protection block	Integration of personal and collective protective equipment, medical support, communications, logistics, and operational safety measures.	The rescuer's life and functional capability are preserved at the emergency scene.
Monitoring and feedback block	Statistical records, near-miss events, post-operation analysis, internal audit, and preventive decisions.	The system is continuously improved, and repeated hazardous episodes are reduced.

The principle of "preventive priority" lies at the center of the model. According to this principle, safety management is directed not merely toward reducing the consequences of an incident, but toward identifying and controlling the causes that may lead to an incident. This is particularly important in rescue operations because the level and composition of risk can change sharply within a short period of time.

The model therefore has to be dynamic, open to repeated assessment, and adaptable to actual operating conditions. Its components are not isolated: the regulatory block establishes responsibility and procedures; the personnel block ensures task-specific competence; the diagnostic block identifies and prioritizes hazards; the operational protection block converts risk assessment into protective actions and resource decisions; and the monitoring block provides information for subsequent improvement.

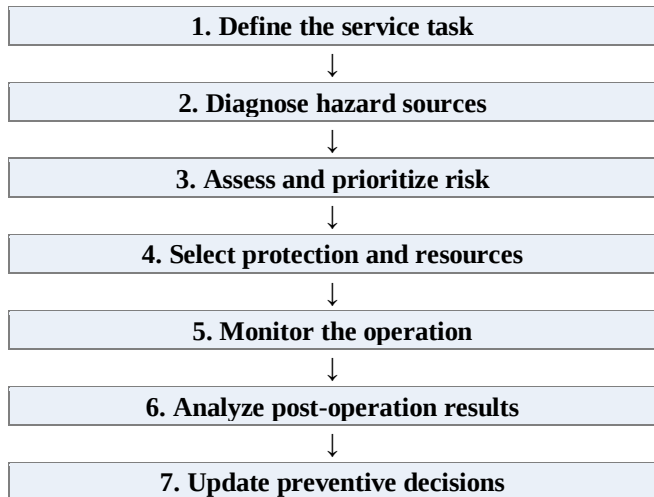


Fig 1. Continuous Occupational Safety Management Cycle Proposed for Rescue Operations

This sequence transforms occupational safety from a separate control action into a continuous management cycle. The cycle links operational planning, hazard recognition, risk-based protection, real-time observation, and post-operation learning. As monitoring results are fed back into subsequent decisions, the system can be continuously refined and repeated hazardous episodes can be reduced.

IV. RESULTS, SCIENTIFIC NOVELTY AND PRACTICAL SIGNIFICANCE

➤ Results

The conceptual analysis shows that occupational safety in rescue units can be structured as a unified management system rather than as a set of disconnected technical measures. The five-block architecture provides a functional link between formal requirements, rescuer competence, risk diagnosis, operational protection, and post-operation feedback. The resulting model establishes a direct connection between preventive management decisions and the changing risk profile of rescue operations.

➤ Scientific Novelty

The scientific novelty of the study lies in substantiating rescuers' occupational safety within the integrated chain "management — risk assessment — organization of protection — monitoring — preventive decision." In contrast to a fragmented approach, the proposed model combines technical, organizational, personnel, psychological, and operational factors within a single adaptive system.

➤ Practical Significance

The model can be used in rescue units to improve internal regulations, maintain and update risk registers, refine certification and professional-development programs, select protective equipment according to task-specific hazards, organize operational monitoring, and adopt preventive decisions on the basis of post-operation analysis. Its block structure also provides a practical basis for distributing responsibilities and documenting safety-management decisions.

V. CONCLUSION

Improving occupational safety in rescuers' activities requires a shift from isolated technical measures to an integrated and continuously updated management model. The proposed five-block conceptual model unites regulatory and management mechanisms, personnel competencies, risk diagnostics, operational protection, and monitoring and feedback. The preventive-priority principle places advance hazard identification and risk control at the center of decision-making, while the feedback mechanism supports repeated assessment and adaptation to changing emergency conditions. As a result, rescuer safety is treated as a central component of operational management and as a factor that supports the reliability and sustainability of rescue-service activities.

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