

Ramil Akhundov<sup>1</sup>, Elshan Hashimov<sup>1,2</sup>, Aziz Talibov<sup>2</sup>

<sup>1</sup> National Defence University, Baku, Azerbaijan

<sup>2</sup> Azerbaijan Technical University, Baku, Azerbaijan

## RISK MANAGEMENT AND MATRIX DECISION MAKING IN EMERGENCY SITUATIONS AT CRITICAL AND MILITARY FACILITIES

**Abstract.** This study develops a methodological framework for risk management and matrix-based decision making in emergency situations at critical and military facilities. The proposed approach is based on the assumption that the risk of an emergency should be assessed not only by the severity of the devastating event, but also by the criticality of the affected protected area. The framework links these two variables through a decision matrix that connects risk levels and zone classes to standardized operational response packages. The study shows that such an approach makes it possible to move from descriptive emergency assessment to structured management action. Its practical value lies in improving the consistency, speed, and traceability of decisions concerning resource allocation, access regulation, surveillance reinforcement, personnel protection, and continuity measures. The results indicate that the matrix model provides a more rigorous and operationally relevant basis for emergency risk management in high consequence facilities than ad hoc or undifferentiated response logic.

**Keywords:** risk management, matrix decision making, emergency situations, critical facilities, military facilities, physical protection, protected zone class, operational response package, decision support, emergency response planning.

### Introduction

Emergency situations at critical and military facilities create a management environment in which risk is no longer a passive analytical category but an immediate determinant of operational decisions [1, 2]. In such conditions, the consequences of failure extend beyond local damage and may affect personnel safety, continuity of command, technological stability, communication, energy support, and the overall ability of the facility to maintain its core functions [3, 4]. This makes emergency risk management a particularly important scientific and practical problem for physical protection systems, because protective measures must be selected and adjusted under time pressure, incomplete information, and rapidly changing conditions.

The problem becomes more acute when emergency effects interact with the existing security architecture of the facility [5]. Fire, explosion, toxic release, infrastructure damage, or cascading technical failures may not only generate direct losses, but also weaken surveillance, restrict movement, complicate communication, reduce response speed, and create new pathways of unauthorized access or further escalation [6]. As a result, the operational picture becomes multidimensional: the facility must simultaneously contain the emergency, preserve critical functions, protect personnel, and prevent secondary security failures. In such circumstances, decision making cannot rely only on general emergency procedures or on isolated risk indicators. It requires a structured mechanism that translates risk assessment into concrete operational choices.

A further difficulty lies in the differentiated structure of critical and military facilities. Internal zones, command nodes, technical systems, restricted sectors, and support elements do not have equal significance [3, 7, 8]. The same emergency may require fundamentally different management actions depending on where it occurs, which functions are exposed, and how quickly disruption may spread. Therefore, effective decision making must account

not only for the severity of the risk itself, but also for the class of the affected zone and the operational importance of the threatened element. Without such differentiation, management responses tend to become either excessively generalized or insufficiently prioritized.

Conventional decision making in emergency conditions often remains descriptive, fragmented, or strongly dependent on expert improvisation [9–11]. Although expert judgment remains essential, reliance on ad hoc interpretation alone reduces consistency, complicates coordination, and makes it more difficult to justify why one package of measures was chosen instead of another. For high consequence facilities, especially military ones, this is a serious limitation. Decisions must be not only fast, but also logically structured, reproducible, and compatible with the internal hierarchy of protected zones and operational priorities [12–14].

In this context, matrix based decision making offers an important methodological advantage. It allows risk interpretation to be linked to predefined management packages through a formal relation between risk level and zone class. Such an approach makes it possible to standardize escalation logic, coordinate actions across subsystems, and support more consistent allocation of personnel, technical resources, access restrictions, response measures, and continuity related interventions. The value of the matrix model lies not in replacing managerial judgment, but in organizing it within a framework suitable for emergency conditions, where the cost of delay or inconsistency may be exceptionally high.

**The aim of this study** is to develop a methodological framework for risk management and matrix based decision making in emergency situations at critical and military facilities by linking risk levels and protected zone classes to standardized operational response packages. The article focuses on the emergency specific features of risk, the logic of risk management under disrupted conditions, the structure of the decision matrix, and the practical role of

standardized response packages in supporting operationally relevant protective decisions.

### Review of Recent Research and Publications

Recent studies on emergency management emphasize that risk assessment is one of the key foundations of operational decision making in high consequence environments [1-4, 15]. In the context of critical infrastructure, researchers have shown that emergency situations should be analyzed not only in terms of direct damage, but also through their impact on continuity of functions, vulnerability of internal systems, and degradation of protective capacity [16, 17]. This perspective is particularly relevant for critical and military facilities, where the effects of an emergency may propagate across command, communication, technical support, and access control structures [3, 4]. A substantial part of the literature addresses the protection of critical infrastructure under disruptive conditions [18, 19, 20]. These studies demonstrate that emergency events often produce compound effects, combining physical damage, functional disruption, and security degradation. For military and other special purpose facilities, the problem is even more complex because the protected object usually includes zones and components of unequal significance, while response measures must be implemented under strict temporal and organizational constraints [4, 21, 22]. As a result, the same level of hazard may require different management actions depending on the criticality of the affected area and the operational role of the exposed element [23, 24].

Another important line of research concerns decision support in emergency situations [25]. Existing works show that rapid response quality depends not only on the accuracy of risk identification, but also on the availability of structured decision mechanisms that can translate risk interpretation into practical action [18, 26]. In many cases, however, emergency decision making remains descriptive or highly dependent on expert improvisation, which reduces reproducibility and complicates coordination [1-4]. This creates a clear need for models that formalize the relation between assessed risk and predefined management responses [17]. Matrix based approaches have been applied in different areas of safety and security management because they allow analytical variables to be connected with operational categories [23]. Their main advantage lies in simplicity, interpretability, and direct applicability under time pressure. At the same time, the available literature rarely offers a sufficiently integrated matrix model for emergency situations at critical and military facilities, where risk level must be interpreted together with the class of the affected zone and the required response package [10]. Most existing models either classify risk without linking it to differentiated action sets, or propose general measures without formalizing their dependence on the internal structure of the protected facility [12, 13].

Thus, the literature confirms the importance of emergency risk assessment, differentiated protection of critical facilities, and decision support formalization, but it does not yet provide a sufficiently unified framework that links emergency risk levels, protected zone classes, and standardized operational response packages [14]. It is this gap that the present study addresses.

### Task Statement

The management of emergency situations at critical and military facilities requires a decision-making framework capable of converting risk assessment into operationally relevant and differentiated protective actions. In such environments, emergency effects interact with the internal structure of the facility, the criticality of protected zones, the condition of personnel and technical systems, and the limited time available for intervention. As a result, the central scientific task is not only to identify and interpret risk, but also to formalize the logic by which different levels of risk should lead to different management responses depending on the significance of the affected zone.

**The aim of this study** is to develop a methodological framework for risk management and matrix-based decision making in emergency situations at critical and military facilities by linking risk levels and protected zone classes to standardized operational response packages.

To achieve this aim, the following tasks are addressed:

- to identify the emergency specific features of risk at critical and military facilities;
- to define the principal variables of risk management under disrupted operating conditions;
- to develop a matrix model that connects risk levels and zone classes with differentiated decision packages;
- to substantiate the practical value of the matrix model for emergency response planning and operational decision support.

The methodological basis of the study includes systems analysis, comparative analysis, structured interpretation of emergency risk conditions, and matrix modeling of management decisions. These methods are used to construct a framework in which emergency risk is treated not only as an analytical indicator, but also as a basis for standardized and operationally consistent protective action.

### Basic Material and Results

Emergency situations at critical and military facilities fundamentally transform the logic of risk management because they affect not only the protected object itself, but also the operational conditions under which physical protection and emergency response must be implemented [1, 3, 22]. Under normal conditions, risk may be interpreted through relatively stable parameters of protection, access control, subsystem readiness, and functional zoning. Under emergency conditions, however, this stability is disrupted. Fire, explosion, toxic release, infrastructure failure, or combined emergency effects may simultaneously produce direct damage, reduce the effectiveness of surveillance and control, complicate communication, delay response, and create additional vulnerabilities inside the protected structure. As a result, risk is no longer only a measure of possible loss, but also a dynamic indicator of how quickly and how severely the internal protective logic of the facility may deteriorate. This makes risk management inseparable from the immediate organization of protective and operational decisions [10].

In critical and military facilities, this problem is intensified by the differentiated structure of the protected space. Not all zones of the facility have equal significance, and not all emergency effects produce the same operational

consequences [23]. A local emergency in a secondary service sector and an emergency affecting a command node, communication element, restricted technological segment, or protected access point may differ radically in their management implications even when their nominal physical scale appears similar. For this reason, emergency risk management cannot be based only on general hazard severity. It must combine the interpreted risk level with the class of the affected zone or element. This makes it possible to distinguish situations in which an identical risk indicator requires different operational responses because the threatened part of the facility has a different functional role, a different consequence profile, or a different value for continuity of operations.

Within this methodological logic, risk management in emergency conditions should be understood as the transition from risk identification to risk controlled intervention. The purpose of assessment is not limited to describing the emergency situation. Its real value lies in determining what package of actions is justified under the current combination of danger intensity, protected zone significance, response feasibility, and available resources. The key management variables therefore include the interpreted level of emergency risk, the class or criticality of the protected zone, the condition of personnel and technical systems, the temporal feasibility of response, and the continuity requirements of the facility. When these variables are not

organized within a structured decision mechanism, management responses tend to become fragmented, delayed, or weakly justified. Under emergency pressure, this increases the probability of inconsistent actions across protection subsystems and weakens the ability of the facility to preserve its essential functions.

For this reason, the study proposes a matrix-based decision model in which the two primary coordinates of management are the level of risk and the class of the affected zone. The first coordinate reflects the severity and urgency of the emergency condition as interpreted through its probable consequences for personnel, operations, and protection capacity. The second reflects the protected significance of the zone in which the emergency occurs or to which its effects may propagate. Their combination creates a structured basis for management choice. Instead of leaving action selection to ad hoc interpretation, the matrix assigns each combination of risk level and zone class to a predefined package of operational and protective measures. In methodological terms, this transforms emergency risk from an abstract analytical variable into a direct management instrument.

The logic of the proposed decision model is summarized in Fig. 1, which presents the matrix relationship between risk level, protected zone class, and the corresponding package of management actions under emergency conditions.

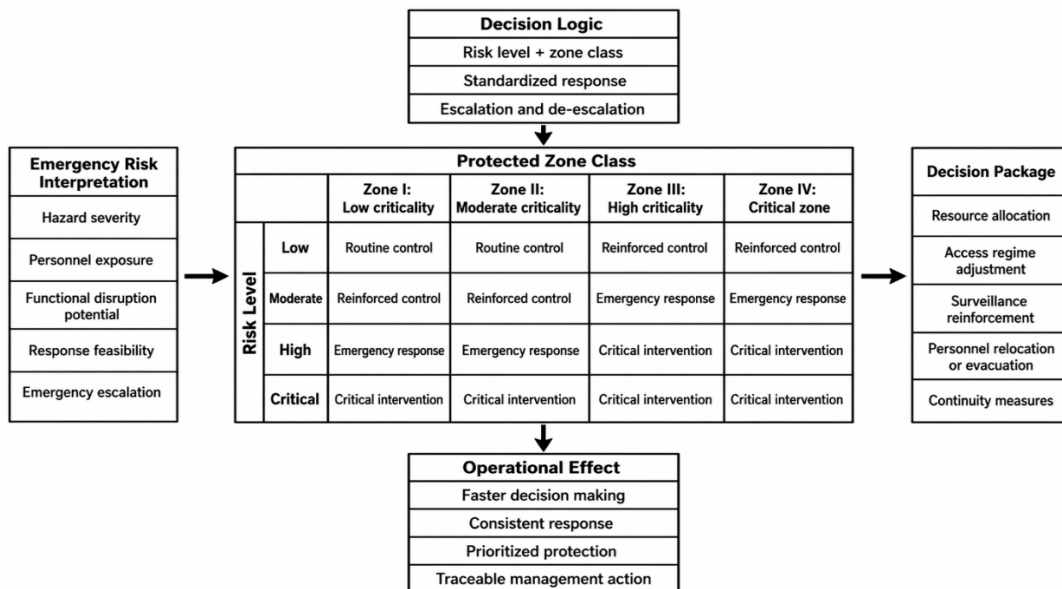


Fig. 1. Matrix framework for risk management and decision making in emergency situations at critical and military facilities

As shown in Fig. 1, the matrix transforms risk interpretation into a structured decision mechanism by linking each combination of risk level and zone class to a predefined set of protective and operational measures. This approach increases consistency of emergency response and creates a common decision language for different subsystems of facility protection and management.

The practical value of the matrix lies in the fact that it does not treat all emergency responses as uniform. Low risk conditions in a peripheral or low criticality zone may justify monitoring reinforcement, local restriction measures, and readiness adjustments without immediate large-scale intervention. The same low risk value in a highly critical

zone may require enhanced surveillance, temporary access tightening, or advance deployment of response resources because the functional consequences of escalation are much greater. Medium risk conditions may justify localized intervention, controlled movement restrictions, selective relocation of personnel, or reinforced coordination measures depending on the class of the zone. High and critical risk conditions require progressively stronger decision packages, including broader access lockdown, emergency resource concentration, evacuation or redistribution of personnel, full strengthening of surveillance and response posture, and immediate continuity preserving actions for critical functions. Thus, the same formal risk level does not

automatically correspond to the same action. The operational content of the response is determined jointly by risk and zone criticality.

This logic also supports escalation and deescalation management. In emergency conditions, decisions must often be revised as the situation changes, resources are consumed or restored, and the spread of consequences becomes clearer. A matrix structure facilitates such revision because it allows the operator or decision maker to move from one cell of the matrix to another as the interpreted risk level or affected zone status changes. This ensures continuity of management logic and reduces the chance that response measures will be selected inconsistently from one stage of the emergency to another. For critical and military facilities, where coordinated action across access control, surveillance, technical support, response forces, and command structures is essential, this property is especially important. The matrix does not replace judgment, but it disciplines judgment by placing it within a predefined and operationally interpretable structure.

In order to operationalize this logic, the decision model must specify what measures belong to each matrix cell. These measures may be grouped into four broad classes: intervention intensity, resource allocation, regime regulation, and continuity preserving or alternative operational actions. Intervention intensity reflects how actively the emergency must be contained and how urgently the affected zone must be stabilized. Resource allocation determines the scale and direction of personnel, technical means, and response assets required under the interpreted conditions. Regime regulation covers access restrictions, movement control, internal routing, and special protective modes. Continuity preserving actions include relocation of critical functions, protection of key nodes, backup activation, and temporary operational restructuring. The composition of these packages should vary according to both the risk level and the criticality of the affected zone. To operationalize the proposed matrix, the main decision packages are grouped by risk level and protected zone class, as presented in Table 1.

Table 1 – Decision packages by risk level and protected zone class

Risk level	Zone I: Low criticality	Zone II: Moderate criticality	Zone III: High criticality	Zone IV: Critical zone
Low	Routine monitoring, local control, readiness check	Routine monitoring with reinforced control of access points and internal movement	Reinforced control, enhanced surveillance, precautionary standby of response personnel	Reinforced control, temporary access tightening, advance readiness of response and continuity staff
Moderate	Reinforced control, localized restriction measures, technical inspection	Reinforced control, selective movement restriction, partial deployment of response resources	Emergency response at zone level, strengthened surveillance, controlled personnel relocation	Emergency response, strict access regulation, immediate reinforcement of protection and continuity measures
High	Emergency response, localized resource concentration, temporary operational limitation	Emergency response, extended restriction regime, active deployment of response forces	Critical intervention, emergency lockdown of the affected sector, rapid protection of key elements	Critical intervention, full strengthening of regime measures, priority protection of critical functions, immediate continuity actions
Critical	Critical intervention, emergency containment, full local control measures	Critical intervention, emergency containment, evacuation or redistribution of exposed personnel	Critical intervention, full sector isolation, maximum concentration of response resources, continuity activation	Critical intervention, highest priority response, full lockdown, evacuation or protected relocation, immediate activation of continuity and backup mechanisms

Table 1 shows that the same risk level may require different operational responses depending on the criticality of the affected zone, while the same zone class may require different actions as risk escalates. This structure makes it possible to standardize decisions without eliminating the necessary differentiation of emergency management in high consequence facilities.

From a results perspective, the proposed matrix model yields several important outcomes. First, it creates a unified decision framework for emergency conditions at critical and military facilities. Instead of relying on fragmented interpretation, the facility obtains a structured relation between assessed risk and operational response. Second, the model preserves the internal hierarchy of protected zones, ensuring that management responses are not based only on general emergency severity, but also on functional significance. Third, the model improves reproducibility and auditability of emergency decisions because the choice of action package can be traced to a defined matrix position rather than to implicit or purely intuitive reasoning. Fourth,

it supports more rational use of limited resources by indicating where reinforcement is most justified under the current combination of risk and zone criticality. Fifth, it provides a framework that is suitable for integration into emergency plans, physical protection procedures, and training scenarios. The model is especially relevant for military facilities because such facilities frequently combine high internal differentiation, strict regime requirements, and limited tolerance for interruption of command and support functions. Under these conditions, emergency management cannot be reduced to generic civil emergency logic. The consequences of poor prioritization are much greater, and the interaction between emergency effects and security degradation is more complex. A matrix-based approach helps address this problem by ensuring that emergency decisions remain anchored in both operational significance and structured risk interpretation. At the same time, the model is also applicable to other critical facilities where protected zones differ sharply in their strategic, technological, or organizational importance.

Thus, the basic material and results of the study show that risk management in emergency situations at critical and military facilities should be formalized as a structured decision process rather than treated as a sequence of isolated reactions. The key methodological result is the development of a matrix model that links interpreted risk levels and protected zone classes to standardized decision packages. The key practical result is that this model strengthens the speed, consistency, traceability, and operational relevance of emergency decisions while preserving the differentiated nature of high consequence protected facilities.

### Conclusions

This study has developed a methodological framework for risk management and matrix-based decision making in emergency situations at critical and military facilities. The results show that emergency risk management in such facilities cannot be reduced to general hazard interpretation or to isolated response actions. Under emergency conditions, risk must be treated as a decision variable that reflects not only the severity of the disruptive event, but also the criticality of the affected zone and the operational consequences of delayed or inadequate intervention.

The study demonstrates that the combination of two analytical coordinates, namely risk level and protected zone class, provides a more adequate basis for emergency decision making than generalized response logic. This makes it possible to differentiate management actions according to the functional significance of the affected area and to avoid the methodological weakness of applying

identical measures to zones with unequal operational importance. As a result, the proposed matrix model supports more precise prioritization of resources, access restrictions, surveillance reinforcement, personnel protection, and continuity related measures.

A further contribution of the study is the formalization of standardized decision packages for emergency conditions. The matrix framework transforms interpreted risk into a structured operational response mechanism and thereby improves the consistency, traceability, and reproducibility of protective decisions. Its practical value lies in the fact that it supports coordinated action under time pressure, incomplete information, and changing emergency conditions, which is especially important for military and other high consequence facilities. Overall, the proposed approach provides a more rigorous and operationally relevant basis for emergency risk management than descriptive or ad hoc decision making. Future research should focus on empirical validation of the matrix model, adaptation of response packages to specific facility types, and integration of the framework into emergency response plans, training procedures, and decision support systems.

**Conflicts of interest.** The authors declare that they have no conflicts of interest in relation to the current study, including financial, personal, authorship, or any other, that could affect the study, as well as the results reported in this paper.

**Use of artificial intelligence.** The authors confirm that they did not use artificial intelligence technologies when creating the current work.

### REFERENCES

1. Akhundov, R. Modeling information processes and deriving measurable requirements in physical protection system design / R. Akhundov, E. Hashimov // Management Information System and Devices. - 2026. - No. 1(188). - P. 5-16. - DOI: <https://doi.org/10.30837/0135-1710.2026.188.005>
2. Akhundov, R. Quantitative categorization of facilities and modeling of potential adversaries / R. Akhundov, E. G. Hashimov // Grail of Science. - 2025. - No. 60. - P. 469-482. - DOI: <https://doi.org/10.36074/grail-of-science.26.12.2025.049>
3. Akhundov, R. Scenario oriented sufficiency criteria for physical protection systems provide a traceable path from threat classes to design requirements / R. Akhundov, E. G. Hashimov, I. Islamov // Grail of Science. - 2026. - No. 63. - DOI: <https://doi.org/10.36074/grail-of-science.06.03.2026.074>
4. Akhundov, R. Methodological limitations of normative design of physical protection systems for critical and military facilities in a dynamic threat environment / R. Akhundov, E. G. Hashimov, I. Islamov // Grail of Science. - 2026. - No. 62. - P. 873-889. DOI: <https://doi.org/10.36074/grail-of-science.20.02.2026.096>
5. Kostin, V., Borovsky A. Definition of basic violators for critically important objects using the information probability method and cluster analysis. CEUR Workshop Proc. - 2020. - Vol. 2667, p.343-347. Available at: <https://ceur-ws.org/Vol-2667/paper75.pdf>
6. Broder, J. F., Tucker E. Risk Analysis and the Security Survey / - B.-H., 2012. DOI: <https://doi.org/10.1016/C2009-0-63855-1>
7. Cozens, P. A review and current status of crime prevention through environmental design (CPTED) / P. Cozens, T. Love // Journal of Planning Literature. - 2015. - Vol. 30, No. 4. - P. 393-412. - DOI: <https://doi.org/10.1177/0885412215595440>
8. Cooper, W. W. Data Envelopment Analysis: A Comprehensive Text with Models, Applications, References, and DEA-Solver Software / W. W. Cooper, L. M. Seiford, K. Tone. - Boston : KAP, 2000. DOI: <https://doi.org/10.1007/978-0-387-45283-8>
9. Yang, J. A 2D-graph model-based heuristic approach to visual backtracking security vulnerabilities in physical protection systems / J. Yang, L. Huang, H. Ma [et al.] // International Journal of Critical Infrastructure Protection. - 2022. - Vol. 38. - P. 100554. - DOI: <https://doi.org/10.1016/j.ijcip.2022.100554>
10. Kaplan, S. On the quantitative definition of risk / S. Kaplan, B. J. Garrick // Risk Analysis. - 1981. - Vol. 1, No. 1. - P. 11-27. - DOI: <https://doi.org/10.1111/j.1539-6924.1981.tb01350.x>
11. Garcia, M. L. Design and Evaluation of Physical Protection Systems / M. L. Garcia. - 2nd ed. - Elsevier, 2008. - DOI: <https://doi.org/10.1016/C2009-0-25612-1>
12. Hashimov, E. Constrained optimization of an integral security indicator for adaptive management of hazardous facilities / E. Hashimov, R. G. Akhundov, A. M. Talibov, I. Islamov // Grail of Science. - 2026. - No. 62. - P. 1003-1014. - DOI: <https://doi.org/10.36074/grail-of-science.20.02.2026.109>
13. Akhundov, R. Conceptual models of multi-level physical protection systems for special-purpose and critical infrastructure facilities / R. Akhundov, E. G. Hashimov, I. Islamov // Grail of Science. - 2026. - No. 61. - P. 591-608. - DOI: <https://doi.org/10.36074/grail-of-science.23.01.2026.066>
14. Rehak, D. Strengthening resilience in the energy critical infrastructure: Methodological overview / D. Rehak, S. Slivkova, H. Janeckova [et al.] // Energies. - 2022. - Vol. 15, No. 14. - P. 5276. - DOI: <https://doi.org/10.3390/en15145276>

15. Reniers, G. L. L. Preparing for major terrorist attacks against chemical clusters: Intelligently planning protection measures with respect to domino effects / G. L. L. Reniers, A. Audenaert // *Process Safety and Environmental Protection*. - 2014. - Vol. 92, No. 6. - P. 583-589. - DOI: <https://doi.org/10.1016/j.psep.2013.04.002>
16. Hashimov, E. Research of the efficiency multiservice networks using MIMO technology / E. Hashimov [et al.] // *Advanced Information Systems*. - 2026. - Vol. 10, No. 1. - P. 66-71. - DOI: <https://doi.org/10.20998/2522-9052.2026.1.08>
17. Lovecek, T. Critical infrastructure protection systems effectiveness evaluation / T. Lovecek, J. Ristvej, L. Simak // *Journal of Homeland Security and Emergency Management*. - 2010. - Vol. 7, No. 1. - DOI: <https://doi.org/10.2202/1547-7355.1613>
18. Akhundov, R. Enhancing the physical protection of critical facilities through the integration of physical process models and machine learning / R. Akhundov, E. Hashimov // *Grail of Science*. - 2026. - No. 61. - P. 722-731. - DOI: <https://doi.org/10.36074/grail-of-science.23.01.2026.083>
19. Gündüz, M. Z. Akıllı şebekelerde iletişim altyapısı ve siber güvenlik / M. Z. Gündüz, R. Daş // *Iğdır Üniversitesi Fen Bilimleri Enstitüsü Dergisi*. - 2020. - Vol. 10, No. 2. - P. 970-984. - DOI: <https://doi.org/10.21597/jist.655990>
20. Mondal, S., Adak, B. and Mukhopadhyay, S. 11 Functional and smart textiles for military and defence applications. *Smart and Functional Textiles*, Berlin, Boston: De Gruyter, 2023, pp. 397-468. Doi: <https://doi.org/10.1515/9783110759747-011>
21. Shoop, B. Mobile detection assessment and response systems (MDARS): A force protection physical security operational success / B. Shoop [et al.] // *Unmanned Systems Technology VIII*. - 2006. - Vol. 6230. - P. 668-678. <https://doi.org/10.1117/12.665939>
22. Hashimov, E. Decision support for physical protection systems using route-level metrics and simulation-based evaluation / E. Hashimov, R. Akhundov, A. Talibov, I. Islamov // *Grail of Science*. - 2026. - No. 63. - P. 531-542. - DOI: <https://doi.org/10.36074/grail-of-science.06.03.2026.059>
23. Kampova, K. Quantitative approach to physical protection systems assessment of critical infrastructure elements: Use case in the Slovak Republic / K. Kampova, T. Lovecek, D. Řehák // *International Journal of Critical Infrastructure Protection*. - 2020. - Vol. 30. - P. 100376. - DOI: <https://doi.org/10.1016/j.ijcip.2020.100376>
24. Zou, B. Evaluation of vulnerable path: Using heuristic path-finding algorithm in physical protection system of nuclear power plant / B. Zou, M. Yang, Y. Zhang [et al.] // *IJCIP*. - 2018. - Vol. 23. - P. 90-99. - DOI: <https://doi.org/10.1016/j.ijcip.2018.08.006>
25. Řehák, D. Complex approach to assessing resilience of critical infrastructure elements / D. Řehák, P. Senovsky, M. Hromada, T. Lovecek // *IJCIP*. - 2019. - Vol. 25. - P. 125-138. - DOI: <https://doi.org/10.1016/j.ijcip.2019.03.003>
26. El Wely, I. C. Analysis of physical protection system effectiveness of nuclear power plants based on performance approach / I. C. El Wely, A. Chetaine // *Annals of Nuclear Energy*. - 2020. - Vol. 153. - P. 108051. - DOI: <https://doi.org/10.1016/j.anucene.2020.107980>

Received (Надійшла) 12.02.2026

Accepted for publication (Прийнята до друку) 29.04.2026

Publication date (Дата публікації) 22.05.2026

#### ВІДОМОСТІ ПРО АВТОРІВ / ABOUT THE AUTHORS

**Ахундов Раміль** – доктор філософії з національної безпеки та військових наук, професор Національного університету оборони, Баку, Азербайджан;

**Ramil Akhundov** – PhD in National Security and Military Sciences, Professor at National Defense University, Baku, Azerbaijan;

e-mail: [mr.axundov1@gmail.com](mailto:mr.axundov1@gmail.com); ORCID Author ID: <http://orcid.org/0009-0001-8798-8044>.

**Гашимов Ельшан Гіяс** – доктор національної безпеки та військових наук, професор, професор Азербайджанського технічного університету; професор Національного університету оборони, Баку, Азербайджан;

**Elshan Hashimov** – Doctor in National Security and Military Sciences, Professor at Azerbaijan Technical University, Professor of National Defense University, Baku, Azerbaijan;

e-mail: [hasimovel@gmail.com](mailto:hasimovel@gmail.com); ORCID Author ID: <http://orcid.org/0000-0001-8783-1277>;

Scopus Author ID: <https://www.scopus.com/authid/detail.uri?authorId=57195631270>.

**Талібов Азіз Машалла** – доктор національної безпеки та військових наук, професор, професор Азербайджанського технічного університету, Баку, Азербайджан;

**Aziz Talibov** – Doctor in National Security and Military Sciences, Professor, Professor at Azerbaijan Technical University, Baku, Azerbaijan;

e-mail: [talibovaziz65@gmail.com](mailto:talibovaziz65@gmail.com); ORCID Author ID: <https://orcid.org/0000-0002-0572-7212>.

#### Управління ризиком і матричне прийняття рішень у надзвичайних ситуаціях на критично важливих і військових об'єктах

Раміль Ахундов, Ельшан Гашимов, Азіз Талібов

**Анотація.** У статті розроблено методологічну основу управління ризиком і матричного прийняття рішень у надзвичайних ситуаціях на критично важливих і військових об'єктах. Запропонований підхід ґрунтується на положенні, що ризик у надзвичайних умовах має визначатися не лише за рівнем небезпеки події, а й з урахуванням критичності ураженої захищеної зони. У межах дослідження ці змінні поєднано в матричній моделі, яка пов'язує рівні ризику та класи зон зі стандартизованими пакетами управлінських і захисних заходів. Показано, що такий підхід забезпечує перехід від описового оцінювання надзвичайної ситуації до структурованого механізму прийняття рішень. Практична цінність моделі полягає в підвищенні послідовності, швидкості та обґрунтованості рішень щодо розподілу ресурсів, регулювання режиму доступу, посилення спостереження, захисту персоналу та забезпечення безперервності функціонування. Отримані результати свідчать, що матрична модель створює більш строгий і практично орієнтований підхід до управління ризиком у надзвичайних ситуаціях на об'єктах із високим рівнем наслідків.

**Ключові слова:** управління ризиком, матричне прийняття рішень, надзвичайні ситуації, критично важливі об'єкти, військові об'єкти, фізичний захист, клас захищеної зони, пакет оперативного реагування, підтримка прийняття рішень, планування реагування на надзвичайні ситуації.