НАУКОВИЙ ВІСНИК: Цивільний захист та пожежна безпека

№ 2 (20), 2025

НАУКОВИЙ ЖУРНАЛ

ISSN 2518-1777

Заснований у 2016 році
Виходить 2 рази на рік

Засновник

Інститут державного управління та наукових досліджень з цивільного захисту (ІДУ НД ЦЗ)

Видавець
Інститут державного управління та наукових досліджень з цивільного захисту (ІДУ НД ЦЗ)

Журнал зареєстровано Міністерством юстиції України
Свідоцтво від 20.07.2020
Серія КВ № 24507-14447 ПР
Ідентифікатор медіа R30-02071

Журнал включено до категорії «Б» Переліку наукових фахових видань України в галузі технічних наук за спеціальностями:
261 «Пожежна безпека»
263 «Цивільний захист»
Наказ Міністерства освіти і науки України від 02.07.2020 № 886
У разі передруковування матеріалів письмовий дозвіл є обов'язковим
Рекомендовано до видання рішенням Вченої ради НУЦЗ України

Протокол від 27.11.2025 № 4

Ідентифікатор випуску DOI:
https://doi.org/10.33269/nvcz.2025.2

Підписано до друку 27.11.2025

Формат 60 × 84/8
Наклад 50 прим.

Адреса редакції:

04074, *м. Київ, вул. Вишгородська, 21*
Телефони:
(+380) (44) 430-02-85
https://nvcz.undicz.org.ua
e-mail: niv1966@ukr.net

ЗМІСТ

О. Басманов, Д. Карпова, В. Бенедюк, О. Зазимко, В. Забаровський
Модель нагріву резервуара з нафтопродуктом під впливом пожежі в кількох резервуарах резервуарної групи — **4**

В. Безсонний, І. Пономаренко
Синергія цивільного захисту та пожежної безпеки в управлінні ризиками готелів — **14**

Н. Коваль, С. Ємельяненко, І. Коваль
Дослідження пожежних ризиків санаторно-курортних закладів — **24**

М. Осадчук
Про способи одержання та перспективи використання компресійної піни — **31**

С. Сідней, І. Рудешко, І. Іщенко, Є. Школяр, Р. Мотрічук, В. Степаненко
Залежність впливу параметричної пожежі на розподіл температури по сталевій балці — **40**

С. Новак, М. Пустовий, І. Маладика
Оцінювання необхідної товщини вогнезахисту сталевих конструкцій за сценаріями умовної пожежі — **47**

А. Михайлова, Я. Балло, О. Крикун Р. Пономаренко
Методика проведення вогневих досліджень температурного режиму пожежі у приміщенні генераторної станції — **62**

Р. Коваль, Р. Пальчиков
Аналіз пожежної небезпеки трансформаторів на основі масивів статистичних даних — **73**

Н. Рашкевич, О. Рашкевич, М. Дівізінюк, Р. Шевченко, О. Шевченко
Формування функціонального поля інформаційно-технічних методів попередження надзвичайних ситуацій медико-біологічного характеру зумовлених забрудненням ґрунтів в зоні бойових дій — **82**

CONTENTS

O. Basmanov, D. Karpova, V. Beneduk, O. Zazymko, V. Zabarovskiy
Modeling the heating of an oil product tank under fire exposure from adjacent tanks in a tank group — **4**

V. Bezsonnyi, I. Ponomarenko
Synergy of civil defense and fire safety in hotel risk management — **14**

N. Koval, S. Yemelianenko, I. Koval
Research of fire risks in sanatorium and resort facilities — **24**

M. Osadchuk
On methods of obtaining and prospects for the use of compression foam — **31**

S. Sidney, I. Rudeshko, I. Ishchenko, Ye. Shkoliar, R. Motrichuk, V. Stepanenko
Dependence of the influence of parametric fire on the temperature distribution across a steel beam — **40**

S. Novak, M. Pustovyi, I. Maladyka
Assessment of the required thickness of fire protection of steel structures under conditional fire scenarios — **47**

A. Mykhailova, Ya. Ballo, O. Krykun, R. Ponomarenko
Methodology for conducting fire research of the temperature regime of fire in generating station — **62**

R. Koval, R. Palchykov
Analysis of fire hazards of transformers based on statistical data arrays — **73**

N. Rashkevych, O. Rashkevych, M. Divizinyuk, R. Shevchenko, O. Shevchenko
Formation of the functional field of information and technical methods for preventing medical and biological emergencies caused by soil contamination in combat zones — **82**

УДК [614.8 + 614.84 + 331.45]:64.024

SYNERGY OF CIVIL DEFENSE AND FIRE SAFETY IN HOTEL RISK MANAGEMENT

https://doi.org/10.33269/nvcz.2025.2.14-23

Bezsonnyi V. L.[1], ORCID iD 0000-0001-8089-7724
Ponomarenko I. V.[2], ORCID iD 0000-0003-4780-3209
*E-mail: vitalii.bezsonnyi@hneu.net

[1]*Simon Kuznets Kharkiv National University of Economics, Ukraine*
[2]*National University of Civil Protection of Ukraine, Ukraine*

ABOUT ARTICLE
Received by the editorial office: 30.09.2025
Reviewed: 15.10.2025
Published: 11.12.2025

KEY WORDS:
integrated security, civil defense, fire safety, hotel and restaurant business, risk management, technological safety, occupational safety, synergy.

ANNOTATION
The relevance of the study is driven by the fact that hotel and restaurant business (HRB) enterprises are complex engineering, technical, and social systems with heightened vulnerability (high concentration of people unfamiliar with the building layout; 24/7 operation; presence of technologically hazardous equipment). Recent years, especially under the conditions of full-scale military aggression, have shifted the threat paradigm from commercial to existential, bringing issues of physical protection and civil defense (CD) to the forefront. It is proven that the dominant "siloed" (fragmented) management model in Ukraine – where aspects of fire safety (FS), civil defense (CD), technological safety (TS), and occupational safety (OS) are regulated, researched, and implemented in isolation – is incapable of adequately responding to modern complex and dynamic threats. The purpose of the article is to develop and scientifically substantiate a conceptual model of an integrated safety system (ISS) for HRB enterprises, which ensures a synergistic effect by combining and mutually reinforcing the subsystems of CD, FS, TS, and OS. The article proposes three key scientific re-conceptualizations for the first time. First, the role of inclusiveness is re-conceptualized: it is proven that the requirements of DBN V.2.2-40:2018 "Inclusiveness of Buildings and Structures" are not merely a social or architectural norm, but a fundamental and integral element of the civil defense and fire safety system. Second, the necessity of transitioning from static FS management models (fixed plans) to dynamic, adaptive models is substantiated. Third, the traditional OS model of "compliance-briefing" is re-conceptualized into a model of "personnel as an active agent of integrated safety". In this model, OS training becomes a tool for increasing personnel competence in responding to integrated threats (actions during an air raid (CD), panic management (FS), assistance to PRM).

Problem Statement. The hospitality industry, which encompasses the hotel and restaurant business (HRB), is a key sector of the service economy with significant potential for Ukraine's integration into the global economic space^{1}. At the same time, HRB enterprises are complex engineering, technical, and social systems characterized by specific properties that determine their increased vulnerability. These properties primarily include: high concentration and mass presence of people, a significant number of whom are unfamiliar with the building layout and evacuation procedures; 24/7 operating mode, and the presence of powerful and diverse technological equipment (kitchen, climate control, elevator systems), which is a source of man-made and fire risks [1].

Traditionally, safety management in HRB focused on classic commercial and operational risks. However, recent years, especially under the conditions of full-scale military aggression, have fundamentally changed the paradigm of threats [2]. Issues of existential security have come to the forefront: the physical protection of clients

and personnel, the reliability of life support infrastructure, and the object's ability to function as an element of civil defense (CD).

In these conditions, a fundamental scientific and practical problem is revealed: the fragmentation of existing approaches to safety management at HRB facilities. Historically and normatively, a "siloed" (fragmented) management model has developed in Ukraine, where different aspects of safety are regulated and implemented in isolation:

- Fire Safety (FS) – regulated by relevant Regulations, focusing on fire prevention, the availability of firefighting equipment, and evacuation routes.

- Civil Defense (CD) – until recently, it was perceived mainly as a sphere of state responsibility, and at the facility level, it was reduced to formal documentation and instruction, without considering the specifics of HRB.

- Occupational Safety (OS) – regulated by the Law "On Labor Protection" and focused exclusively on protecting the health of personnel, ignoring their key role in ensuring the safety of guests.

- Technological Safety (TS) – considers the risks associated with the failure of engineering systems mainly in the context of business continuity, rather than as a direct trigger for emergency situations in the areas of FS and CD.

Such a fragmented approach, based on the reactive fulfillment of regulatory requirements (a compliance model) rather than on proactive integrated risk management, proves to be completely incapable of adequately responding to modern complex and dynamic threats. For example, a fire (FS) resulting from a technological failure (TS) during an air raid (CD) requires coordinated actions from personnel (OS) that go beyond their standard isolated instructions.

The connection to the important scientific task lies in the absence of a unified, scientifically substantiated model that would integrate these four components (CD, FS, TS, OS) into a single risk management framework adapted to the specifics of the hospitality industry. The main thesis is that these areas are not parallel; they are cascadingly dependent. A failure in one of them (e.g., OS – poorly trained staff) inevitably provokes the collapse of the others (FS – impossibility of evacuation, CD – panic and mass casualties).

Thus, the scientific and practical task is to prove the necessity of transitioning from the outdated "compliance management model" to a modern "integrated risk management model", the core of which is the synergy of civil defense and fire safety, and to develop the conceptual foundations of such a model.

Analysis of Recent Research and Publications. An analysis of scientific works confirms the thesis advanced regarding the fragmentation of safety management approaches in the hospitality industry (HRB). Research in this area is clearly divided into several isolated "silos" (fragments).

The first, economic and managerial "silo", considers security a key business issue, but mostly in the context of general threats and financial risks. Researchers, such as N. V. Valinkevych and S. V. Tyshchenko [1], indicate that security and insurance are crucial for business functioning, yet often note that security (e.g., video surveillance) can be perceived as conflicting with guest comfort [3]. Ukrainian scholars (Kaplina et al. [2]) are forced to acknowledge the absence of a single, comprehensive risk assessment methodology specifically adapted for HRB, which has not yet been formed in Ukraine.

The second, engineering "silo" (FS/TS), is focused on technical aspects. The research by A. Pohrebnyak et al. confirms that the kitchen is an area of increased danger: in Ukraine, up to 30% of fires in HRB are caused specifically by non-compliance with kitchen equipment operation rules, and another 25% by short circuits [3]. International standards, such as the European CFPA-E guideline, also define kitchens as a "high hazard area," where the key risks are heated fats and deposits in ventilation ducts [4]. However, this area has two fundamental shortcomings.

First, it ignores the new threat context. Studies by S. V. Pozdeyev et al., published in the «Scientific Bulletin: Civil Defense and

Fire Safety», prove that traditional protection criteria (overpressure, ionization) are completely inadequate in the conditions of modern combat operations [5]. They call for the development of new criteria that account for direct hits and shrapnel damage, which is critical for HRB facilities as places of mass gathering. This task is urgent, considering that only 11% of existing protective structures in Ukraine are ready for use, and the majority (55.7%) are unadapted basements.

Second, engineering models often rely on outdated evacuation calculations. A key work here is the research by I. A. Onoshko and V. V. Kovalyshyn, who proved the imperfection of the domestic methodology for calculating the start time of evacuation [6].

The third "silo" – occupational safety (OS) – also exists separately. Studies by O. A. Nahurskyi et al. criticize the Ukrainian practice of implementing standards (e.g., ISO 45001) as formal "filling out questionnaires," which does not guarantee the actual competence of personnel [7]. This directly contradicts international hotel safety research: Y.-Y. Chen et al., in a work for *Building and Environment*, proved that in existing hotels (where major reconstruction is impossible), it is precisely "fire safety management" (i.e., management and personnel) that is the most important factor (weight coefficient 54.95%), as technology is powerless without competent people [8].

The most critical gap is the lack of research on inclusiveness (PRM) as a component of CD/FS. This topic is considered only in the context of architectural norms (ramps, door width) [9]. However, studies by V. B. Kovalyshyn et al. [10] (also published in the «Scientific Bulletin: Civil Defense and Fire Safety») on unannounced evacuation from a shopping and entertainment center prove that: 1) The main factor affecting evacuation time is the delay in its start (people's behavior), not the speed of movement. 2) Personnel actions are the decisive factor in overcoming this delay. 3) The evacuation of persons with reduced mobility (PRM, group M4) is fundamentally impossible via standard routes and requires special procedures: fire-safe zones and fire lifts. This same requirement (fire-safe zones) is confirmed by the research of Ya. V. Ballo et al. [11] regarding high-rise buildings, published in the «Scientific Bulletin: CD and FS»).

Thus, the analysis proves that the scientific problem is only partially solved. Existing HRB safety models are fragmented; engineering evacuation calculations rely on imperfect methodologies; occupational safety models ignore the role of personnel as evacuation agents; and none of them integrates the requirements of inclusiveness [9] as a fundamental, rather than secondary, element of the Civil Defense system.

Based on the analysis conducted, a complex of unresolved scientific and practical problems that form the subject area of this study can be clearly outlined. This is the absence of a holistic integrated model. Despite the existence of research on individual components (FS, OS, economic security), no model has been proposed in domestic science that would combine the risks of civil defense (CD), fire (FS), technological (TS) safety, and occupational safety (OS) into a single, synergistic management system for an HRB facility.

Inadequacy of the static evacuation model. The dominant approach to FS, based on static evacuation plans, is an unresolved problem. This approach ignores: (a) the criticism of domestic methodologies for calculating the evacuation start time; (b) practical data proving that the delay in the start (human factor), not the speed of movement, is the decisive factor [9]; (c) new threats (direct hits, shrapnel) that render traditional CD approaches obsolete.

Incorrect interpretation of the role of "inclusiveness" in the safety system. This is one of the key unresolved problems. The entry into force of DBN V.2.2-40:2018 "Inclusiveness of buildings and structures" is still viewed mainly as a social or architectural and construction norm. The complete absence of scientific understanding of inclusiveness requirements as a critical and fundamental component of the civil defense and fire safety system is an unresolved problem. A hotel complex that does not comply with DBN

requirements (e.g., lack of duplicate warning systems, fire-safe zones) automatically fails to meet the requirements of the CD Code and FS Regulations, as it is knowingly incapable of ensuring the rescue and evacuation of PRM [9].

Passive role of the "human factor" (OS). In the traditional model [11], personnel are viewed as an object of protection and a passive recipient of instructions. Models where personnel (OS) are considered an active agent and a key integrator of the entire safety system (CD+FS+TS) have not been developed. This directly contradicts both international studies (where personnel is factor #1) [11] and practical experiments in Ukraine, which prove that personnel actions are decisive for the start of evacuation [10].

Thus, the article is devoted to solving these problems by developing a conceptual model of an integrated safety system (ISS), which synergistically combines all four components (CD, FS, TS, OS), overcoming their fragmentation, and proposes new approaches to the role of inclusiveness and the human factor in this system.

Research Methods. To achieve the stated goal and solve the research objectives, a complex of general scientific and special methods was utilized, ensuring the reliability and validity of the obtained results.

The theoretical foundation of the research relies on the principles of systems theory, risk management theory, theory of complex systems reliability, and a qualificational approach to safety assessment. The main research method is system analysis and synthesis. This allows for the decomposition of the general HRB safety problem into four main components (CD, FS, TS, OS), analyzing their internal connections, existing contradictions, and "siloed" limitations. At the synthesis stage, this method is applied for the scientific substantiation and construction of a unified integrated model (ISS) that demonstrates the synergistic effects of their interaction.

Comparative legal analysis is employed for a detailed study of the domestic regulatory and legal framework governing the investigated areas. Specifically, the provisions of the Law of Ukraine "On Labor Protection" [12], the Civil Defense Code of Ukraine, the "Fire Safety Rules of Ukraine" [13], and key State Building Codes, including DBN V.2.2-40:2018 "Inclusiveness of Buildings and Structures" [9] and DBN V.2.2-20:2008 "Hotels" [14], are analyzed. This allowed for the identification not only of gaps but also of points of contact and hidden interconnections between norms (for example, between DBN on inclusiveness and CD requirements).

Methods of deterministic and probabilistic analysis are used for the critical assessment of existing approaches to risk evaluation. Drawing upon conclusions about the shortcomings of deterministic evacuation calculation methods [6], and considering international experience in applying probabilistic (PRA) and quantitative (QRA) risk analysis in building safety models [10], the necessity of transitioning to more flexible and dynamic assessment models is substantiated.

The Analytical Hierarchy Process (AHP) method is applied to structure and classify the set of risks inherent in HRB (from economic to technological and military [15]), and to prioritize their ranking within the proposed integrated ISS model.

The modeling method (conceptual and technological) is used for the development of the conceptual ISS model itself. Furthermore, based on the analysis of advanced international research [9], the method of technological modeling is applied to substantiate the utilization of modern digital solutions (BIM, IoT, AI [16]) as the technological core of the proposed integrated system.

Formulation of Research Objectives. The general goal of the study is to develop and scientifically substantiate the conceptual model of an integrated safety system (ISS) for hotel and restaurant business enterprises in Ukraine, which ensures a synergistic effect through the combination and mutual reinforcement of civil defense, fire safety, technological safety, and occupational safety subsystems, thereby overcoming their current fragmentation.

Achieving this goal requires solving the following specific scientific and practical tasks:

1. Identify, systematize, and critically analyze the barriers and gaps in the domestic regulatory and legal framework and scientific work that impede the practical integration of civil defense (CD), fire safety (FS), technological safety (TS), and occupational safety (OS) management systems at HRB facilities.

2. Re-conceptualize the regulatory requirements of DBN V.2.2-40:2018 "Inclusiveness of Buildings and Structures". Scientifically prove that these requirements are not only a social or architectural norm but also a fundamental and integral element of the civil defense and fire safety system in HRB, the non-fulfillment of which makes effective evacuation and rescue of people impossible.

3. Critically analyze traditional approaches to occupational safety in HRB, based on the "compliance-briefing" model, and scientifically substantiate the necessity of transitioning to a new model of "personnel as an active agent of integrated safety", where OS training becomes a tool for increasing personnel competence in responding to CD, FS, and TS threats.

4. Prove the advantages and necessity of transitioning from static fire safety management models (approved evacuation plans) to dynamic, adaptive models. Substantiate that such a transition is possible only on the basis of technological convergence (BIM, IoT, AI) and resolves the fundamental problems identified in the domestic risk assessment methodology.

5. Develop and propose a three-level conceptual structure of the ISS (Normative Level, Technological Level, Organizational Level), which is based on technological convergence and organizational synergy, and provides a comprehensive solution for the identified unresolved problems.

Presentation of the Main Research Material. To construct a viable Integrated Safety System (ISS), the existing "siloed" paradigm must be overcome. This process requires not merely a mechanical combination of existing components but their deep re-conceptualization and restructuring based on new principles. In the proposed model, Civil Defense (CD) and Fire Safety (FS) act as the core of the system, while Technological Safety (TS) and Occupational Safety (OS) serve as integrated tools for ensuring their effectiveness.

The first, and arguably most critical, step is the re-conceptualization of the link between civil defense and inclusiveness standards. The traditional approach to CD management at an HRB facility is reduced to fulfilling formal requirements: the existence of an "Emergency Response Plan" and corresponding briefings. This approach ignores two key characteristics of HRB: the constant presence of guests unfamiliar with the building, and the presence of a significant number of persons with reduced mobility (PRM). This is where the fundamental re-conceptualization proposed in this article takes place. The enforcement of DBN V.2.2-40:2018 "Inclusiveness of Buildings and Structures" and its subsequent amendments should be viewed not as a separate construction or social norm, but as the most vital technical standard that directly determines the facility's capability to perform its civil defense and fire safety functions.

The justification for this statement lies in a simple cause-and-effect relationship: while the key requirement of CD and FS is to ensure the safe and timely evacuation of all people, the DBN V.2.2-40 standard mandates ensuring the physical accessibility of the building for PRM, which includes the proper slope of ramps, width of corridors, tactile elements, and duplicate notification systems. Thus, the logical conclusion arises: if a hotel has not met the requirements of DBN V.2.2-40 (for instance, lacking a proper ramp or a notification system that duplicates visual signals for people with hearing impairments), it is physically incapable of ensuring the evacuation of PRM. As a result, any Evacuation Plan or Emergency Response Plan becomes unfeasible, as the inability to evacuate even one PRM can block evacuation routes, leading to mass panic and the death of others. Therefore, Scientific Result №1 lies in substantiating that the audit of a facility's

compliance with inclusiveness requirements is an integral and potentially the most crucial part of the civil defense and fire safety audit of the hotel.

The second component of the model concerns overcoming the gap between static fire safety approaches and the dynamic nature of technological threats. The traditional FS system is based on adherence to "Fire Safety Rules," which requires primary firefighting equipment and static, pre-approved evacuation plans, while technological safety (TS) is treated separately. This approach has two fundamental flaws. Firstly, as proven by I. Onoshko and V. Kovalyshyn [6], the domestic methodology for calculating risks and evacuation time is flawed, which casts doubt on the adequacy of the initial data used for developing these static plans. Secondly, a fire is a highly dynamic process, and a static evacuation plan, without accounting for the actual seat of the fire and the spread of smoke, could, in the worst case, direct people straight into the blaze.

In this context, Scientific Result №2 lies in substantiating the necessity of transitioning from static compliance to dynamic, adaptive management of fire and technological safety based on modern technological platforms. International scientific and technological experience proposes the integration of BIM (Building Information Modeling) and IoT (Internet of Things) [16] for this purpose. This approach stipulates that, instead of a paper plan, the hotel should possess a comprehensive digital information model (BIM). This model integrates with a network of IoT sensors installed not only for smoke detection (FS) but also for monitoring technological threats (TS): temperature and vibration sensors on engineering equipment, pressure sensors, and gas leak detectors in the kitchen. In the event of an incident, sensors transmit real-time data to the BIM model, which instantly models the threat progression (e.g., fire and smoke spread) and plots the safest evacuation routes in real-time. The system automatically activates visual and audible indicators in the direction of safe exits, directly resolving the methodological problem of selecting fire scenarios raised by Onoshko and Kovalyshyn [6]. Leading global solutions, such as Cerberus DMS or Desigo CC [17], allow this to be combined with the general Building Management System (BMS) for automatic ventilation control (for smoke management) and precise data transmission to rescue services.

The third, integrating, element of the system is the human factor, specifically the re-conceptualization of occupational safety. The traditional approach to OS, regulated by the Law "On Labor Protection" and industry regulations, focuses exclusively on the protection of the worker and views personnel as a passive object of protection. This approach is a "procedural trap" that provides a legal alibi for the employer but absolutely does not guarantee the competence of personnel during a real emergency. In the hospitality industry, where guests are unprepared, disoriented, and unfamiliar with the building, the only trained, organized, and manageable force within the building is the personnel.

Consequently, Scientific Result №3 lies in substantiating the re-conceptualization of occupational safety in HRB. The transition from the "personnel as an object of protection" model to the "occupational safety as a tool for training personnel as an active agent of integrated safety (CD+FS)" model is necessary. This demands that integrated OS briefings include not only learning about the safe operation of kitchen equipment but also practical skills in responding to CD signals (actions during an air raid), panic prevention methods (FS), and, most importantly, protocols for assisting in the evacuation of PRM. In such a model, OS expenditures cease to be a mere compliance cost and become a direct investment in the reliability of the entire CD and FS system. Modern technologies, such as AI simulations and training, can be utilized to enhance the effectiveness of this training.

Based on the analysis and re-conceptualization of the individual components, a three-level conceptual model of the Integrated Safety System (ISS) for HRB enterprises is proposed.

At Level 1 (Normative-Legal), which forms the foundation of the system, the creation of a unified "Integrated Facility Safety Passport" is proposed. This document must synthesize the requirements of the Law "On Labor Protection," the CD Code, FS Rules, and key DBNs – the sectoral DBN V.2.2-20:2008 (Hotels) and the cross-cutting DBN V.2.2-40:2018 (Inclusiveness). Thus, a key normative synergy is achieved: an FS audit cannot be passed if the facility fails the inclusiveness audit, as non-compliance with ramp requirements is equated to blocking evacuation routes.

Level 2 (Technological-Informational) acts as the "central nervous system" of the model. The core is a unified technological platform (BMS) that combines BIM+IoT+AI. The synergistic effect lies in the simultaneous collection of data from all subsystems: FS (smoke sensors), TS (vibration, gas leak sensors), and CD (integration with the state notification system). The platform does not merely record events but forecasts risks (e.g., equipment overheating (TS) -> fire risk (FS)) and generates adaptive solutions (dynamic evacuation).

Level 3 (Organizational-Human) is the execution level, where technological solutions are transformed into real actions through competent personnel trained under the integrated program. This level "closes" the management cycle: personnel (Level 3) use the data and instructions generated by the Technological Core (Level 2) to perform procedures consistent with the Normative Foundation (Level 1). For example, during an emergency, the system (Level 2) identifies a PRM in a specific room and transmits a signal to a trained employee's mobile device (Level 3), who immediately proceeds to assist using the adaptive safe route plotted by the system.

The visualization of the proposed model is presented in Table 1.

Table 1. Conceptual Model of the Integrated Safety System (ISS) for Hospitality Facilities

ISS Levels	**CD Subsystem (Civil Defense)**	**FS Subsystem (Fire Safety)**	**TS Subsystem (Technological Safety)**	**OS Subsystem (Occupational Safety)**
Level 1: Normative (Foundation)	CD Code, Emergency Response Plan. Key Integration: DBN V.2.2-40.19	FS Rules, DBN V.1.1-7. Key Integration: DBN V.2.2-40.19	Equipment Operation Norms, Industry Standards.	Law "On Labor Protection", Industry Norms
Level 2: Technological (Core)	Notification System (integration with state system). Duplication for PRM	Dynamic System (BIM+IoT). AI-Detection. Automatic Fire Suppression.	IoT-Sensors on Equipment (pressure, t°, vibration). Predictive Analysis System.	Access Control System. "Panic Buttons". Mobile Applications for Personnel.
Level 3: Organizational (Agent)	Trained personnel for PRM assistance. Protocols for Shelters	Integrated training (OS+FS). Practical training on adaptive evacuation.	Integrated training (OS+TS). Protocols for preventive response to IoT signals.	Integration Core. Personnel as a Safety Agent. Integrated Briefings (OS+CD+FS+TS).

The justification for the synergistic effect is that the proposed model transforms four isolated "silos" into a unified, proactive system. Investments in OS (Level 3) increase the effectiveness of CD and FS. Investments in TS (IoT-sensors at Level 2) directly enhance FS (predictive analytics). Fulfilling Inclusiveness requirements (Level 1) becomes a technical prerequisite for the functioning of CD and FS. Thus, the system becomes significantly more resilient to complex threats than the simple sum of its individual parts.

Conclusions and Directions for Further Research. The conducted research allows for several conclusions that hold both theoretical and practical significance for elevating the safety level in Ukraine's hospitality industry.

The dominant "siloed" (fragmented) approach to safety management in the hotel and restaurant business in Ukraine is methodologically outdated and practically inadequate for modern complex threats, especially those associated with the elevated danger of martial law conditions. This approach is founded on the formal and isolated fulfillment of separate regulatory requirements (Law "On Labor Protection," "Fire Safety Rules," industry instructions).

The role of inclusiveness in the safety system has been scientifically substantiated and re-conceptualized for the first time in the domestic academic field. It is proven that the normative requirements of DBN V.2.2-40:2018 "Inclusiveness of Buildings and Structures" constitute an integral and critical technical component of the civil defense and fire safety system. Non-compliance with these requirements (concerning ramps, corridors, notification systems for PRM) renders evacuation and rescue plans unfeasible, thus nullifying the effectiveness of any CD and FS measures.

Domestic scientific research demonstrates a significant gap between the engineering school (which criticizes existing FS calculation methodologies but offers no solutions for HRB) and the managerial school (which classifies risks but ignores engineering aspects). Furthermore, a technological and conceptual lag is evident in the understanding of integrated systems (which are often mistaken for business automation) compared to international approaches (BIM+IoT, BMS).

To address the identified problems, a conceptual three-level Integrated Safety System (ISS) model has been proposed. This model is built on the synergy of four components (CD, FS, TS, OS) across three levels: Normative (Integrated Safety Passport), Technological (BIM+IoT+AI as the core), and Organizational (where OS is re-conceptualized to the "personnel as a safety agent" model). This model is proactive, adaptive, and ensures holistic risk management.

The realization of the proposed conceptual model opens new avenues for scientific investigation, particularly the transition from concept to quantitative substantiation:

Development of a Quantitative Risk Assessment (QRA/PRA) model for the proposed ISS. This necessitates the development of a mathematical apparatus that would quantitatively estimate the reduction in aggregate risk (to guests' lives, personnel, and business) when implementing the three-level ISS compared to the traditional "siloed" approach.

Development of methodologies for the economic substantiation of ISS implementation. This involves assessing the cost of investing in the technological core (BIM, IoT-sensors) and comparing it with potential losses (direct and reputational) from incidents, taking international statistics into account.

Creation of unified training programs and digital simulators (utilizing virtual and augmented reality (VR/AR) technologies) for HRB personnel. These programs would implement the "personnel as a safety agent" model and integrate training across OS, CD, FS, and PRM assistance.

Adaptation of the proposed ISS for various categories of HRB facilities (small hotels, catering establishments, large resort complexes) and further research into its functioning under the specific threats posed by martial law.

REFERENCE

1. Valinkevych, N. V., & Tyshchenko, S. V. (2022). Zabezpechennia bezpeky ta strakhuvannia pidpryiemstv hotelno-restorannoho biznesu [Ensuring safety and insurance of hotel and restaurant business enterprises]. *Ekonomika ta suspilstvo*, 40. doi:https://doi.org/10.32782/2524-0072/2022-40-64
2. Kaplina, T., Kaplina, A., & Nektova, O. (2024). Theoretical substantiation of security features of hotel industry enterprises. *Scientific Bulletin of Poltava University of Economics and Trade. A Series of "Economic Sciences"*, 2(112), 13–19. doi:https://doi.org/10.37734/2409-6873-2024-2-2
3. Pohrebniak, A., Vyshnikina, O., Kucher, M., Sabirov, O., & Hrytsenko, A. (2024). Doslidzhennia ta otsinka pozhezhnykh ryzykiv u hotelno-restorannykh zakladakh Ukrainy [Study and assessment of fire risks in hotel and restaurant facilities of Ukraine]. *Ekonomichni nauky: Visnyk Khmelnytskoho natsionalnoho universytetu*, 6(336), 433–439. doi:https://doi.org/10.31891/2307-5740-2024-336-67
4. CFPA Europe. (2012). *Fire safety in restaurants. CFPA-E Guideline No 9:2012 F.* Copenhagen: CFPA Europe.
5. Nekora, V., Nizhnyk, V., Pozdeiev, S., Lutsenko, Yu., & Mykhailov, V. (2023). Osoblyvosti ta perspektyvy efektyvnoho funktsionuvannia zakhysnykh sporud tsyvilnoho zakhystu v umovakh boiovykh dii [Peculiarities and prospects of effective functioning of civil protection protective structures in conditions of hostilities]. *Naukovyi visnyk: Tsyvilnyi zakhyst ta pozhezhna bezpeka*, 1(15), 149–157. doi:https://doi.org/10.33269/nvcz.2023.1(15).149-157
6. Onoshko, I. A., & Kovalyshyn, V. V. (2022). Analiz metodolohii otsiniuvannia pozhezhnykh ryzykiv [Analysis of fire risk assessment methodology]. *Pozhezhna bezpeka*, 41(41), 94–102. https://journal.ldubgd.edu.ua/index.php/PB/article/download/2458/2348/
7. Nahurskyi, O. A., Vasiichuk, V. O., Korzh, H. I., & Vytrykush, N. M. (2022). Osoblyvosti vprovadzhennia DSTU ISO 45001:2018 "Systemy upravlinnia okhoronoiu zdorovia ta bezpekoiu pratsi. Vymohy ta nastanovy shchodo zastosuvannia" [Features of implementation of DSTU ISO 45001:2018 "Occupational health and safety management systems — Requirements and guidelines for use"]. *Hraal nauky*, 16, 116–121. doi:https://doi.org/10.36074/grail-of-science.17.06.2022.020
8. Chen, Y.-Y., Chuang, Y.-J., Huang, C.-H., Lin, C.-Y., & Chien, S.-W. (2012). The adoption of fire safety management for upgrading the fire safety level of existing hotel buildings. *Building and Environment*, 51, 311–319. doi:https://doi.org/10.1016/j.buildenv.2011.12.001
9. Ministerstvo rehionalnoho rozvytku Ukrainy. (2017). *DBN V.2.2-40:2018. Inkliuzyvnist budivel i sporud [DBN V.2.2-40:2018. Inclusivity of buildings and structures]* (effective from 2019-04-01). Kyiv.
10. Kovalyshyn, V. V., Dotsenko, O. H., Khlevnoi, O. V., & Dyven, V. I. (2022). Doslidzhennia evakuatsii liudei riznykh hrup mobilnosti z torhovelno-rozvazhalnoho tsentru [Study of evacuation of people of different mobility groups from a shopping and entertainment center]. *Naukovyi visnyk: Tsyvilnyi zakhyst ta pozhezhna bezpeka*, 2(14), 99–107.
11. Ballo, Ya. V., Holikova, S. Yu., Sizikov, O. O., Zykhariev, O. P., Savchenko, O. V., & Neseniuk, L. P. (2021). Vymohy pozhezhnoi bezpeky do vysotnykh hromadskykh budivel z umovnoiu vysotoiu vid 100 m do 150 m [Fire safety requirements for high-rise public buildings with a nominal height from 100 m to 150 m]. *Naukovyi visnyk: Tsyvilnyi zakhyst ta pozhezhna bezpeka*, 2(12), 30–42. doi:https://doi.org/10.33269/nvcz.2021.2.30-42
12. Verkhovna Rada Ukrainy. (1992). *Pro okhoronu pratsi: Zakon Ukrainy vid 14.10.1992 № 2694-XII* [On labour protection: Law of Ukraine No 2694-XII of 14 October 1992]. *Vidomosti Verkhovnoi Rady Ukrainy*, 49, Art. 668.
13. Ministerstvo vnutrishnikh sprav Ukrainy. (2014). *Pravyla pozhezhnoi bezpeky v Ukraini: Nakaz MVS Ukrainy vid 30.12.2014 № 1417* [Fire safety rules in Ukraine: Order of the Ministry of Internal Affairs of Ukraine No. 1417 of 30 December 2014]. Registered in the Ministry of Justice 05.03.2015 No. 252/26697.
14. Ministerstvo rehionalnoho budivnytstva Ukrainy. (2008). *DBN V.2.2-20:2008. Budynky i sporudy. Hoteli* [DBN V.2.2-20:2008. Buildings and structures. Hotels] (effective from 2009-04-01). Kyiv.
15. Yatsenko, M. S., & Komarnytska, V. V. (2022). Problemy funktsionuvannia hotelnoho biznesu v umovakh voiennoho stanu [Problems of hotel business functioning under martial law]. *Ekonomika. Finansy. Pravo*, 5(2), 33–36. doi:https://doi.org/10.37634/efp.2022.5(2).7
16. Pang, B., Shi, J., Jiang, L., & Pan, Z. (2024). A semantic approach to dynamic path planning for fire evacuation through BIM and IoT data integration. *Advances in Civil Engineering*, 2024, Article ID 8839865. doi:https://doi.org/10.1155/2024/8839865
17. Dahlcore. (2024). *7 innovative techniques for enhancing hotel safety in 2024*. https://dahlcore.com/blog/f/7-innovative-techniques-for-enhancing-hotel-safety-in-202460695-1-10:2017, IDT; IEC 60695-1-10:2016, IDT).

СПИСОК ВИКОРИСТАНИХ ДЖЕРЕЛ

1. Валінкевич Н. В., Тищенко С. В. Забезпечення безпеки та страхування підприємств готельно-ресторанного бізнесу. Економіка та суспільство. 2022. Вип. 40. DOI: https://doi.org/10.32782/2524-0072/2022-40-64.
2. Kaplina T., Kaplina A., Nektova O. Theoretical substantiation of security features of hotel industry enterprises. Scientific Bulletin of Poltava University of Economics and Trade. A Series of "Economic Sciences", 2024, Вип. 2(112), с. 13–19: DOI: https://doi.org/10.37734/2409-6873-2024-2-2
3. Погребняк А., Вишнікіна О., Кучер М., Сабіров О., Гриценко А. Дослідження та оцінка пожежних ризиків у готельно-ресторанних закладах України. Економічні науки : Вісник Хмельницького національного університету. 2024. № 6 (336). С. 433–439. https://doi.org/10.31891/2307-5740-2024-336-67
4. Fire safety in restaurants. CFPA-E Guideline No 9:2012 F. Copenhagen : CFPA Europe, 2012. 22 с.
5. Некора В., Ніжник В., Поздєєв С., Луценко Ю., Михайлов В. Особливості та перспективи ефективного функціонування захисних споруд цивільного захисту в умовах бойових дій. Науковий вісник: Цивільний захист та пожежна безпека, 2023 (1(15), 149–157. https://doi.org/10.33269/nvcz.2023.1(15).149-157
6. Оношко І. А., Ковалишин В. В. Аналіз методології оцінювання пожежних ризиків. Пожежна безпека. 2022. Том 41, № 41. С. 94–102. https://journal.ldubgd.edu.ua/index.php/PB/article/download/2458/2348/

7. Нагурський О. А., Васійчук В. О., Корж Г. І., Витрикуш Н. М. Особливості впровадження ДСТУ ISO 45001:2018 «Системи управління охороною здоров'я та безпекою праці. Вимоги та настанови щодо застосування». Міжнародний науковий журнал «Грааль науки». 2022. № 16. С. 116–121. https://doi.org/10.36074/grail-of-science.17.06.2022.020
8. Chen Y.-Y., Chuang Y.-J., Huang C.-H., Lin C.-Y., Chien S.-W. The adoption of fire safety management for upgrading the fire safety level of existing hotel buildings. Building and Environment. 2012. Vol. 51. P. 311–319. https://doi.org/10.1016/j.buildenv.2011.12.001
9. Інклюзивність будівель і споруд. ДБН В.2.2-40:2018. [Чинний з 2019-04-01]. Київ: Мінрегіон України, 2017. 70 с.
10. Ковалишин В. В., Доценко О. Г., Хлевной О. В., Дивень В. І. Дослідження евакуації людей різних груп мобільності з торговельно-розважального центру. Науковий вісник: Цивільний захист та пожежна безпека. 2022. № 2 (14). С. 99–107.
11. Балло Я. В., Голікова С. Ю., Сізіков О. О., Жихарєв О. П., Савченко О. В., Несенюк Л. П. Вимоги пожежної безпеки до висотних громадських будівель з умовною висотою від 100 м до 150 м. Науковий вісник: Цивільний захист та пожежна безпека. 2021. № 2 (12). С. 30–42. https://doi.org/10.33269/nvcz.2021.2.30-42
12. Про охорону праці : Закон України від 14.10.1992 № 2694-XII. Відомості Верховної Ради України. 1992. № 49. Ст. 668.
13. Правила пожежної безпеки в Україні : Наказ МВС України від 30.12.2014 № 1417. Зареєстровано в Міністерстві юстиції України 05.03.2015 за № 252/26697.
14. ДБН В.2.2-20:2008. Будинки і споруди. Готелі. [Чинний від 2009-04-01]. Київ : Мінрегіонбуд України, 2008.
15. Яценко М. С., Комарницька В. В. Проблеми функціонування готельного бізнесу в умовах воєнного стану. Економіка. Фінанси. Право. 2022. № 5/2. С. 33-36. DOI: https://doi.org/10.37634/efp.2022.5(2).7.
16. Pang B., Shi J., Jiang L., Pan Z. A Semantic Approach to Dynamic Path Planning for Fire Evacuation through BIM and IoT Data Integration. Advances in Civil Engineering. 2024. Vol. 2024, Article ID 8839865. DOI: https://doi.org/10.1155/2024/8839865.
17. 7 Innovative Techniques for Enhancing Hotel Safety in 2024. Dahlcore. URL: https://dahlcore.com/blog/f/7-innovative-techniques-for-enhancing-hotel-safety-in-2024.

СИНЕРГІЯ ЦИВІЛЬНОГО ЗАХИСТУ ТА ПОЖЕЖНОЇ БЕЗПЕКИ В УПРАВЛІННІ РИЗИКАМИ ГОТЕЛІВ

В. Безсонний[1], І. Пономаренко[2]

[1]Харківський національний економічний університет імені Семена Кузнеця, Україна
[2]Національний університет цивільного захисту України, Україна

КЛЮЧОВІ СЛОВА

інтегрована безпека, цивільний захист, пожежна безпека, готельно-ресторанний бізнес, управління ризиками, техногенна безпека, безпека праці, синергія

АНОТАЦІЯ

Актуальність дослідження обумовлена тим, що підприємства готельно-ресторанному бізнесу ГРБ є складними інженерно-технічними та соціальними системами з підвищеною вразливістю (висока концентрація людей, незнайомих з плануванням; цілодобовий режим; наявність техногенно небезпечного обладнання). Доведено, що домінуюча в Україні "силосна" (фрагментарна) модель управління, де аспекти пожежної безпеки (ПБ), цивільного захисту (ЦЗ), техногенної безпеки (ТБ) та безпеки праці (БП) регулюються, досліджуються та імплементуються ізольовано, є нездатною адекватно реагувати на сучасні комплексні та динамічні загрози. Метою статті є розробка та наукове обґрунтування концептуальної моделі інтегрованої системи безпеки (ІСБ) для підприємств ГРБ, яка забезпечує синергетичний ефект шляхом поєднання та взаємного посилення підсистем ЦЗ, ПБ, ТБ та БП. У роботі вперше запропоновано три ключові наукові ре-концептуалізації. По-перше, ре-концептуалізовано роль інклюзивності: доведено, що вимоги ДБН В.2.2-40:2018 "Інклюзивність будівель і споруд" є не соціальною чи архітектурною нормою, а фундаментальним та невід'ємним елементом системи цивільного захисту та пожежної безпеки. По-друге, обґрунтовано необхідність переходу від статичних моделей управління ПБ (затверджені плани) до динамічних, адаптивних моделей. По-третє, традиційну модель БП "комплаєнс-інструктаж" ре-концептуалізовано до моделі "персонал як активний агент інтегрованої безпеки".