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Approaches to the Population Sheltering in Selected Countries in Relation to Threats and the Security Environment

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Abstract
The aim of this article is to analyze the approaches of the Czech Republic, Poland, Austria, Germany and the United States of America to the issue of sheltering in the context of current security threats with regard to the development of the geopolitical situation. The article defines the basic methods of sheltering, types of shelters with regard to related normative legal acts and other documents, their current technical state, the capacity of shelters and the structure of threats for which sheltering is used, current initiatives in the field of sheltering and information support for the population. Variants of approaches to sheltering within individual countries are subjected to comparison and multi-criteria analysis. The output of the multi-criteria analysis is the order of alternative approaches to the sheltering of the population compiled on the basis of the proposed criteria, including a verbal assessment for the purpose of interpretation and contextualization of the findings.

KEY WORDS: *population sheltering; threats; security environment; comparison; multi-criteria analysis, Saaty method*

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1. Introduction

More than ever, security has become a global issue. Significant changes can be seen in the international security environment, which is undergoing an extensive process of transformation aimed at restoring the influence of major military powers. In parallel with this change, natural and anthropogenic disasters are also intensifying, and the vulnerability of the population to them is growing. A key task to minimize the loss of civilian life is the management of shelters. The construction of protective infrastructure for population sheltering took place mainly in European countries during the Cold War. The altered security environment following the Cold War frequently led to a reassessment of civil protection and shifted the focus towards a different threat structure, including floods, terrorism, and biological threats. The issue of sheltering has been neglected in many states, as concerns about direct military threats have diminished. Concurrently, the potential for utilizing shelters in response to other threats has not been fully explored [1]. As a result of the evolving geopolitical situation, there arises a challenge to reassess the approach to sheltering [2].

While previous works have examined sheltering approaches in individual countries in the past, there is a need for comprehensive comparative analysis across multiple nations in the context of the current, rapidly evolving security environment. This study meets this demand by conducting a multi-country comparison of population sheltering approaches in the Czech Republic, Poland, Austria, Germany and the United States. By employing comparison via multi-criteria analysis and verbal assessment for the purpose of interpretation and contextualization of the findings, this research provides valuable insights into the relative strengths and weaknesses of different national approaches.

The practical problem this research aims to address is the need for updated sheltering policies that are responsive to both traditional and emerging threats. Many countries face challenges such as aging shelter infrastructure, unclear responsibilities for shelter maintenance, and public uncertainty about sheltering procedures. By comparing national approaches to sheltering, authors can examine the main common features and differences, highlight beneficial initiatives, evaluate the strengths and weaknesses of various approaches at the national level, and provide a basis for potential improvements in the current state of population protection in the studied areas. The findings have practical implications for emergency planners, civil defense authorities, and policymakers seeking to optimize sheltering capabilities in an evolving threat environment.

The aim of this article is to analyze the approaches of selected countries to the issue of sheltering and to conduct a comparative study of these approaches. Through this analysis, the research seeks to identify best practices and innovative solutions that could be adapted to strengthen sheltering preparedness across different national contexts.

2. Selected Aspects of the Sheltering in the Czech Republic

The construction of shelters in the Czech Republic dates back to the establishment of the Civil Air Raid Protection under the responsibility of the Ministry of the Interior. The Civil Air Raid Protection was established on 11 April 1935 by the adoption of Act No. 82 Coll., on Protection and Defence against Air Attacks. One of the main tasks of the Civil Air Raid Protection was to provide a sufficient number of shelters for the civilian population. After the Second World War, the construction of shelters began in 1948 in connection with the political developments after February 1948. Shelters for the population began to be built, with a focus on sheltering against conventional weapons. [3]

A change occurred in 1958, when the Resolution of the Government of the Czechoslovak Republic of 15 January 1958, No. 49 on the Civil Defence of the Czechoslovak Republic, was adopted. From the beginning of the 1960s, shelters with increased resistance to weapons of mass destruction began to be built [4]. On 1 January 1976, the civil defence was transferred to the Ministry of Defence and the construction of shelters against weapons of mass destruction continued until 1989 [3].

After 1990, a transformation of civil defence was undertaken, focusing on contemporary non-military threats. The construction of new permanent shelters was suspended; however, those already under construction were completed, and maintenance was carried out on all existing shelters. During this period, shelters were constructed to accommodate 1.35 million inhabitants, representing 13.1% of the population [5]. In 1993, the term "civil protection" was officially introduced [6]. By the Resolution of the Government of the Czech Republic of 15 January 1993, civil protection was transferred from the jurisdiction of the Ministry of Defence to the Ministry of the Interior, specifically under the administration of the Fire Rescue Service of the Czech Republic.

Since 2000, population protection (including sheltering), has been legally established with the adoption of Act on the Integrated Rescue System [7]. According to this law, the sheltering of the population on its territory is ensured by the municipal office. The Concept of Population Protection until 2006 with the outlook to 2015 [8] stipulated that the fund of permanent shelters will not be further expanded from the state budget and that the costs of maintenance, inspections and operation of these shelters will be reduced [2].

In 2003-2004, surplus technology was removed from the shelters, and in 2006 financial support for the maintenance of permanent shelters was discontinued. Given the focus on non-military threats in population protection, further utilization of the Czech Republic's shelter fund was not anticipated, and to date, more than 70 % of the shelters (with a capacity for 667,000 people) [5] have been removed from the registry.

The Concept of Population Protection until 2013 with the outlook to 2020 [9] states that permanent shelters should not be relied upon in non-military emergencies and has emphasized the importance of improvised shelters [6], [10]. Suitable buildings and spaces for the construction of improvised shelters were to be selected by municipal authorities in cooperation with the Regional Fire Rescue Service during the planning phase. In the event of an escalating threat of war, the following would be utilized for the purpose of sheltering the population:

1. Functional permanent pressure-resistant shelters and protective systems of underground transport structures, or decommissioned permanent shelters suitable for reactivation to their original purpose,
2. Decommissioned permanent shelters not suitable for full reactivation to their original purpose and other selected spaces appropriate for conversion into improvised shelters. [9]

Due to heightened public interest in the location of shelters related to the war in Ukraine, the Ministry of the Interior initiated an inspection in 2023 of all registered permanent shelters with a capacity exceeding 500 people. The inspection was carried out by the Regional Fire Rescue Services, and the results are published on the website of the Fire Rescue Service of the Czech Republic [5]. This record is shared with municipalities, which also have access to the list of decommissioned shelters. The map of registered permanent shelters is freely accessible to the public in the Terinos application [11]. The registered permanent shelters have a capacity to accommodate 685,000 people, representing 6.3% of the Czech Republic's population, with 70% of these shelters located in Prague [5].

The Concept of Population Protection until 2025 with the outlook to 2030 [12] emphasizes the importance of improvised shelters for population sheltering during an armed conflict [6]. The state will support only the maintenance and inspection of protective systems in underground transport structures and the shelter fund of selected university hospitals, which corresponds to approximately 50% of the shelter fund in the Czech Republic.

3. Selected Aspects of the Sheltering in the Republic of Poland

The foundational document of security policy is the National Security Strategy of the Republic of Poland from 2020, which includes the following among its goals for ensuring and enhancing the resilience of the state and civil defence: "*Redefine the civil defence system and the population protection system by making it universal, both within urban agglomerations, as well as in rural areas, focusing on building the capacity of the system to constantly adapt and respond to the changing challenges and threats. Develop a law comprehensively regulating the subject matter of civil defence*" [13]. The excerpt from the National Security Strategy of Poland shows that the Republic of Poland (Poland) is currently undergoing

fundamental changes in the area of legislative regulation of the issue of sheltering. The issue of sheltering in Poland has historically fallen under the competence of the Ministry of National Defence, but in 1996 it was transferred to the competence of the Ministry of the Interior and Administration [14]. At present, the issue of sheltering remains the responsibility of the National Headquarters of the State Fire Service under the Ministry of the Interior and Administration [14]. The "*law comprehensively regulating the subject matter of civil defence*", as referred to in the National Security Strategy [13], is likely to evolve into The Law on the Protection of the Population and on the State of Natural Disasters (in original language: "Ustawa o ochronie ludności oraz o stanie klęski żywiołowej") [15]. However, the final form of this legal regulation, including any possible follow-up regulations, has not yet been fully determined. In its report [16], the Supreme Audit Office (of Poland) states that in the current situation arising after the adoption of new legislation in the field of national defence and before the adoption of the key Law on the Protection of the Population and on the State of Natural Disasters [15], there is basically no firm legislative regulation of the issue of civil protection (including sheltering).

In terms of protective infrastructure and permanent shelters, the situation in Poland is similar to the situation in the Czech Republic and some other European countries, except for some specifics. Most permanent shelters were built in Poland in the 1950s and 1960s in large cities and industrial centers. The shelters did not have very good pressure resistance and their construction was inefficient in terms of capacity-to-cost ratio. The current shelter fund of permanent shelters would provide shelter for a very small percentage of the population (about 4% or less). Most of the shelters are located in Warsaw. The actual equipment, durability and usability of the shelters are low. Currently, the construction of permanent pressure-resistant shelters is neither being carried out nor planned, and often, adequate maintenance of the existing stock is not performed [14]. This is confirmed by the Supreme Audit Office in its report [16], which points out the unsatisfactory condition of a large portion of the shelters.

The key document on sheltering in Poland is the 2018 Directive of the Chief of National Civil Defence and its annexes [17]. This Directive [17] contains, among other things, a classification and categorisation of the forms of shelters and shelter options for the population. It also contains various technical and functional requirements for protective structures (e.g. movement around the shelter, hygiene requirements, etc.).

An interesting initiative is that of the Polish government, which, through the State Fire Service, conducted an inventory of almost 235,000 buildings in 2022 to assess their potential for various forms of sheltering. The survey was conducted in response to the population's concerns following Russia's invasion of Ukraine and the related increase in public interest in the issue of sheltering [18]. According to the results of the inventory [18], Poland has a declared sheltering capacity for up to 49 million people, which is more than the population of Poland (population of less than 37 million people) [19]. Simplified categorisation (intended for the population) of shelters divides variants into shelters ("schrony"), hiding places ("miejsca ukrycia"), temporary shelters ("miejsca doraźnego schronienia") [18]. Based on the findings of [16], [17] and [18], it can be deduced that shelters and hiding places are different variants of shelters that together represent a capacity for less than 4% of the population, which confirms the figure given in [14]. Thus, more than 90% of the declared shelter capacity is comprised of temporary shelters. These are characterized as places that utilize the inherent protective properties of buildings, which, according to [16], are primarily intended for protection from weather events and lack distinctive protective or operational features.

As part of the information support for the sheltering, the map application "Schrony" [20] was created. The application enables users to search for shelters easily based on the aforementioned categorisation, depending on their geographic location. The application operates on the web and the authors have not identified an equivalent in the form of a mobile application.

4. Selected Aspects of the Sheltering in the Federal Republic of Germany

The construction of the protective infrastructure in Germany began as early as 1920 due to the need for civil air defense. The intensification of the construction of shelters began after the Second World War, and during the Cold War the variety of shelters also increased (in cellars, schools, underground parking lots and stations, hospitals, important operations, etc.). By the end of the Cold War, 2,000 public shelters had been registered. The largest systems had a capacity for up to 10,000 people [21].

The issue of sheltering was addressed by the Act on Construction Measures for the Protection of the Civilian Population [22]. However, the change in the security environment after the end of the Cold War led to a focus on modern threat scenarios (especially natural threats and terrorism) and caused the abolition of this law. Moreover, after the reunification of Germany (since 1990), no new shelters were built, and the existing shelters operated in the new federal states (especially in East Germany) were not even included in the concept of public shelters. [1]

To fulfil civil protection tasks, the federal government adopted the Act on Federal Civil Protection and Disaster Relief (ZSKG) in 1997, which defines the types of protective structures:

1. Public shelters ("Öffentliche Schutzräume"),
2. House shelters ("Hausschutzräume"),
3. Structural operational safety ("Baulicher Betriebsschutz"). [23]

The government also enacted the Act on the Establishment of the Federal Office of Civil Protection and Disaster Assistance (BBK) [24], which brought the issue of shelter within its jurisdiction. The Act on Federal Civil Protection and Disaster Relief was also reflected in the New Population Protection Strategy of 2002 and the overall change in approaches to

population protection saw the abandonment of public shelters in 2007, which were subsequently phased out and decommissioned. [1]

In response to the gradual phasing out of public shelters that were owned by the federal states, options for purchasing shelters from the Institute for Federal Real Estate (BImA) were explored. In 2009, responsibility for their use was also transferred to this office. With effect from 1 September 2020, BImA has taken over their overall management and is therefore currently the central point of contact for all issues relating to public shelters. BImA's task was also to ensure the complete abolition of civil defence structures and, at the request of the owners of these structures, to abolish their obligations arising from civil defence requirements. [1]

Shelters in Germany were built according to a uniform concept and the structural requirements (construction and design principles) for public and private shelters [25] date back to the Act on Construction Measures for the Protection of the Civilian Population [22], from 1968 to 1996. Interestingly, public shelters were never designed to protect against direct hits from nuclear weapons. Therefore, in most cases, they provide only what is referred to as basic protection, namely, static resistance and mechanical stability, protection against radioactive fallout, effects of fire, and combat chemical agents, utilizing a filtration ventilation system designed for this purpose. Requirements for enhanced protection were particularly applied to protected workplaces [25].

In the current context of the war in Ukraine, the situation has changed. The federal government decided to review the reverse concept of public shelters, suspended their decommissioning until further notice, and, together with the federal states, conducted a complete inventory of the shelters that had not yet been decommissioned. Currently, there are 579 public shelters available (with a capacity of 477,593 shelter spaces, i.e., approximately 0.6% of the German population), which are very unevenly distributed across the country [26]. These shelters are not ready for use, as the focus of population protection and information is primarily on warnings and evacuation. The time and cost of reactivation depends on the level of protection the shelters are to offer, ranging from debris and fragmentation protection as the lowest level to protection from nuclear threats (CBRN protection) as the highest level of protection. In addition, BImA has proposed other measures aimed at increasing protective capacities, which are currently being evaluated. The findings of the inventory will then form the basis for further decision-making. [21]

In the event of armed conflict, protective infrastructure should ensure that every citizen has the right to access a shelter close to their residence, and that such shelters are readily available. These shelters can also be used during disasters and emergencies as emergency shelters. [21]

5. Selected Aspects of the Sheltering in the Republic of Austria

The origins of the building of protective infrastructure in Republic of Austria (Austria) were very similar to the situation in other European countries, in the context of the threat of the Cold War and the deteriorating security environment. Similarly, there have been changes in the approach to the issue of sheltering since the 1980s, especially with regard to a peaceful unified Europe.

According to the Federal Ministries Act [27], civil protection is the responsibility of the Federal Ministry for Digital and Economic Affairs for civil engineering matters related to civil protection and spatial and state planning, and of the Federal Ministry of the Interior for all other civil protection matters. However, the Austrian Civil Protection Association plays a key role in developing protective infrastructure, overseeing civil protection associations across all federal states. At the same time, it serves as the point of contact for the population and public institutions regarding individual crisis preparedness [1].

The individual federal states are responsible for the regulation of shelter construction and design, based on their respective building codes according to the general clause of the Federal Constitutional Law [28]. Within their jurisdiction, they are also authorized to regulate the maintenance and repair of shelters. However, there is no obligation to include the issue of sheltering in state regulations. Building protective infrastructure is thus approached in different ways. This fact is also evidenced by the significant differences in the number of shelters and their coverage among the individual federal states [3].

Moreover, there is no federal law or provision specifically addressing the construction and maintenance of shelters, except for certain cases like shelters in elevator or tunnel systems, or international regulations that primarily apply to wartime situations. Any obligations regarding the necessary construction measures for the construction of shelters are specified in the applicable building regulations [25].

The issue of sheltering is addressed particularly in relation to a possible nuclear accident. Information on emergency preparedness in the event of a radiation emergency is therefore provided to citizens. However, this guidance directs them to utilize their own (safety) flats by enhancing the natural protective properties of buildings and adhering to behaviour rules (iodine prophylaxis, temporary stays in closed and isolated spaces, food control, etc.) due to the necessity of (re)activating public shelters [29]. Overall, there are three options for protection:

1. Safety flat without built-in filter (“Sicherheitswohnung ohne eingebauten Filter”), offers temporary protection, requiring the insulation of all penetrations to ensure safety,
2. Security flat with built-in filter (“Sicherheitswohnung mit eingebautem Filter”) with air filtration and pressurisation using a special filtering device,
3. Basic safety room (“Grundschutzraum”) public shelter providing protection from fire, falling debris and external radiation. [29]

In Austria, only in certain cases are public shelters built for large populations. Mostly private shelters attached to the living quarters of buildings are used. The number of shelters and their technical condition is very difficult to determine due to the lack of records of shelters built in the private sector. However, it is estimated that in 1982 there were shelters in public buildings for about 60,000 inhabitants; by 1984 the number of shelters in public buildings had increased and provided shelter for 127,000 inhabitants. As for the total of all shelters (public and private), estimates in 1980 were about 250,000 shelter places, in 1984 about 350,000 places [30].

The current capacity of the shelters cannot be determined, as even official public sources vary significantly in their figures - according to source [31], shelter in Austria is secured for only 3% of the population, while according to source [32], there are 2 million shelter spaces available (approximately for 22% of the population). The government's approach to sheltering in response to recent changes in the security environment is not yet apparent from public sources.

6. Selected Aspects of the Sheltering in the United States of America

In the United States of America (USA), sheltering is an important part of protecting the population from a wide range of natural and anthropogenic threats. In the USA, the role of the state primarily involves providing methodological support for sheltering. Methodological assistance is provided in the form of expert guidelines and other documents, ranging from less extensive documents to comprehensive guidelines and methodologies that include detailed descriptions of shelter construction and suitable modifications of selected spaces. The implementation of sheltering is then carried out by the population and other entities (e.g., local authorities), using the methodological materials and in cooperation with the state, or other institutions at the national or local level. In certain cases, the role of sheltering in the USA overlaps with emergency survival for the population, and the activities of nonprofit organizations (such as the American Red Cross) play a significant role. [33], [34]

The issue of sheltering the population is part of comprehensive emergency management, which is based on the Robert T. Stafford Disaster Relief and Emergency Assistance Act and related regulations [35]. Primarily, the Federal Emergency Management Agency (FEMA), a part of the Department of Homeland Security, is responsible for overseeing sheltering activities and providing methodological support related to sheltering [33]. Examples of documents distributed by FEMA include:

1. Safe Rooms and Shelters [36],
2. Taking Shelter from the Storm [37],
3. Design and Construction Guidance for Community Safe Rooms [38],
4. Standards for Fallout Shelters [39],
5. Expedient Shelter Handbook [40].

Due to the decentralized nature of the issue and the wide range of shelter types, it is difficult to determine the capacity in relation to protective features and the technical condition of shelters in the USA. Part of the management and record-keeping of shelters is the National Shelter System, which contains a database of shelters using continuously updated data from the American Red Cross and other entities. [41]

However, even the National Shelter System is primarily intended for operational record-keeping and evaluation of shelter options (e.g. at the site of a disaster) and obtaining accurate data on total capacity is beyond the scope of this article. [41]

FEMA's website primarily recommends the following sheltering options to the population, although there are more sheltering options to consider:

1. Mass Care Shelters – collective sheltering (e.g., in the case of a hurricane) in a predetermined facility, directly linked to the emergency survival of the population.
2. Sheltering in Place – seeking shelter at one's current location, akin to the concept of "sheltering using the inherent protective properties of buildings" employed in the Czech Republic.
3. Stay-at-Home – sheltering within one's home, primarily as an anti-epidemic measure [42].

As evident from the lists above, the concept of sheltering in the USA differs from the commonly used approach to sheltering (e.g., in the Czech Republic), as it focuses on a broader spectrum of threats and includes variants of sheltering the population that may not always be considered part of the sheltering issue, depending on the specific approach.

FEMA also offers comprehensive informational support for population sheltering, including through its mobile application available on Android and iOS platforms [43].

In the USA, sheltering is also considered part of broader security measures, such as enhancing the resilience of businesses against a wide range of threats [44].

7. Research methodology

Based on the methods of comparison and multi-criteria analysis, approaches to sheltering within the selected countries are assessed. A quantitative pairwise comparison method, the Saaty method [45], is used to determine the weights of the criteria. The weighted sum method is used for multi-criteria analysis [46].

The scale shown in Table 1 was used to evaluate the relative intensity of importance *Sij* of the criterion in row *i* relative to the criterion in column *j* within the application of the Saaty method. The standardized weights of the criteria are then calculated as the geometric means of the individual rows divided by the sum of the geometric means of all rows.

Table 1.

Evaluation of criteria by the Saaty method – scale [45]

Intensity of Importance (*Sij*)	**Definition**
1	equal importance of criteria
3	moderate preference
5	strong preference
7	very strong preference
9	absolute preference
$S_{ij} = \frac{1}{S_{ji}}$	reciprocals of all scaled ratios that are entered in the transpose positions

For a multi-criteria analysis of the variants of each country's approach to sheltering using the weighted sum method, the criteria matrix shown in Table 2 was created. At the same time, Table 2 summarizes the results of the multi-criteria analysis using the weights calculated by the Saaty method. All criteria were designed as maximization criteria. The weighted sum method is partially modified compared to its usual approach. The standard procedure involves converting the matrix into a normalized criterion matrix prior to performing the weighted sum. This step typically serves to eliminate the mutual incommensurability of the criteria. Regarding the fact that only integer scoring scales with a unified point range of 1 to 3 are used for evaluation, this step is identified by the authors as redundant and omitted from the procedure. The design of the rating scales is proposed further in the text. The calculation using the weighted sum method is then based on Formula 1 [46].

$$h(Vi) = \sum_{j=1}^{k} w_j \cdot h_{i,j} \quad (1)$$

where: *h(Vi)* - the weighted sum of the sheltering approach evaluations (based on proposed scales for criteria) for the i-th country, $i \in \{1,2,\ldots,5\}$; w_j – weight of the j-th criterion, $j \in \{1,2,\ldots,6\}$; $h_{i,j}$ - evaluation of the i-th variant based on the j-th criterion.

8. Results of Analysis

Multi-criteria analysis was performed using the weighted sum method and the following set of maximization criteria. The criteria were evaluated based on the scales outlined below.

The limits of the analysis can be seen in the subjective evaluation of the multi-criteria analysis by the authors. The results of the performed analysis may also be distorted due to a possible lack of relevant information, as some information related to the sheltering may be classified or otherwise unavailable to the public. Shelter capacities may also differ if some shelters have recently been removed from the register or, conversely, re-registered. Another limitation is the limited number of countries included in the comparison.

Legislation, standards and other guidelines:

1. The issue of population sheltering does not have basis in key legal statutes pertaining to national security, nor in subsequent and related regulations (such as methodologies, directives, guidelines, etc.), or they are so outdated that they cannot be followed. The evaluation also applies to cases where the criterion cannot be assessed.
2. Currently, the issue of sheltering does not have a firm, established basis within valid and effective legal statutes, but related regulations in a valid and effective form (e.g., methodologies, directives, guidelines, etc.) do exist in specific forms and can be followed. Alternatively, the issue of sheltering has a firm, established basis within valid and effective legal statutes, but related regulations (e.g., methodologies, directives, guidelines, etc.) in a specific, valid, and effective form do not exist.
3. The issue of sheltering has a firm, established basis within valid and effective legal statutes, and related regulations in a valid and effective form (e.g., methodologies, directives, guidelines, etc.) do exist in specific forms and can be followed.

Shelter capacity for the population in relation to protective characteristics:

1. Permanent pressure-resistant shelters can only accommodate a small percentage of the population, and the capacity of identified improvised shelters is also presumed insufficient to serve as a form of shelter for the remaining part of

the at-risk population. A significant portion of the population would have to rely on improvised sheltering (using the inherent protective properties of buildings) or other forms of shelter even in cases where these forms are not considered adequate (e.g., in the event of a nuclear threat). The evaluation also applies to cases where the criterion cannot be assessed.

2. It is anticipated that permanent pressure-resistant shelters along with identified improvised or permanent non-pressure-resistant shelters are capable of collectively accommodating the at-risk population in scenarios where this mode of protection is required (e.g., in the event of a nuclear threat), with the majority of the shelter capacity (>50%) being made up of improvised shelters or permanent non-pressure-resistant shelters. It is also assumed that the capacity of other methods of sheltering is adequate given the nature and severity of the threat.
3. It is anticipated that permanent pressure-resistant shelters and identified improvised or permanent non-pressure-resistant shelters are together capable of collectively accommodating the at-risk population in scenarios where this protection is required (e.g., in the event of a nuclear threat), with the majority of the shelter capacity (>50%) consisting of permanent pressure-resistant shelters. It is also assumed that the capacity of other methods of sheltering is adequate given the nature and severity of the threat.

Technical condition of shelters:

1. It is assumed that shelters do not undergo regular inspection and maintenance of technical elements essential for operational readiness and required protective features, nor are hygienic limits for population sheltering met or checked. The evaluation also applies in cases where the criterion cannot be assessed.
2. It is presumed that shelters are regularly inspected and maintained, and hygienic limits for population sheltering are adhered to or monitored. However, due to their ownership status (public vs. private shelters) or other uncertainties, it is not possible to determine their proportion relative to shelters that do not meet requirements for inspection, maintenance, and hygienic standards.
3. It is assumed that regular inspections and maintenance of technical elements essential for operational readiness and required protective features are carried out in shelters, and hygienic limits for sheltering individuals are met and monitored. The shelter is prepared to be operational within the planned timeframe.

Range of threats:

1. The approach to sheltering within the state is focused on protecting the population from the impact of a single type of threat (e.g., only nuclear weapons or only radiation accidents), or a very limited number of them. The evaluation also applies to cases where the criterion cannot be assessed.
2. Sheltering is considered as a form of protection for the population in relation to some other anthropogenic or even natural threats.
3. The approach to sheltering corresponds or is close to the general, comprehensive concept of sheltering according to Article 61 of the Geneva Conventions. Sheltering, when relevant, is implemented against a wide range of threats and is closely linked with other tasks, such as emergency survival.

Current initiative in sheltering:

1. The state's approach to sheltering does not show a significant initiative responding to changes in the security situation since the end of the Cold War. Sheltering as a measure of population protection is not a priority for the country. The evaluation also applies to cases where the criterion cannot be assessed.
2. The state's approach to sheltering shows a significant initiative that takes into account the changing security situation and evolving concepts of security after the end of the Cold War, e.g., in connection with the increasing risk of selected natural and anthropogenic threats (increased occurrence of selected extreme meteorological events related to climate change, developing terrorism in the 21st century, etc.).
3. The state's approach to sheltering shows a significant initiative responding to current trends (not older than 5 years) in the security situation (especially the military invasion of Ukraine by Russia).

Information support for population:

1. Information support is either not implemented or its role is negligible in terms of preparedness and response to adverse events. The evaluation also applies in cases where the criterion cannot be assessed.
2. There are partial, specific, identified, significant gaps in information support in the area of preparedness for the occurrence of an adverse event or in the area of response to an adverse event (e.g., informing the population for the purpose of coordinating sheltering in real-time).
3. Information support for sheltering creates a comprehensive system that functions in both preparedness and response to adverse events, utilizing modern technologies. No significant deficiencies are apparent.

Table 2.

Multi-criteria analysis

Criteria	Legislation, standards and other guidelines	Shelter capacity	Technical condition	Range of threats	Current initiative	Information support for population	Weighted sum	Rank
Weight (rounded)	0,1317	0,1843	0,1769	0,1559	0,1756	0,1756		
Czech Republic	2	1	2	2	1	1	1,4645	3.
Poland	2	1	1	2	3	2	1,8145	2.
Germany	2	1	1	1	2	1	1,3073	4.
Austria	1	1	1	1	1	1	1,0000	5.
United States	3	1	1	3	2	3	2,1020	1.

In Table 2, a multi-criteria analysis of the alternatives is presented—the weights were calculated using Saaty method, and the multi-criteria analysis itself was conducted using the weighted sum method. The evaluation of the alternatives for each criterion is based on a consensus among the authors.

Conclusions

On the basis of a multi-criteria analysis using the proposed set of criteria and calculated weights, the ranking of countries was determined according to the degree of fulfilment of the criteria.

The USA has become the highest-rated country primarily due to extensive methodological support for various types of sheltering, which is supplemented by a firm legislative framework. Additionally, the approach to sheltering in the United States is both modern and broad, specifically in terms of the threats against which it is designed. Furthermore, comprehensive information support is provided to the population. The United States is ranked highly despite the fact that some criteria could not be evaluated in comparison with European countries – namely, the shelter capacity criterion and the technical condition criterion. Shelter capacity cannot be evaluated, particularly because sheltering in the USA is carried out by a wide range of entities and obtaining unified data on shelter capacity exceeds the scope of this research. For a similar reason, the technical condition criterion also cannot be evaluated. It is also important to note that the comparison of shelter capacity and technical condition of shelters with European countries is problematic because the broad concept of sheltering in the USA likely includes capacities that, in countries such as the Czech Republic, would be considered as capacities for the emergency survival of the population. In the case of the USA, the current initiative criterion has not been fully met, primarily because fulfilling this criterion requires a key initiative that addresses recent changes in the security environment, particularly those related to the war in Ukraine. In the case of the USA, a key initiative was not identified. However, given the geopolitical status and geographical position of the USA, it can be assumed that the shifts in the security environment did not necessarily translate into pressure for changes in the sheltering approach and related initiatives in the USA.

The issue of sheltering within the European states included in the comparison has some common characteristics, especially in terms of the historical development of sheltering during the Cold War and the often problematic role of sheltering in contemporary times. Poland is ranked second in the multi-criteria analysis, mainly due to a major current sheltering initiative in relation to the Russian invasion of Ukraine in 2022, which led to an extensive inventory of premises and the development of information support tools for sheltering. Despite the fact that certain initiatives have taken place in other countries and that some sources, including Polish official sources (e.g. [18]), are rather sceptical about the results of the inventory and the state of sheltering in Poland, it is still probably the most extensive and substantial initiative in response to current security trends within the scope of this article. The only European country included in the evaluation that approaches Poland in terms of its initiative is Germany. However, according to the authors, at the time of writing this article, Germany has not yet made sufficient progress in addressing sheltering-related issues to consider its initiative in response to current trends as substantial. The Czech Republic ranked third in terms of the results of the multi-criteria analysis. In terms of sheltering, the Czech Republic does not stand out particularly among the other countries included in the comparison. In the criterion of the technical condition of shelters, particularly permanent shelters, the Czech Republic is rated slightly higher compared to Poland. As far as the criterion of legislation, standards and other guidelines is concerned, the Czech Republic has a more stable legal regulation, but methodological materials for sheltering are more up to date in Poland. Germany and Austria ranked fourth and fifth respectively. Germany scores higher in the case of the legislation, standards and other guidelines and the current initiative criteria, mainly due to the existence of more comprehensive legislation and the previously described initiative in the area of response to current security threats.

With the proposed criteria, differences between states were identified based on the rating scales. An exception is the shelter capacity criterion, which was rated equally for all states included in the comparison. For the European countries, this uniformity in ratings primarily stemmed from the low capacity of dedicated shelters, whereas for the USA, it was due to the inability to determine the sheltering capacity within the scope of the submitted article. The technical condition criterion was difficult to evaluate due to limited information about the actual state of the shelters and was probably the most prone to inaccuracies in the evaluation – in cases of uncertainty, the lower of the considered evaluations was awarded (e.g. in the case of Poland). However, the criteria shelter capacity and technical condition are associated with the highest weights of the criteria, which, in addition to expressing their importance, indicates the need to carry out more detailed research in the given area in relation to the abovementioned conclusions.

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