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# A COMPARATIVE ANALYSIS OF CHEMICAL ACCIDENT DATABASES AND RECOMMENDATIONS FOR IMPROVED SAFETY PRACTICES

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ABSTRACT: *The prevention and effective management of industrial accidents is key to protecting public health, the environment, and economic stability. The comparison of online platforms and databases allows us to present a comprehensive picture of safety practices in different industrial sectors, as well as their efficiency and effectiveness. This will help to identify best practices and areas where further improvements are needed for the country concerned. As a result of our comparative analysis, targeted measures can be taken to prevent and manage accidents, reduce the number and severity of industrial accidents, and continuously improve industrial safety standards and practices.*

*Furthermore, comparative analyses allow us to identify differences in industrial safety cultures and the lessons that can be learned from them. We provide suggestions for improving the efficiency and competitiveness of industrial processes while focusing on the safety of workers, the public, and the environment, as a key priority.*

KEYWORDS: *analysis, database, chemical accident, industrial safety, public protection*

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## INTRODUCTION

The prevention and effective management of industrial disasters is a priority area of industrial safety, in which data and their analysis play a major role. Accidents in hazardous plant environments can cause loss of life, environmental damage, and economic loss. In order to prevent and manage this, there are a number of databases and online platforms that collect and analyse these incidents and provide information and tools to improve industrial safety.

The MINERVA Portal is part of an initiative supported by the European Union (EU) to provide information and resources for disaster management. The portal aims to strengthen EU internal civil protection cooperation and support EU member states in disaster response and crisis management. It provides a wide range of information and tools, including the latest research, guidelines, and best practices. It also provides an opportunity for different organisations and professionals to connect, share experiences, and work together on disaster management.

In addition to the MINERVA Portal, there are several other online platforms that serve similar purposes, providing detailed information and case studies on the causes and consequences of disasters, helping to analyse and study industrial accidents. To mention a few of the databases we have examined, ARIA in France, ZEMA in Germany, IOGP (also available on the eMars website), the Failure Knowledge Database in Japan, Tukes in Finland, and the CSB database in the US contain useful experience.

In order to make effective use of these databases and online portals in industrial security, it is important to take into account relevant factors such as the availability of platforms, linguistic diversity, and user experience. When developing platforms, particular attention should be paid to overcoming language barriers and designing user-friendly interfaces to make information and tools in the field of industrial disaster prevention and management accessible to as many professionals and organisations as possible.

Our aim is to present internationally existing and proven databases to give a comprehensive picture of the possibilities, thus providing support for public protection. In addition, our research has sought to collect and present as many and as broad a range of databases as possible, rather than presenting as few and as detailed as possible, in order to enhance the potential.

## MINERVA PORTAL

The MINERVA Portal[1] is an online platform providing information and resources on how the European Union manages various disaster situations. MINERVA strengthens civil protection cooperation within the EU and assists EU member states in disaster response and crisis management. The MINERVA Portal offers a range of information and tools to support disaster response actions, including the latest research, guidelines, and best practices. It provides an opportunity for different organisations and professionals to connect, share experiences, and work together on disaster management. It is publicly available and accessible to anyone interested in information on disaster management.

The disadvantage is that the platform is mainly available in English, which may limit access for those who do not speak that language. Too much information available on the platform can make it difficult for users to find the information and tools that are most relevant to them.

We suggest that the information and tools on the platform should be made available in several languages to make them accessible to more people/nations. It would be important to group and structure the information on the platform and to create an easy-to-navigate user interface so that users can easily find the information and tools that are relevant to them.

[1] European Commission website: https://minerva.jrc.ec.europa.eu/en/minerva (Accessed: 2 April 2024).

The statistics available on the eMARS platform provide a wealth of important information on chemical accidents[2] in the European Union. Analysis of the statistics provided by eMARS can help to identify possible trends and patterns and assess the frequency and severity of incidents. Some important observations based on the statistical data are:

– The number of accidents recorded by eMARS may vary over the years. An analysis of annual trends can help to identify possible upward or downward trends.
– The statistics provided by eMARS show the proportion of different types of chemical accidents, which allows trends to be identified as to which types of accidents were more frequent over a given period.
– The eMARS statistics provide a general picture of which areas in the European Union have been most affected by chemical accidents, enabling authorities and professionals to assess areas where more attention needs to be paid to preventive measures or risk management.
– The statistics recorded by eMARS show the consequences of chemical accidents, including injuries, deaths, environmental damage, and property losses.

The statistical data recorded in the eMARS system support our conclusion that the number of accidents and incidents involving dangerous substances is not decreasing.

*Figure 1* shows the Seveso tier function of the database. Under the Seveso III Directive, "tier" is one of the important definitions used to indicate the categories of risk assessment and safety measures. The tiering helps operators and authorities to identify which establishments are at risk, to what extent, and what measures should be implemented accordingly. The highest tier, or upper threshold, represents the highest risk, while the lowest tier represents a lower threshold, or below threshold, establishments with a lower risk. Under the Seveso III Directive, the classification of the levels sets out in detail the obligations of establishments and the rules to be applied in order to prevent disasters and ensure the safe handling of dangerous substances.

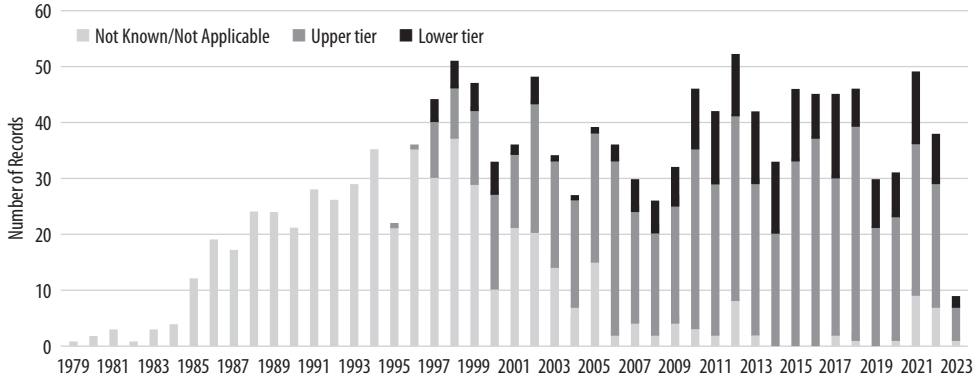


Figure 1 *Seveso tier (Recast by the authors based on Seveso tier data*)*

* Seveso tier: https://emars.jrc.ec.europa.eu/en/emars/statistics/statistics (Accessed: 3 April 2024).

[2] European Commission website: https://emars.jrc.ec.europa.eu/en/emars/statistics/statistics (Accessed: 3 April 2024).

On the information interface, you can find statistics on published accidents under Events by Country. The industry type chart illustrates industrial activities related to different industries and sectors. These include general chemical manufacturing, the production of various chemicals, petrochemicals, and oil refining. In addition, activities such as the processing of metals, energy supply, agriculture, food processing, various industrial processes, water supply, and wastewater treatment are also observed. The diagram also describes other specific activities, such as the plastics and rubber industry, waste storage, treatment and disposal, explosives production and storage, and industrial gas production.

In *Figure 2*, under Reasons for Reporting, you will find the factors that provide useful statistical information on accidents. Accidents can cause different types of injuries, damage, and hazards to people, property, the environment, and communities. The severity and impact of accidents can vary greatly depending on location, weather conditions, and other factors. These and similar events often require special measures and responses to minimize damage and protect those affected.

Events reported for special circumstances to which the database refers are events that occurred under special or exceptional circumstances and thus may deviate from the usual accident patterns or characteristics. Chemical accidents can be civilisation- or natural disaster-related events (Natural Hazards Triggering Technological Accidents – NaTech events),[3] incidents resulting from extreme weather events, or events that have secondary effects or carry a greater-than-average hazard. NaTech events of natural origin were the second most frequent with 26%, behind civilisation-related events.

The Life Cycle Diagram describes the different phases of the accidents in the database, including from their occurrence to the analysis and documentation of their impacts and consequences.

The MINERVA Portal integrates EU-funded projects and initiatives by supporting EU-level civil protection strategies. Unfortunately, there is limited international access.

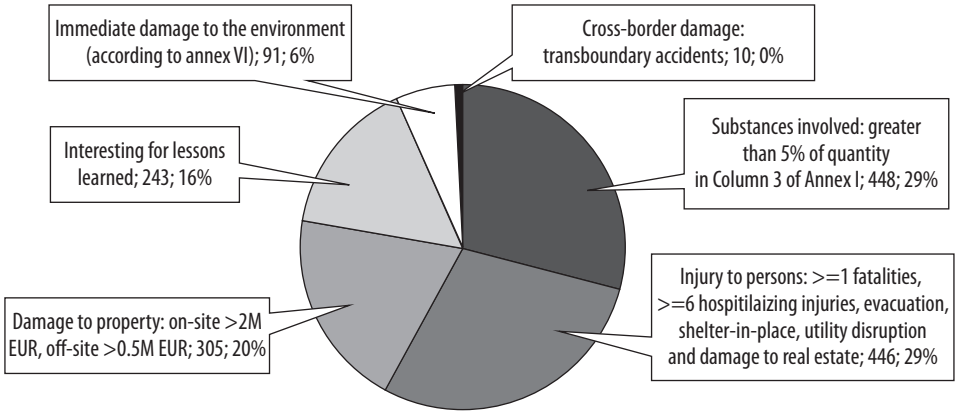


Figure 2 *Reasons for Reporting (Recast by the authors based on Reasons for Reporting*)*

* Reasons for Reporting: https://emars.jrc.ec.europa.eu/en/emars/statistics/statistics (Accessed: 3 April 2024).

[3] Natural hazards such as earthquakes and floods can initiate events that challenge the safety and operation of hazardous installations. Accidents triggered by such events are known as NaTech – Natural Hazards Triggering Technological Accidents.

Although MINERVA is publicly available, the data and tools are mainly designed for disaster management authorities and organisations in EU member states. In our opinion, the accessibility and content of the platform should be extended to non-EU countries, so that other regions can benefit from the knowledge and experience gathered by the EU. Efforts should also be made to simplify the platform and make it easier to navigate so that information and tools are more easily accessible to those interested.

## EUROPEAN CHEMICALS AGENCY

The European Chemicals Agency (ECHA)[4] is a decentralised body of the European Union, established in Helsinki on 1 June 2007, which took over the management of the Classification, Labelling and Packaging Regulation in the EU in 2009 (the regulation was extended in 2013–14 with two further regulations covering biocidal products and the export and import of certain dangerous substances).[5] Its main purpose is to support the implementation of EU chemical policies and serve as a centre of knowledge on the sustainable management of chemicals. ECHA is responsible for implementing and coordinating the EU chemicals legislation.[6] It collects and publishes a wide range of data and information on chemicals through the REACH (Registration, Evaluation, Authorisation and Restriction) system.

## EUROPEAN ENVIRONMENT AGENCY

The EEA[7] is the European Environment Agency, which collects and disseminates environmental data and information in the member states of the European Union. The EEA has databases containing information on chemicals that affect environmental impacts and risks.

## THE ARIA DATABASE (IN FRENCH AND ENGLISH)

Within the Ministry of Ecological Transition/Directorate General for Risk Prevention, the Bureau for Analysis of Industrial Risks and Pollutions (BARPI)[8] is responsible for the collection, analysis, and dissemination of information and feedback on industrial and technological accidents. ARIA (Analyse, Recherche et Information sur les Accidents) is an online platform in France specialised in accident analysis, research, and information on major accidents in the chemical, petrochemical, and refining industries (accidents graves des industries de la chimie, de la pétrochimie et du raffinage).

The ARIA platform provides detailed information on major accidents in the chemical, petrochemical, and refining industries, allowing their causes and consequences to be investigated and studied. ARIA case studies and reports offer users the opportunity to learn and apply lessons learned from accidents. Its website is public and accessible to anyone interested in chemical accidents, not only in France but worldwide. Its disadvantage is that it is mainly available in French or English, which may limit insight for those who do not speak these languages. The platform generally offers static content and limited possibilities for

[4] European Chemicals Agency 2024, 523–525.
[5] European Chemicals Agency 2014, 263–264.
[6] See more: https://www.echa.europa.eu/.
[7] See more: https://www.eea.europa.eu/en.
[8] See more: https://www.aria.developpement-durable.gouv.fr/le-barpi/.

interaction or communication between users. It focuses primarily on the French chemical and petrochemical industries, making the content less relevant for those working in other countries or interested in other industries. ARIA can be a useful resource for those interested in chemical accidents and their consequences, especially for those working in France.

Detailed accident analyses are available in the database, unfortunately, most of them are only in French. It would therefore be advisable to make them available in several languages and improve interactivity.

## ZEMA/INFOSIS (IN GERMAN)

The ZEMA[9] (Zentrales Melde- und Auswertesystem, i.e., Central Reporting and Evaluation System) is an accident reporting system in Germany that is used to document and monitor accidents and incidents involving hazardous substances and can be important for future preventive measures. It enables the identification of potential errors, problems, and lessons to be learned from accidents, which can help to prevent future incidents. ZEMA stores all accident-related information in a central database, which can simplify access to and analysis of the data. Among its many benefits, there are also privacy concerns. Access to the data stored in ZEMA may be restricted for security and privacy reasons, which can sometimes make it difficult for those who need it to access the data. Reporting systems in general can contribute to increased bureaucracy, especially if reporting requirements are overly strict or complex. Regulatory schemes can often limit the flexibility of individual companies or institutions to meet reporting requirements, to their detriment. ZEMA is a modern and useful tool for the management and prevention of hazardous material incidents.

The portal pays particular attention to the issue of chemical safety. Its materials are available in several languages, although interactivity is limited. Therefore, it is recommended to improve data interoperability and interactivity.

## THE INTERNATIONAL ASSOCIATION OF OIL & GAS PRODUCERS SAFETY ZONE (IN ENGLISH)

The IOGP Safety Zone is an online platform run by the International Association of Oil & Gas Producers (IOGP).[10] The IOGP Safety Zone aims to provide a variety of comprehensive learning tools and expert content on safe working practices in the oil and gas industry. The platform is available online, making it easily accessible to anyone working in the oil and gas industry anywhere in the world. It offers content developed by experts with significant experience in the industry, so users can access reliable and relevant information. The downside is that the platform's content is generally static and offers limited opportunities for interaction or communication among participants. The content tends to be generic and not suitable for all companies or industrial environments, which can sometimes limit users' access to relevant information. Although the platform offers a lot of free content, some specific or more detailed studies require a subscription, which may limit wider access. This platform is a useful tool for promoting safe working in the oil and gas industry, addressing safety challenges, and educating workers.

[9] See more: https://www.infosis.uba.de/index.php/en/site/13947/zema/index.html.
[10] See more: https://safetyzone.iogp.org/Main.asp.

The portal focuses on oil and gas accident analysis based on international standards and guidelines. Access to data is limited due to the sensitivity of the subject. In addition to the oil and gas industry, it would be useful to consider other, broader industries and accidents. Given the critical infrastructure involved, it is not expected that there would be a significant change in the availability of data.

## THE JAPANESE FAILURE KNOWLEDGE DATABASE (IN JAPANESE AND ENGLISH)

The online platform sozogaku.com[11] collects and documents data on different types of accidents in Japan. The main purpose of the database is to make such incidents studyable and analysable in order to learn from them and prevent similar incidents in the future. The website has extensive content in the field of Japanese work and organisational psychology, covering a variety of topics and studies. The platform offers information specifically related to Japanese workforce and workplace culture, which may be useful for those working in Japan or interested in the Japanese labour market. It takes a generally scientific approach to the topic of work and organisational psychology, which can help users to find reliable and relevant information. The website is primarily available in Japanese and English, which may limit those who do not have English language skills. It generally provides static content and limited opportunities for interaction or communication among users. The frequency and content of website updates may vary and may not always reflect current research or developments in the field of work and organisational psychology. Sozogaku.com may be a useful resource for those interested in Japanese work and organizational psychology.

It is likely to process and contain Japan-specific analyses and disaster data due to its geographical location. This also has a disadvantage, as its international relevance is limited, mainly due to language specifics. It would be useful in the future to share international comparative analyses and studies on the portal.

## eMARS

The European Commission operates a reporting system and database, the Major Accident Reporting System (eMARS), for the purpose of reporting the experience of major accidents involving dangerous substances.[12]

The European Major Accident Reporting System is extremely useful for international cooperation and data sharing, as the most important analyses of chemical accidents are available on this platform. Unfortunately, language barriers and different national data protection regimes do not make it easy to share information. In order to facilitate data access, it is recommended to consider multilingual posting and of course the introduction of more transparent data protection rules and measures.

[11] The Japanese Failure Knowledge Database: http://www.sozogaku.com/fkd/en/ (Accessed: 4 April 2024).
[12] European Commission website: https://emars.jrc.ec.europa.eu/EN/emars/content (Accessed: 30 March 2024).

## TUKES VARO REGISTRY OF CHEMICAL ACCIDENTS IN FINLAND (IN FINNISH)

The website tukes.fi/onnettomuudet[13] is an online platform operated by the Finnish Safety and Chemicals Agency (Tukes). The website aims to provide information on accidents and incidents in Finland and to promote a safer working environment. It provides official information from the Finnish Safety and Chemicals Agency so that interested parties can obtain reliable and authentic data. The platform is regularly updated with documentation of recent accidents and incidents, allowing users to have up-to-date information on the safety situation. Case studies and analyses on the website can help users understand the causes and lessons learned from accidents, which can help prevent future incidents. The website is mainly available in Finnish, which may limit access for those who do not speak this language. This may make it difficult for people from international or other language areas to access the information. It generally provides static content and limited opportunities for interaction or communication among users, focusing mainly on Finland.

The portal is a science-based website, backed up by official sources, where you can find up-to-date data, safety advice, and orientation information. On the negative side, interactivity is an area that needs improvement. Of course, the issue of multilingual access is also relevant here.

## THE U.S. CHEMICAL SAFETY BOARD (IN ENGLISH)

The U.S. Chemical Safety Board's (CSB) database provides detailed investigations of numerous accidents, and these data are available on the board's website.

The U.S. Chemical Safety and Hazard Investigation Board is an independent federal agency in the United States of America whose mission is to investigate the causes of chemical accidents and disasters and to prevent future potential accidents. The CSB operates independently of government or industry interests and conducts objective investigations to understand the causes of chemical accidents. As a result of these investigations, the CSB makes recommendations and suggestions aimed at preventing future accidents and creating a safe working environment. However, the CSB can only make recommendations but has no enforcement powers, so the implementation of the proposed measures is the responsibility of the organisations and authorities concerned. CSB investigations can take a long time and the publication of reports can take longer, which may lead to delays in the implementation of the recommended measures. The operation of CSB is linked to funding issues, and the agency does not always have sufficient resources to operate effectively and conduct investigations.[14]

The Chemical Safety Board provides access to detailed reports and case studies by having access to an extremely wide range of databases. Because of its geographical focus, it is mainly concentrated on the United States, which leaves a gap in international cooperation. It would also be advisable to develop international cooperation and international data sharing.

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[13] Tukes VARO registry of chemical accidents in Finland: https://tukes.fi/onnettomuudet (Accessed: 4 April 2024).

[14] US Chemical Safety Board: https://www.csb.gov/about-the-csb/mission/ (Accessed: 4 April 2024).

## CAMEO/ALOHA: CAMEO (COMPUTER-AIDED MANAGEMENT OF EMERGENCY OPERATIONS)

The CAMEO (Computer-Aided Management of Emergency Operations)[15] and ALOHA (Areal Locations of Hazardous Atmospheres) software are tools developed by the US Environmental Protection Agency (EPA) to model the spread of substances and potential hazard zones in the event of a chemical accident.

On the positive side, the system allows for a rapid and effective response to chemical accidents by modelling the spread of substances and their potential effects on the environment and people. It provides detailed information on the possible consequences of accidents, which can help decision-makers to make appropriate responses. It has an easy-to-use user interface that allows users to easily enter data and interpret results.

On the downside, the modelling of the system may be subject to a certain degree of inaccuracy, especially if inadequate data on material properties and environmental conditions are available. Since the system uses modelling, the results are only estimations and do not always accurately reflect reality. Although the CAMEO/ALOHA system offers many useful features, there are some chemical accident situations that it cannot fully model or manage.

The CAMEO/ALOHA system is an important tool for managing chemical accidents and supporting disaster response efforts, particularly in the United States.

## ALOHA (AREAL LOCATIONS OF HAZARDOUS ATMOSPHERES)

ALOHA is a hazard modelling program used as part of the CAMEO software suite to plan and manage chemical emergencies. It allows detailed estimation of chemical releases and modelling of threat zones, such as toxic gas clouds, flammable gases, and explosions, which are depicted on maps. Red, orange, and yellow zones indicate threat levels.[16]

The ALOHA software is often used in disaster planning and emergency response, particularly in the management of chemical emergencies. The application is flexible and easy to use and is widely available to emergency management and safety professionals worldwide. With ALOHA, users can anticipate and prepare for potential hazards and manage disasters more effectively, minimising their negative impact on people and the environment.

CAMEO Chemicals is a key database for planning and managing chemical emergencies. It contains critical response information, physical properties, and health hazards, and predicts potential hazards from mixing chemicals. The information contained in the database will promote effective response and management during chemical emergencies and includes transport information derived from UN/NA identifiers.

The CAMEO Data Manager Software application allows you to track information such as chemical inventories and facility availability to assist with emergency response and planning in your local community as required by the EPCRA Act (Emergency Planning and Community Right-to-Know Act). Data can be entered manually or by importing a Tier2

[15] Computer-Aided Management of Emergency Operations website: https://www.epa.gov/cameo (Accessed: 4 April 2024).

[16] ALOHA Software: https://www.epa.gov/cameo/aloha-software (Accessed: 11 April 2024).

Submit file and the application is part of the widely used CAMEO software suite for chemical emergency management and planning.[17]

MARPLOT (Mapping Application for Response, Planning, and Local Operational Tasks) is a mapping program in the CAMEO software suite used for planning and responding to chemical emergencies. The easy-to-use interface allows for the addition and editing of objects on the map, with various background base maps and online layers. MARPLOT can be used interactively with other CAMEO programs, such as ALOHA threat zone estimators, or by linking it to CAMEO Data Manager Software records.[18]

Tier2 Submit™ is a program to assist facilities in preparing an electronic form for the annual Tier II Hazardous Substance Inventory Report under the EPCRA Act. The latest version of the program, which is updated annually, is Tier2 Submit 2023, which is for the 2023 reporting year. The deadline for completing Tier II reports is 1 March 2024, and it is important to check for state- or tribe-specific requirements. The data can be exported to the CAMEO Data Manager for additional emergency planning and response tasks. Both tools are part of the CAMEO® software suite.[19]

## NOAA HAZMAT DATABASE

It is the US National Oceanic and Atmospheric Administration's chemical and hazardous substance information database. The NOAA HazMat database[20] has several advantages and disadvantages. Among the benefits is that it contains a wide range of information on the characteristics of chemicals and hazardous substances, including their properties, hazards, and regulations related to their handling and transport. It is publicly accessible, making information on essential chemicals available to anyone. It can also provide expert support on chemical-related issues, which can help interpret data and make the right decisions.

Although the NOAA HazMat database contains a wealth of information, one of its drawbacks is that it sometimes lacks details or updates, which can limit its usefulness in certain situations. The database does not always contain all the necessary information on all chemicals, especially those that are less well-known or less frequently used. Since the data are compiled and updated by humans, there may be inaccuracies or misunderstandings in the database, which can lead to incorrect decisions.

## CONCLUSION

In our study, we presented databases that contribute to the professional activities of a country, a region, or in some cases, different defence organisations. These platforms can be regarded more or less as information platforms, but they can also contribute to the process of security activities. In *Table 1*, we have compared the advantages and disadvantages (pros and cons) of the eight most relevant databases used around the world in tabular format for ease of illustration and transparency. The main reason for selecting the following databases

[17] CAMEO Data Manager Software: https://www.epa.gov/cameo/cameo-data-manager-software (Accessed: 11 April 2024).
[18] MARPLOT Software: https://www.epa.gov/cameo/marplot-software (Accessed: 11 April 2024).
[19] Tier2 Submit Software: https://www.epa.gov/epcra/tier2-submit-software (Accessed: 11 April 2024).
[20] NOAA HazMat database: https://www.noaa.gov/ (Accessed: 11 April 2024).

is to provide an insight into how countries with different conditions, climates, hazards, socialisation, and social backgrounds can help and support the documentation of chemical accidents and contribute to reducing their numbers. For Hungary, it is more relevant to adopt a system that is suited to European conditions because of the almost identical environmental and economic impacts, but it is also worthwhile to look at and adopt useful and proven content and designs from other regions.

Unfortunately, due to limitations of space, we cannot summarise our suggestions for the platforms in the table above, but they are included in the manuscript in the presentation of each database. Our unanimous opinion is that Hungary also needs a multilingual platform where information and studies on events in Hungary and the Central European region can be shared. Of course, it should also be taken into account that environmental changes can affect almost any area, so we can no longer say that tornadoes, hurricanes, etc. can only affect America or the ocean coast.

Table 1 *Database comparison (edited by the authors)*

| No. | DATABASES | ADVANTAGES | DISADVANTAGES |
|---|---|---|---|
| 1. | eMARS (EU) | International cooperation and data sharing | Language barriers |
| | | Chemical accident analysis and reporting | Data protection challenges |
| 2. | MINERVA Portal | Supporting EU-level civil protection strategies. | The platform is related to EU projects and does not provide detailed information on the member states' own disaster management systems. |
| | | Integrating EU-funded projects and initiatives. | Limited international access, although MINERVA is publicly available, the data and tools are mainly intended for disaster management authorities and organisations in EU member states. |
| | | Promoting cooperation between EU member states. | |
| 3. | ARIA (France) | Detailed accident analyses | Language barriers |
| | | Public access | Limited interactivity |
| 4. | Infosis (Germany) | Focus on chemical safety | Limited data interoperability |
| | | Multilingualism | Limited interactivity |
| 5. | CSB (USA) | Detailed reports and case studies | It focuses mainly on the US. |
| | | Extensive database | Lack of international cooperation |
| 6. | SafetyZone (IOGP) | Oil and gas accident analysis | Restricted public access |
| | | Application of international standards and guidelines | Mainly limited to the oil and gas industry. |
| 7. | Sozogaku (Japan) | Analysis of Japan-specific disasters | Limited international impact |
| | | Japan-focused language content | Language barriers |
| 8. | Tukes (Finland) | Official source | Available mainly in Finnish. |
| | | Topicality | Limited interactivity |
| | | Safety advice and information | Limited international relevance |

The number of NaTech events will increase in the future as the temporal distribution of heavy rainfalls increases. Considering the priority, it is advisable to follow the French practice in Hungary and create our own database. In Hungary, there are areas, such as the Veszprém region, where earthquakes occur at a higher rate, but the analysis based on experience shows that it is not necessarily important to deal with earthquakes in all areas, because there are areas where the inland water hazard is more frequent, and therefore local precipitation is the most important issue to be dealt with. In light of this, it is necessary to assess, region by region what NaTech events can be expected in that area and record this data in the national NaTech database.

An assessment system should be developed in Hungary.

Development opportunities:

– Establish a national NaTech database;
– Identify relevant NaTech events;
– Further develop the technical guide:
  - Develop an evaluation methodology;
  - Demonstrate good practices (organisational measures).

The opportunities for improvement also show that there is still work to be done in the area of assessing, managing, and identifying relevant events for the assessment and management of natural hazards that pose challenges to the safety and operation of hazardous installations. In the absence of the developments listed above, we can only monitor events in the hope that the worst will not happen. However, once the right measures and improvements are in place, we can influence the scale of devastation caused by an event and its outcome.

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- Seveso tier: https://emars.jrc.ec.europa.eu/en/emars/statistics/statistics (Accessed: 03 April 2024).
- The Japanese Failure Knowledge Database: http://www.sozogaku.com/fkd/en/ (Accessed: 4 April 2024).
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