



Development of a Methodology for Pooling Resources and Optimising Investments in the Field of CBRN Training and Capacity Building

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(This article is part of the Special Issue **SICC Series CBRNe Conference**)

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<https://doi.org/10.18280/ijse.140324>

ABSTRACT

Received: 7 March 2024

Revised: 27 April 2024

Accepted: 13 May 2024

Available online: 24 June 2024

Keywords:

CBRNe, CBRN training, CBRN preparedness, CBRN defence, resource pooling, sustainability, network, eNOTICE

Deterrence, preparedness, and response to evolving chemical, biological, radiological, and nuclear CBRN threats are being strengthened by international communities and states. These threats require closer top-down and bottom-up cooperation at all levels in order to enable collaborative shared efforts, foster an environment for learning from one another, pool resources and expertise, and take advantage of synergies with an ultimate objective of improving institutional and collective safety and security. Improving preparedness and response necessitates closer and stronger interactions among various stakeholders, including security practitioners, researchers, policy makers, innovation providers, small and medium-sized enterprises (SMEs), and industry. In this context, forging a dynamic multidisciplinary CBRN network could be a more effective approach to promote synergies and addressing the need for stronger cooperation. A resource pooling strategy helps build a highly cooperative CBRN stakeholder community and ensures the network's long-term viability and sustainability. This study examines practical methods to ensure sustainability in pooling and sharing resources, knowledge, and best practices in the field of CBRN training and capacity building. It details how a solution-oriented strategy was created, including a generalised method for combining resources and maximising institutional and government investments. This study was conducted by combining the results of a literature review on best practices in resource pooling and sharing, determining its applicability to CBRN defence, and examining the Horizon 2020 project, European Network of CBRN Training Centres (eNOTICE), as a case study to draw real-time input from the project activities. This work proposes a novel and strategic contribution to the field of CBRN defence in the form of a practice-oriented concept and methodology, for establishing and maintaining CBRN networks at local, regional, and global levels. This top-down and bottom-up transversal strategy offers a way forward that can help CBRN-related dynamic interdisciplinary networks to establish, maintain, and develop in a sustainable way.

1. INTRODUCTION

The notion of public security has been transformed by the high count of chemical, biological, radiological, and nuclear (CBRN) terrorist events (558 recorded incidents between the years 1990 and 2020) across the world [1]; making CBRN risk assessment and defence a top security priority of Nation-States.

The occurrence of terrorist attacks on European soil and the increasing complexity of these attacks, followed by the alarming usage of CBRN materials has raised significant concerns among policy makers to prevent and mitigate CBRN terrorism threats [2]. Improving preparedness and response to CBRN risks requires specialised training, capacity building, and closer and stronger interactions between a range of

stakeholders including security practitioners, researchers, policy makers, innovation providers, small and medium-sized enterprises (SMEs), and industries.

At the European Union level, a variety of cooperative and engagement mechanisms exist [3]; however, serious efforts are needed for closer bottom-up and top-down collaboration at all levels (local, national, and international), specifically under a network-centric approach. A network-centric approach can improve institutional and collective security and safety by enabling collaborative shared efforts, fostering an environment for learning from one another, pooling resources and expertise, and taking advantage of synergies. Forging a dynamic multidisciplinary CBRN network could be a more effective approach to promote synergies and address the need for stronger cooperation.

The extant literature indicates that few CBRN related networks exist both at the global level (i.e., CBRN Centres of Excellence) [4] and within the European Union in the form of research projects commissioned by the European Commission. This demonstrates that while there has been recent universal recognition of the benefits of establishing such networks, there has still been little success in determining the best approach to involve all relevant CBRN actors together in a successful and sustainable way. One example of an EU-funded project which has taken great efforts to approach this task is the Horizon 2020 project, eNOTICE (European Network of CBRN Training Centers) [5].

2. RESOURCE POOLING FOR NETWORK DEVELOPMENT AND SUSTAINABILITY IN THE PUBLIC POLICY AND DEFENCE SECTORS

Resource pooling could be understood as the process of grouping together resources with the goal of maximising operational and financial advantages by improving efficiency and decreasing expenses [6]. Effective and efficient usage of scarce resources lies at the heart of pooling, within which a specific set of methods and mechanisms are used to combine resources from two or more entities into a single network of pooled resources for achieving productivity, harmonisation, and reliability. This concept carries special significance for the public security and defence sector, as it is used for addressing political and economic complexities and ensuring resilience, by offering Nation-States access to previously unavailable or unsystematically organised resources, through the principle of strategic allocation of resources. Specifically in the EU and NATO, resource pooling and sharing (P&S) [7] has been utilised widely over recent years that could be defined as a process to combine, merge, mix and/or share specific resources and capabilities for enhancing Member States' defence capabilities and preparedness and reducing costs via multilateral or bilateral cooperative agreements [8]. It has been used extensively to ensure public security and defence via the European Defence Agency (EDA), which supports various (P&S) initiatives to maximise the organization and management of trans-national expertise, equipment, technology, and best practices among member states [9].

Focusing on the public security and defence sector, CBRN threats transcend geographical boundaries carrying global concerns, thus requiring shared efforts and closer cooperation from different stakeholders, specifically Nation-States, on a global level. Promoting a shared understanding of CBRN risks

and developing collective mechanisms to reduce these threats could play a critical role in attaining this cooperation. Within the EU and other regions, closer cooperation can be achieved through a network (i.e., CBRN network), which serves as an organisational setting for connecting diverse stakeholders from different geographical units having shared goals and collective interests, and pooling individual resources to be shared among the network members [10]. Closer cooperation through a CBRN network could play a crucial role in increasing harmonisation and standardisation specifically in training and capacity building by sharing CBRN related knowledge, information, infrastructure, learning experiences, good practices, and expertise for enhanced prevention, preparedness, and response against CBRN threats that also aligns with the aims and objectives of the 'EU CBRN Action Plan' [3].

Sustainability is the most critical aspect for ensuring durability, as it is directly tied to the concept of time and the specific impact of an activity on the social, environmental, and economic dimensions of society [11]. In the context of CBRN defence, a CBRN network should be designed in such a way that it has a durable resource pooling mechanism and makes positive contributions to the three societal dimensions, mainly yielding dividends in the form of enhanced public security via improved CBRN training and capacity building. For this objective, a sustainability planning approach is mainly employed where a sustainability plan in the form of a roadmap is developed to document effective strategies for continuing successful programs, activities, and partnerships. Successful examples [12, 13] from the literature that can be applied to a self-sustained network have been taken into consideration and integrated into the resource pooling strategy or methodology as part of a sustainability planning approach for ensuring self-sustained CBRN networks.

3. DEVELOPING A EUROPEAN NETWORK OF CBRN TRAINING CENTRES

The eNOTICE project, which operated between 2017 and 2023, was a project funded under the European Horizon 2020 Programme for the research call, "SEC-21- GM-2016-2017: Pan European Networks of practitioners and other actors in the field of security". eNOTICE aimed at creating a truly collaborative and sustainable CBRN community of stakeholders by establishing a European network of CBRN Training Centres (TC) to build cohesion between security practitioners, research, and innovation providers. While conducting the project, it became evident that the development of a resource pooling strategy could help build a highly cooperative CBRN stakeholder community and ensure the network's long-term viability and sustainability at the end of the project. This study is inspired by the observation that CBRN related networks can be expanded further on a sustainable basis by utilising the concept of resource pooling. Thereby, this research focuses on this aspect and examines in detail practical methods to ensure sustainability in pooling and sharing resources, knowledge, and best practices in CBRN training and capacity building. It describes how a solution-oriented strategy, or methodology, was created, including a generalised method for combining resources of network members and maximising institutional and government investments.

4. METHODOLOGY

For the development of the strategy or methodology comprising a generalised method for pooling resources and optimising institutional and government investments, a qualitative approach in combination with a practice-based approach was followed in three steps. First, a desk study, entailing a comprehensive review of the existing literature on resource pooling and optimising resources was conducted. The desk study focused on the relevance of pooling and sharing resources in the CBRN defence sector and the identification of effective strategies for resource pooling, to be utilised in the field of CBRN defence. The desk study was followed by the evaluation of the needs, goals, and elements critical for the development of a CBRN network (i.e., the eNOTICE network). This was done by carrying out an analytical assessment of various project reports or deliverables yielding real-time key insights and stakeholder inputs for defining and formulating the methodology to pool resources and optimise investments. In the last step, the inputs from the previous two steps were used to outline the strategy or methodology for the pooling of resources and optimising investments in the field of CBRN training and capacity building.

5. RESULTS

Firstly, a detailed mapping of resource pooling in the CBRN defence sector was carried out within a CBRN network frame. Figure 1 provides a detailed mapping of the CBRN network's objectives, relevant stakeholders, resources that could be pooled, important areas of consideration, and potential tools in the form of capacity development for efficient resource pooling. A critical assessment of all these mapped elements was conducted that aimed at identifying (Figure 1) the most viable options to develop a resource pooling strategy or methodology within a CBRN network frame.

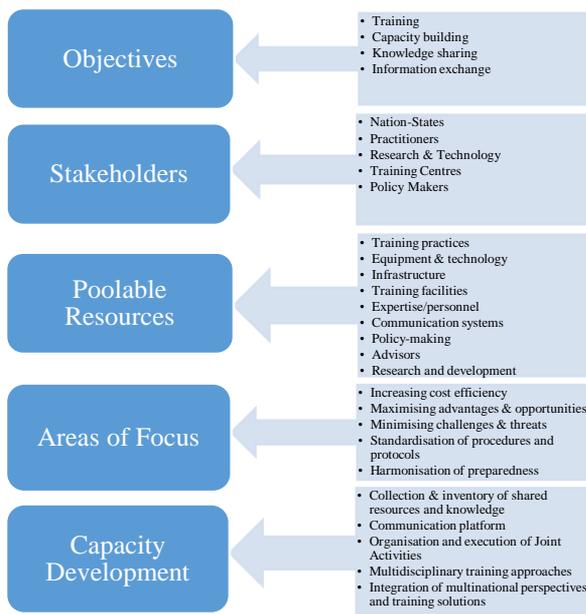


Figure 1. Mapping for resource pooling framework

5.1 Framework for pooling resources and optimising investments

Following the resource mapping, the desk study yielded that

a range of approaches (i.e., resource-dependence approach, network approach, and transaction cost approach) are utilised by different industries, placing a varying level of emphasis on individual organisations and on the entire network of interacting organisations [14].

Mainly, a network approach to resource pooling has been taken into consideration, which places a strong emphasis on the usage of different resources of several interacting organisations to achieve common goals, compared to other approaches which place a strong emphasis on localised individual gains [14]. In this approach, each participating organisation benefits from interactions with other organisations, resulting in continuous improvement to the whole network. Business network studies focused on resource pooling indicate that specific attention is paid to ensure close alignment between the perceptions of customers and providers, specifically regarding operations and customer experiences [15]. In the humanitarian aid sector, relief organisations are trying to implement complementary resource pooling for effective resource pooling which originates from the theory of complementarities [15]. This theory focuses on the notion that the value generated from the combination of different resources is larger than the value created by the sum of individual resources [16]. Lastly, existing literature indicates that enhanced interactivity plays a key role in the form of interactive instruments among the actors, yielding substantial gains for resource pooling [17].

Thereby, a network approach, which aims to obtain a perfect fit between the needs and perceptions of various participating actors, along with resource complementarity and interactivity, have been used to develop a generalised method for resource pooling within a CBRN defence network frame. Additionally, to further develop the methodology, the work done for the development of the CBRN training centre network was utilised by critically analysing the eNOTICE reports ranging from WP2 to WP5. These include WP2: D2.3 – Mapping and needs-and-gaps analysis of the CBRN stakeholders, D2.5 Framework and Sustainability plan for the European CBRN Training Centre network; WP3: D3.15-3.18 Links to other CBRN networks and platforms, integration and interface functions on the eNOTICE information and communication platform reports; WP4: D4.8-4.12 eNOTICE joint Activities planning reports; D4.13 eNOTICE Plan to pool resources and optimise investments for increased CBRN Training Capacity and; WP5: D5.3-5.18 eNOTICE evaluation reports on the functioning of the information and communication platform.

Analysis of these reports led to the development of a generalised method for resource pooling within a CBRN network frame, organised into the following six elements:

- CBRN stakeholders
- Needs
- Services
- Inventory of complementary poolable resources
- Pooling methodology
- Pooling mechanism

Firstly, it is critical to outline the list of stakeholders within a CBRN network that could contribute significantly to a resource pooling mechanism. Secondly, an evaluation of the stakeholders' needs is crucial to understanding what kind of resources are required to fulfill those needs, followed by the identification of services that each stakeholder could provide in order to prepare an inventory of resources that can be pooled for usage by all the network members. Finally, a pooling

methodology can be developed to outline the best methods for resource pooling, by which the pooling mechanism can be implemented to create a sustainable CBRN network.

Corresponding to the first step, the eNOTICE project deliverables were carefully examined to identify different profiles of CBRN stakeholders to be key actors for the formulation of a network. In relation to the second and third steps, an assessment of the realistic needs and expectations of these CBRN stakeholders was carried out, for identifying different factors which motivate or prevent these stakeholders from carrying out cooperation and becoming part of a shared platform, specifically a network.

Focusing on the fourth step, the implementation of the practical approach adopted by the eNOTICE project to bring together different stakeholders and share their respective expertise was examined in order to develop an inventory of complementary resources which could be successfully pooled and encourage interactions and communication between different actors involved in a CBRN network. It provided a comprehensive understanding of the demand and supply sides within the CBRN defence sector and how to establish a working mechanism to promote interactions among different stakeholders. Relating to the fifth step, the working methodology of the eNOTICE project in the form of a standardised methodology, consisting of joint activities and the sharing of key tools and services, including a web-based communication platform, was objectively studied to devise an optimal pooling strategy or methodology.

Lastly, to develop a pooling mechanism, which serves as an organisational foundation and operational structure, the sustainability framework of the eNOTICE project was evaluated, highlighting crucial inputs in developing a sustainable resource pooling strategy within a CBRN network frame.

For practical implementation, each step of the outlined process in Figure 2 corresponding to the strategy or methodology for resource pooling is broken down and defined in detail to successfully develop a CBRN training network, pool resources within the network, and ensure sustainability of the network. The pooling methodology and mechanism (highlighted in yellow) refer to the activities and organisational structure specifically developed within the framework of the eNOTICE project (see Figure 2).

5.1.1 CBRN stakeholders

In the field of CBRN defence, CBRN stakeholders are the main actors or organisations that take part in the prevention, preparedness, and response activities against CBRN threats. In Figure 2, a set of stakeholders (Nation-States, Practitioners, Research, Technology, & Industry actors, Training Professionals & Centres and Policy Makers) have been identified based on the insights taken from the eNOTICE project. These stakeholders act as critical players and beneficiaries in collective CBRN defence. Nation-States, as sovereign entities, can be considered as the driving force behind the effective development and functioning of a resource pooling strategy applied to a CBRN network, as they can offer state-of-the-art infrastructure facilities, government owned training centres, and encourage policies and regulations for prevention and response against CBRN risks. Practitioners are the primary stakeholders and the direct beneficiary and users of CBRN training activities, CBRN related equipment and technology, and multidisciplinary exercises. Research, Technology & Industry actors encompass all the actors from

the research and development sector who are responsible for bringing innovation, product testing and technology development to the CBRN defence field. These stand as strategic actors because they carry the mandate for providing the most updated technology and solutions by participating in demonstrations and product validation exercises in a network frame. Training Professionals & Centres can play an intermediary role in connecting all the stakeholders together, offering critical infrastructure, resources and expertise required for testing different products and the training of CBRN personnel, thus fostering a connection among all actors in a network frame. Lastly, Policy Makers can be the main steering force behind developing standardised guidelines and regulations and designating individual training centres with specific capabilities within the resource pooling framework for strengthening CBRN preparedness and response. A detailed description of these stakeholders can be found in the eNOTICE project deliverables D2.3 and D4.13 [18, 19].

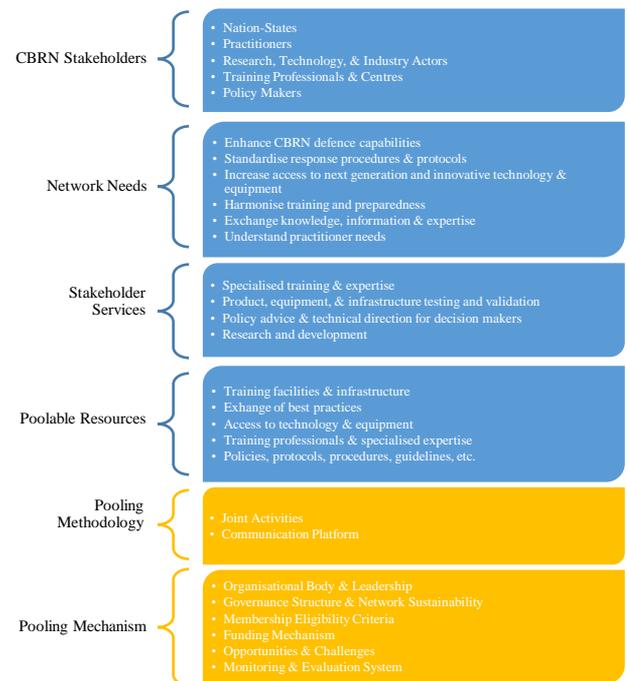


Figure 2. Detailed illustration of resource pooling framework for the eNOTICE network

5.1.2 Needs, services, and poolable resources

Each of the enlisted stakeholders have specific needs which can help in identifying a specific set of resources on the demand and supply side within a network setting (listed in Figure 2). The pooling of resources and network formulation involves the interaction and integration of services as well as capabilities of each stakeholder yielding structural links that is the main driving force of the network. The probable inventory of resources that could be pooled in developing a CBRN network are explained in Table 1 and for a further detailed understanding, eNOTICE project Deliverable D4.13 [19] can also be referenced.

5.1.3 Pooling methodology

It can be defined as a driving force that is critical for utilising the pooled resources and linking all the stakeholders together within a network. A combination of top-down and bottom-up approaches has been suggested in the form of two key instruments (developing Joint Activities and a shared

communication platform) to create opportunities for establishing linkages between stakeholders, increase frequency of interactions, enhance quality of collaborations, develop new agreements, foster effective communication and information exchange between the network members, enhance visibility of the network, engage with potential partners, and evaluate pooling efforts and feedback. Joint Activities provide the foundation for carrying out complementary resource pooling and can comprise of various multidisciplinary activities such as field and tabletop exercises, demonstrations, simulations and serious gaming, policy meetings, and workshops. Furthermore, a communication platform can offer a dedicated platform and a tool for ensuring the effective exchange of information both among network members and externally to public and potential partners.

Table 1. List of resources and services that can be pooled by CBRN stakeholders

CBRN Stakeholder	Resources & Services Which Can be Offered or Shared in a CBRN Network Resources to be Pooled in a Network
Nation-States	<ul style="list-style-type: none"> Specialised capabilities National funding Government-owned training centres Specific infrastructure and facilities Varied training programs Diversity in training practices and CBRN emergency response experiences
Practitioners	<ul style="list-style-type: none"> Feedback on practitioners' needs Expert testing and validation of new products or equipment Updated versions of trusted equipment & verified technology
Research, Technology, & Industry actors	<ul style="list-style-type: none"> Access to emerging technologies to increase training and response capabilities High level and high quality specialised CBRN education Diversified training approaches, areas of focus (C, B, R & N), and training capacity Facilitate exchange of information concerning current practices, technologies, and systems for CBRN training
Training Professionals & Centres	<ul style="list-style-type: none"> Provide a platform and requisite infrastructure to conduct activities such as tabletop exercises, serious gaming, and technology testing and demonstrations Provide interdisciplinary networking opportunities Implementation of political policy/decisions to improve prevention, preparedness, response, and recovery protocols, guidelines, and legislation
Policy Makers	<ul style="list-style-type: none"> Legal direction to increase regulations of equipment and technology use, national investment, and funding in R&D, etc. Advocacy for standardisation of training capabilities and protocols, and harmonisation of practices among network members

Source: Adapted from eNOTICE project deliverable D4.13 [19]

Pooling Mechanism. This is the most critical element of the resource pooling strategy, comprising of institutional and operational pillars required for successfully and effectively implementing the resource pooling strategy or methodology. It involves the identification and definition of particular aspects such as the organisational body and leadership, governance and sustainability, eligibility criteria, funding mechanism, opportunities, and challenges, and monitoring and evaluation system of the network. These could be understood as strategic elements required for the long-term sustainable functioning of the CBRN network.

5.2 Definition of the CBRN network pooling mechanism

As highlighted in the previous section, the pooling mechanism defines the critical elements and organisational structure for the development of a functional and sustainable CBRN network.

5.2.1 Organisational body & leadership

In relation to the organisational body and leadership, the most important aspects to be considered are the rationale and objectives behind the creation of a CBRN network: Its scope, network members, capabilities, and resources of its members. These elements are the prime agents that can influence the nature of the organisational structure and the designation of specific roles and responsibilities corresponding to the leadership and coordination structure. A mix of top-down and bottom-up approaches is suggested, where public bodies of Nation-States could launch this initiative, or private actors (i.e., Technology Suppliers) could take the lead in launching the initiative under the CBRN network frame. Concerning the nature of the organisational body, a semi-formal organisational body is recommended for carrying out decision-making, accountability, and evaluation functions. This approach could be referred to as an 'unincorporated association' or a specific organisation which is established by reaching an agreement between parties or individuals in pursuit of common goals, apart from achieving financial profit [20]. In this approach, a minimum level of commitment is ensured by the members of the network by establishing a particular set of statutes, incorporating a specific governance structure, operational procedures, and regulations. Advantages of both approaches (a formal or informal approach) can be acquired by the adoption of this semi-formal approach [21]. The semi-formal approach is specifically recommended because this structure offers greater flexibility and renders the established network more accessible to both public and private entities wishing to become a member of the network. In Figure 3, an example of a semi-formal governance structure is given, which could be adopted to establish a CBRN network.

5.2.2 Governance and sustainability

Focusing on the governance structure and sustainability, a CBRN network's durability and long-term operations are also mainly influenced by the governance structure type, therefore requiring careful deliberation. The key to the sustainable pooling of resources and the network's existence lies in the long-term vision of the network, the responsibilities of the governing bodies, and the network's financial mechanism. Under the semi-formal governance structure, an Executive Board can pursue members' needs, engage in beneficial opportunities, make decisions relating to strategic aspects, encourage interactions and participation of members, offer

support to the Secretariat, establish the priorities of the CBRN network and represent the established network to third parties. The Secretariat can act as a supervisory legal authority and can carry out organisational management, administrative aspects, support activities, offer communication and information exchange, manage financial aspects along with evaluation, and coordinate the needs of several partners. Working Groups can offer steering capacities for the CBRN network. To ensure effectiveness of the proposed strategy, an evaluation mechanism is recommended, which involves constant monitoring and carefully deliberated progress reports offering strategic feedback. These would enable the visibility of achieved goals and strengthen the commitment of CBRN stakeholders/members, thereby resulting in the sustainable functioning and operation of the network. To understand further how the various roles and responsibilities could be assigned under the semi-formal governance structure system, see the eNOTICE project deliverable D4.13 [19].

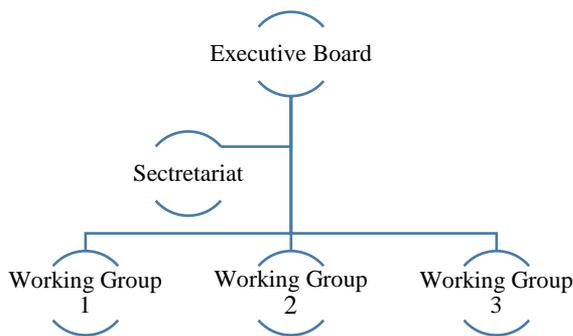


Figure 3. Semi-formal leadership structure example
Source: Adapted from eNOTICE Project Deliverable D4.13 [19]

5.2.3 Membership eligibility

The membership eligibility criteria to become part of the network can be determined by two key factors involving a membership profile and the geographical scope. These factors also affect what kind of resources can be offered and pooled within the CBRN network. The specific profile of actors and their geographical proximity can both be used and could be driven by the need for the harmonisation and standardisation of training, both within the EU and at an international level. A funding mechanism is key to ensuring the availability of investments and resources for optimal usage by members of the network. In relation to the funding mechanism for a semi-formal network structure, a membership fee is proposed as a main source of funding that would be required from specific members of the network on a regular specified time interval, along with financial contributions or external funding. This funding scheme will ensure the financial viability of the network via the creation of a set of formalised expectations from stakeholders and a budget management structure.

5.2.4 Opportunities and challenges

Keeping in mind the sustainability aspect, a key set of opportunities and challenges have also been taken into consideration and outlined and can significantly affect the long-term and effective working of the resource pooling strategy or methodology applied to a CBRN network. The opportunities include cost efficiency and the effective utilisation of resources, skills development, increased awareness and outreach, a new niche for technology suppliers and increased cross-border CBRN preparedness capacities.

While challenges involve harmonisation and standardisation, varying national rules and regulations, sharing of classified information and data, language barriers, and the availability of funds. These challenges can be addressed through carefully sorting out solutions by working on areas of mutual interest and shared goals, rather than focusing on areas of conflict and differences.

5.2.5 Monitoring and evaluation

Lastly, for monitoring and evaluation, a carefully planned system is required for the successful working and long-term viability of the resource pooling strategy or methodology. It is recommended that developing criteria or indicators on a selective timeframe is critical to the network's effective functioning and durability. For monitoring and evaluating the efficiency of the mechanism for resource pooling and optimising investments, a quality management system can be established that involves the development of standard operating procedures (SOPs) and key performance indicators (KPIs). The European Foundation for Quality Management (EFQM) model of excellence [22] and SWOT analysis [23] can be used as a potential methodology for developing a well-tailored approach to carry out monitoring and evaluation activities. In addition, supporting instruments can be developed to carry out the evaluation of different activities such as those in the eNOTICE Community Centre (ECC) platform, a capacity label offering a catalogue which defines the capabilities and resources offered by the network members, and specific guidelines for organising and assessing Joint Activities. The quality management system and these supporting instruments have been successfully developed as part of the eNOTICE project and can be further explored in detail in the project deliverable D4.13 [19].

6. DISCUSSION

This study explored theoretical concepts on strategies and best practices for pooling resources and optimising investments and their application within the defence and security sectors, and specifically within the field of CBRN training. There are numerous methodologies for pooling resources within a network framework, aimed at increasing member capabilities through exchange of knowledge and expertise, shared operational costs, and expanding opportunities for research and development. The desk research conducted for the purposes of this study identified the theory of complementary resource pooling as the most efficient methodology for pooling resources in a network setting. With complementary resource pooling, both the needs and capacities of network members are considered, enabling a free exchange between members to share their available resources. In the defence sector, this theory has been applied to various NATO and EU programmes to minimise operational and training costs by increasing expertise, enhancing interagency collaboration, and sharing technology, innovation, and equipment among the Member States [7, 9], and demonstrating the heightened need to develop a collective resource pooling methodology within the field of CBRN safety and security. Through this study, a proposed strategy was developed, providing the framework and critical elements needed for the foundation of a functional and sustainable network to enhance CBRN knowledge, training, and capabilities. The methodology for pooling and optimising

resources proposed in this study also involved evaluating and identifying the best operational practices to ensure sustainability over time, including the implementation of a semi-formal organisational structure, aimed at providing network members with both a flexible resource pooling mechanism while also keeping members engaged and accountable to actively participate and contribute to the network's governance, funding, communications, and operations.

The unique attribute of this study comes from the successful testing and implementation of the methodology throughout the course of the European project eNOTICE from the years 2017 to 2023, demonstrating the functionality of the proposed methodology for the pooling and optimisation of resources, and its success in maintaining the continued existence of a practical and beneficial European Network of CBRN Training Centers. The rigorous testing, evaluations, and collection of member inputs conducted throughout the course of project eNOTICE were a critical component in the design and development of the proposed pooling mechanism, which could be used globally to establish a functional and sustainable CBRN network. These continuous reviews highlighted the significant impact which this type of network structure has in creating strategic synergies, enhancing training capabilities, expanding opportunities and access to innovative research and technological developments, and increasing overall member capacities both individually and as a collective whole [24]. In particular, eNOTICE's distinct contribution to the development of a CBRN resource pooling mechanism stems from its unique design of an online network platform (eNOTICE Community Centre) and the organisation and lessons learnt from the execution of multiple Joint Activities across several European countries. This unique attribute lends credibility to the methodology developed in this study and provides a practical example of how this mechanism can be adopted and tailored by interested parties to strengthen CBRN training and capacity building in a network setting.

It is crucial, however, to highlight that there may be some limitations in our proposed methodology for the development of a CBRN network. The main challenge involves recognising the peculiar dynamics of various regions having different political, strategic, and defence policies, legislation, or organisational structures, which could serve as a barrier to the successful implementation of this strategy or methodology. However, a detailed analytical assessment of needs, goals, objectives, and the vision of stakeholders can help to overcome this barrier, yielding an effort fuelled by joint preparedness and response motivations in different regions, especially in the case of cross border crises. It is also important to note that within the framework of the project, the eNOTICE network did not include all potential stakeholders involved in every phase of CBRN protection, preparedness, response, and recovery, as this went beyond the scope of the project's intended objectives. However, for the development of a truly comprehensive CBRN network, it could prove beneficial to consider enlargement of the membership profile to also include actors involved in the recovery operations in the aftermath of a CBRN incident. While this had not previously been included in the network mechanism, there could be significantly positive effects associated with involving these stakeholders in the network, to increase the dialogue and collaboration between first responders, technology providers, policy makers, and also those responsible for the activities and

operations which help to secure the site of a CBRN emergency and return conditions back to normal.

The most significant aspect stemming from this research is ensuring the sustainability of the network. The eNOTICE project offered an example of the challenges which a network and its individual members face in seeking to maintain and sustain itself in the long-term; it is difficult to maintain long-term sustainability. However, this study highlights methods by which these challenges can be addressed, by encouraging networks to implement a clear governance and funding mechanism and a well-defined sustainability plan which assist in focusing on the dividends and the shared objectives providing a push factor for ensuring the CBRN network's durability and long-term operability. A potential area of research that can be investigated further is the harmonisation and standardisation of training capacities and capabilities for establishing and promoting viable multidisciplinary CBRN networks on international and regional levels as a way forward.

7. CONCLUSION

This study aimed to outline the development of a strategy or methodology for pooling resources and optimising investments within a network frame in the field of CBRN defence, based on theoretical concepts and an in-depth review of the Horizon 2020 eNOTICE (European Network of CBRN Training Centres) project. The successful implementation of this methodology or strategy for the sustainable operability of the eNOTICE network signifies that it can generate tangible benefits for the CBRN defence sector, strengthening collaborative preparedness, and effective response to cross-border crises. Its applicability as a successful collaborative tool for a CBRN stakeholder network demonstrates that it is a practical and innovative approach which can be used in several contexts to establish and maintain networks at various levels. While there are still some limitations and challenges to be explored which can be overcome in the future through the application of the methodology to other case studies. On the other hand, this approach enables stakeholders with shared motivations and objectives to optimise the pooling of resources, develop effective partnerships, integrate technological innovations in their workflow, and foster collaboration and synergies to strengthen CBRN training capacities and capabilities. The novel contribution of this top-down and bottom-up transversal strategy lies in its promotion of an approach towards sustainability, which should help CBRN-related dynamic interdisciplinary networks to maintain and develop in a fruitful way. This study offers a critical tool - a methodology - for building and expanding sustainable CBRN related networks, focused on improving national and cross-border capacities, providing layered protection against CBRN threats to move forward in the direction of achieving effective and enhanced global CBRN resilience, preparedness, and response.

ACKNOWLEDGMENT

This work is supported by the eNOTICE project and its partners through which this research was made possible, and inputs were drawn for devising the strategy or methodology for pooling resources and optimising investments.

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