D4.8 MATRICIAL TOOL AND AD HOC GUIDANCE

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Abstract: A matrix-based tool has been developed for evaluating the ability of multi-organizational/multinational teams to interoperate during preparation for and response to Extreme Wildfire Events and other civil protection operations. In this report we explain the tool's operation, give an example of its use after the 2018 Sweden European Union Civil Protection Mechanism (EUCPM) activation, and indicate how the tool can be used to improve interoperability.

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1. Introduction

Extreme Wildfire Events (EWE) frequently involve cooperation between responders and other stakeholders from numerous nations and organizations. To effectively handle these major catastrophes, many services and agencies must cooperate with one another and strive to achieve the same level of interoperability that they do during their ordinary daily operations.

The need for multi-organizational cooperation becomes an increasingly pressing issue, as incidents become more and more complex, technology develops at an increasing pace, and civilian first responders hold higher expectations for standardization.

The need for interoperability extends beyond compatibility of equipment and procedures: interoperable organizations must be able to communicate with each other (Barry, 2003), understand each other, work together, and build on each other's capabilities to reach common goals.

To meet these challenges, FIRE-RES Innovative Action 4.7 has been established to test an interoperability evaluation tool to assess how well multi-national, multi-organizational teams can interoperate during EWEs. This previously prototyped matricial tool assesses the capability of various first responder organizations to collaborate, across several layers of preparedness and response.

In this report we describe the origins of the matricial tool, how the tool calculates evaluation scores, and how the tool can be incorporated into EWE preparation and response.

2. Evaluation tool background

Bourquard and Coat (2009) define interoperability as "compatibility of equipment and procedures allowing systems and organizations to cope or communicate". Although all can agree that this is essential to efficient interorganizational response to EWEs, it is not always clear how to achieve it, and stakeholders can have different opinions about what needs to be done to reach an acceptable level of interoperability.

In this context, responding to a real need, the Bouches-du-Rhône Fire Department developed a matrix-based interoperability evaluation tool inspired by a US Department of Homeland Security campaign guide (SAFECOM, 2004). This campaign guide was created in the aftermath of 9/11, to enable radio communications interoperability at a basic interagency level (fire department and police). The framework presented in the SAFECOM guide has been used in the US and organizations in other countries such as Public Safety Canada, National Policing Improvement Agency UK, and Scottish Ambulances Services.

The Bouches-du-Rhône Fire Department adapted the SAFECOM framework to create an interoperability evaluation tool (Monet, Mannaioni *et al.,* 2018) that meets two objectives:

- Address all aspects of n a t i o n a l interagency civil protection operations: policy and guidance, training and communication, and command and control practices.

- Assess and score each aspect and create a combined score using weights reflecting the importance of each aspect.

The original version of this tool was slightly modified to reflect international operations and used to assess interoperability in a 2018 European Civil Protection Mechanism (EUCPM) wildfire operation in Sweden involving both Swedish and French responders. It is this version of the tool that will be tested in FIRE-RES Innovative Action 4.7.

In the sections below we describe the structure of the matricial interoperability evaluation tool, provide an example of its use in the Swedish-French wildfire operation, and present considerations for its future use in EWE preparation and response.

3. Matricial Interoperability Evaluation Tool

3.1. Overview

The tool evaluates seven components of interoperability:

- Governance

- Standardised Operational Procedures (SOPs)

- Data Technologies

- Voice Technologies

- Training and Exercises

- Language

- Operations

For each interoperability component, five levels of increasingly enhanced interoperability are defined. These Evaluation Levels are shown in Table 1 below and described in more detail in the following section.

Table 1. Interoperability component Evaluation Levels

Interoperability Component	Evaluation Level				
	1	**2**	**3**	**4**	**5**
Governance	National agencies working separately	No formal joint work between national agencies	Occasional bilateral or multilateral formal group for join work and missions	Multilateral agreement (s) for join work and missions	Specific bilateral agreement (s) for join work and missions
SOPs	Harmonized national SOPs	National SOPs to receive international aid	Regional SOPs	Multilateral SOPs	Specific bilateral SOPs
Data Technologies	Manual files swap	Bilateral files exchange via commercial software	Sharing by a dedicated ad hoc interface App	One-way sharing with standards-based software	Two-way sharing
Voice Technologies	Swap radio	Gateway	Shared channels	Proprietary channels system	Bi or multilateral standards-based sharing systems
Training/ Exercises	National unified training doctrine	National full-scale exercises	Cross bordered training and exercise	Regional training and exercising	Multilateral training and exercising
Language Skills	Use of interpreters and/or immediate translation tools (e.g., smartphones)	Basic use of third language (A)	Independent use of third language (B)	Proficient use of third language (C)	Use of host country language
Operations	Teams working separately with limited communica-tion	Teams working together with formalised (briefing, radio) com-munications	Teams achieved being integrated in the local command system	International teams taking roles in local ICS	Same incident command system

The first step in assessing a joint operation is to use the table above to assign an Evaluation Level of 1 – 5 for each interoperability component. A Component Score is calculated for each component by multiplying its Evaluation Level by a Component Weight. An Overall Score is then calculated by adding up the seven Component Scores.

The Component Weights used to calculate the Overall Score reflect the relative importance of the seven interoperability components. The first four components, Governance, SOPs, Data and Voice Technologies, are considered of equal importance. Training and Exercises as well as Language skills are deemed twice as important as the first four components. Finally, the Operations component is judged to be four times as important as the first four components.

Table 2 shows the Component Weights necessary to reflect the relative importance of each component, and in addition give a maximum Overall Score of 100.

Table 2. Component Weights for Overall Interoperability Score

Interoperability Component	Evaluation Level	Component Weight	Component Score
Governance	1-5	**1.67**	1.67 – 8.33
SOPs	1-5	**1.67**	1.67 – 8.33
Data Technologies	1-5	**1.67**	1.67 – 8.33
Voice Technologies	1-5	**1.67**	1.67 – 8.33
Training and Exercises	1-5	**3.33**	3.33 – 16.66
Language Skills	1-5	**3.33**	3.33 – 16.66
Operations	1-5	**6.66**	6.66 – 33.33
		Overall Score	**20-100**

3.2. Interoperability component details

3.2.1. Governance

The following levels of international cooperation are considered:

- *National agencies working separately*: no real connection between national civil protection bodies.

- *No formal joint work between national agencies:* bilateral work (meetings, decisions) is done in an informal manner.

- *Occasional bilateral or multilateral formal group for joint work and missions*: some bilateral or multilateral work is done through formal arrangements; agreements and written decisions are made on particular topics.

- *Multilateral agreement(s) for joint work and missions*: multilateral agreements, guidance or frameworks exist (example: EUCPM – European Union Civil Protection Mechanism)

- *Specific bilateral agreement(s) for joint work and missions:* one or more bilateral agreement exist, for example for cross bordered operations, going beyond just multilateral agreements.

3.2.2. Standard Operating Procedures

The evaluation levels of this component follow a pattern similar to the previous component's:

- *Harmonized national SOPs:* this provides a basis for interconnection with other countries.

- *National SOPs to receive international aid*: at least one of the participating countries has implemented Host Nation Support (HNS) as operational guidance to receive international aid.

- *Regional SOPs*: some work has been done to share best practices at the regional level

- *Multilateral SOPs*: SOPs exist at the multilateral level (EU, UN, …)

- *Specific bilateral SOPs*: Bilateral or cross bordered policies are in place, implemented at the "ground" level, empowering multilateral SOPs.

3.2.3. Data Technologies

We consider the following levels of digital data exchange:

- *Manual files swap*: exchange of data with the simplest and most resilient tool: USB stick.

- *Bilateral files exchange via commercial software:* e.g., email software.

- *Sharing through a dedicated ad hoc interface App*: use of a commercial dedicated app to share data, e.g., WeTransfer®

- *One-way sharing with standards-based software*: use of ad hoc software to share data in a single direction (provides security).

- *Two-way sharing*: use of ad hoc standardised and dedicated software to share data in both directions (provides more security).

3.2.4. Voice Technologies

Voice communication can be enabled through the following technologies:

- *Swap radio*: on the operational field, to compensate for a lack of radio communications interoperability, international teams exchange radio communication devices to ensure the best intercommunication.

- *Gateway:* works as a "parrot" repeating from one channel to another, automatically.

- *Shared channels*: two countries use different radio communications systems and devices, but similar technology allows having one or more common channels.

- *Proprietary channels system*: two countries use the same ad hoc system, allowing full radio communication interconnection.

- *Bi or multilateral standards*-based *sharing systems*: two countries work with a standardised and secured radio communication system. This system is extensible to a multi-agency configuration to talk and share with full security.

3.2.5. Training and Exercises

Interoperability is also facilitated by the practice of common training or exercises.

- *National unified training doctrine*: adoption of common training standards and practices across a country is the first step toward interoperability. This is not always the case in Europe, where training doctrine can vary across countries (e.g., differences across federal states).

- *National full*-scale *exercises:* solidifies common national doctrine, which facilitates international sharing.

- *Cross bordered training and exercises*: frequent in Europe, the first real action and proof of international interoperability.

- *Regional training and exercises*: before full multilateral training, some regional training is done (e.g., as in Nordic or Mediterranean countries).

- *Multilateral training and exercises:* this is typically what EUCPM does in Europe with the Union Civil Protection Mechanism training program and Module Exercises (MODEX).

3.2.6. Language Skills

Different languages within an EWE operation or any international civil protection operation may present a significant challenge to command, control, and communication, and potentially affect unity of effort if not mitigated. We now must assume that, in Europe, the predominant language is English (the obvious "third language" mentioned in Table 1), but in all cases, the host nation language will be used at least at the ground level. So, overcoming language barriers will be mandatory, through the use of liaison officers, translators, or smart phone-based tools such as Google Translate, to facilitate interaction and coordination within the incident management team and at the operative level.

Communication is conveyed through both verbal and nonverbal means, and inevitably information loss, miscommunication, and misunderstanding will have a negative impact on operations. So, the language skills of participating teams are very important to achieve effective interoperability.

Our Evaluation Levels for language skills follow the *Common European Framework of Reference for Languages*, where A means "basic user", B "independent user", and C "proficient user".

3.2.7. Operations

Operations management is the most important interoperability component and given the highest weight in calculating the Overall Interoperability Score. We assess this component based on the sharing of command and control practices and tools.

- *Teams work together with limited communication:* during an incident agencies or countries work in silos with very limited communication. This does not allow efficient pursuit of a common objective.

- *Teams work together with formalised (briefing, radio) communications*: the two national agencies exchange, through their representatives, direct information through formal technical and management tools.

- *Teams integrated in the local command system*: international incoming teams are integrated into the management of the incident country, for example via a Sector Chief, allowing tactical information to be effectively exchanged.

- *International teams take roles in local ICS*: one step further in integration can take place if incoming teams and experts have acquaintance with the local incident command and control system, allowing their involvement in the organization at different levels (Sectors, Incident Command Post (ICP), liaison officers)

- *Same incident command system*: the collaborating agencies are fully interoperable, while using the same system, organization chart, and communication network.

4.   Using the tool

4.1.   Example practices

For multi-national/multi-organizational training and exercises, EWE, or other civil protection action, this tool can be used during preparation to identify improvements to be undertaken; or for after action review (e.g., after an EUCPM activation) to assess the progress or to re-think the preparation.

This tool can be incorporated into EWEs or other civil protection activities in many ways. Here we give four examples of how the tool could be used.

Practice 1: A high authority managing collaboration uses the tool to establish a score, guiding further steps to improve collaboration.

Practice 2: Representatives from each participating national agency use the tool to assess interoperability. Afterwards, a meeting is organised to compare assessments and

- Identify critical items where the officials don't give the same score (addressing how, why and how to converge), triggering a discussion that leads to shared understanding and a consensus on shortcomings.

- Develop a joint improvement plan (training, exercises, meetings, etc.).

Practice 3: Each of two official representatives requests evaluations from a small sample of responders from his agency. Each responder gives his score using the tool. A harmonisation meeting is then held to understand why collaborators from the same agency possess different perspectives on the ability to cooperate internationally. The next step is comparable to *Practice 2*: hold an international consensus meeting (with or without subordinates) that results in mutual understanding and a consensus on courses of action.

Practice 4: Engage a consultant or outside expert to perform the assessment. This can provide a very helpful perspective, however a third party's inability to access technical specifics might occasionally hinder this type of external review.

4.2. Case Study

In 2018 a European Union Civil Protection Mechanism (EUCPM) action was initiated in response to wildfires in Sweden, which resulted in collaboration between Swedish and French responders. After this EUCPM activation, the matricial tool was used to produce independent evaluations by the head of the French detachment Colonel P. SCHALLER and the Swedish official E. EDGART. The results are shown in Table 3. Each evaluator provided an Evaluation Level of 1-5 for each interoperability component (Eval 1 and Eval 2). These Evaluation Levels were then multiplied by their associated Component Weights to produce Component Scores (Score 1 and Score 2). Overall Scores were calculated by adding up the Component Scores.

As it can be seen in Table 3, the Overall Scores were quite similar despite the different nationalities of the evaluators. The tool also highlights very clearly the interoperability components that need to be improved (SOPs, training and technologies), as well as noticeable differences in perceptions of interoperability within the first four components. These differences, as well as the areas with lower scores, are valuable guides to further discussion and remedial action.

Table 3. Comparison of evaluations of the 2018 Sweden EUCPM activation

Interoperability Component	Evaluation Level					Eval. 1	Eval. 2	Weight	Score 1	Score 2
	1	2	3	4	5					
Governance	National agencies working separately	No formal join work between national agencies	Occasional bilateral or multilateral formal group for join work and missions	Multilateral agreement (s) for join work and missions	Specific bilateral agreement(s) for join work and missions	2	4	1.67	3.33	6.66
SOPs	Harmonized national SOPs	National SOPs to receive international aid	Regional SOPs	Multilateral SOPs	Specific bilateral SOPs	2	4	1.67	3.33	6.66
Data Tech	Manual files swap	Bilateral files exchange via commercial software	Sharing by a dedicated ad hoc interface App	One-way sharing with standards-based software	Two-way sharing	3	1	1.67	5.00	1.67
Voice Tech	Swap radio	Gateway	Shared channels	Proprietary channels system	Bi or multila-teral standards-based sharing systems	3	1	1.67	5.00	1.67
Training/ Exercises	National unified training doctrine	National full-scale exercises	Cross bordered training and exercise	Regional training and exercising	Multilateral training and exercising	2	3	3.33	6.67	10.00
Language Skills	Use of interpreters and/or immediate translation tools (e.g., smartphones)	Basic use of third language (A)	Independent use of third language (B)	Proficient use of third language (C)	Use of host country language	4	4	3.33	13.33	13.33
Operations	Teams working together with limited communication	Teams working together with forma-lised (briefing, radio) communications	Teams achieved being integrated in the local command system	International teams taking roles in local ICS	Same incident command system	3	2	6.67	20.00	13.33
								Overall Score	*56.67*	*53.33*

5.Conclusion

The matricial interoperability evaluation tool offers a simple and user-friendly framework for evaluating and enhancing teamwork to prepare for and respond to EWEs. Additionally, the tool is broad enough to be applied to other civil protection activities.

The tool can be used to document in a structured manner the lessons learned in the aftermath of crises. Alternatively, it can be used at any time to monitor existing cooperative activities (e.g., cross-border operations) to check and identify areas for improvement, building a kind of "pathway toward interoperability".

The tool can be used in an iterative process at the national level (testing > improving > testing again) to increase the effectiveness of each participating state as well as to serve as a foundation for knowledge sharing and cooperation.

Of course, the tool relies on the subjective judgement of the evaluators using it. The scores are influenced by diverse points of views, backgrounds, national and corporate cultures. However, by highlighting "trigger points" of interoperability, this methodology fosters a dialogue that can enhance cooperation and shared preparedness.

Users of this tool need to be aware that ratings can vary due to the evaluators' varied points of view. Evaluations can evolve over time and be impacted by the evaluator's most recent incident management experience. However, as evaluators gain experience with the tool, taking into consideration various perspectives and the knowledge gained from numerous instances, it will give more consistent results.

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