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The Benefits of Alerting System Based on Standardised Libraries[1]

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Abstract – The understanding of the alert content and trust by the recipients can be influenced by the alert message composition. This paper discusses advantages and disadvantages of an alert library based method to compose alert messages that aims at achieving harmonized alert messages all over Europe in terms of content and style. Additionally, it builds on further advantages by making use of the storage and processing capabilities of state-of-the-art receiving devices, based on the alert library method to compose alert messages.

Keywords – *alert message, alert libraries, risk, hazard information.*

1. Introduction

Early warning systems have the potential to significantly reduce the impact of crises in terms of injuries and losses to life and property from existing hazards. However, this statement is only true if alert messages to the population are actually received, noticed, understood and trusted by those at risk. The understanding of the alert message content and trust by the recipients can be influenced by the alert message content, delivery mode and style. Recipients are more likely to trust the alert and implement the right protective actions when the alert message includes sufficient information about the hazard, i.e. type, location, time, intensity and certainty, as well as guidance on protective actions and issuing source (PPW, Perry et.al, Mileti, et.al.). Specific guidelines related to the alert message style are also identified, e.g. most important information should be provided first, so that the use of headlines is recommended (Working Group on Natural Disaster Information Systems). It is also important to avoid the use of ambiguous and complex words, expert jargon or complex sentences and misspellings in the alert message that could cause a complete different meaning in the message than the desired one. Additionally, European countries have an added difficulty: the variety of cultures and languages combined with a significant migration and tourism movements make it even more complex to inform effectively the (whole of the) population at risk for a given incident.

Harmonized or even standardized ways to compose alert messages throughout Europe (and even beyond) could significantly help to address these issues and improve the effectiveness of alert messages, concerning the level of understanding of an alert message and trust on it. On the one side, standards can enforce the use of identified best practices in the literature that are not yet systematically followed, minimizing human errors at the same time. On the other side, the ambiguity introduced by the cultural diversity in Europe can be also minimized, when targeting mixed crowds, if the style and methodology to compose alert messages is harmonized. In this context, this paper discusses the use of alert message libraries, which can contribute to a harmonized methodology to create alert messages.

2. Alert message content: required information items

With the purpose of creating a harmonized methodology to formulate alert messages, and given the discussion in the introduction, it appears very suitable to create alert libraries that can be used to compose alert messages in a modular manner using standardized terminology that can be translated into any language. Departing from the recommended information items in the introduction, we can abstract the recommended alert message content as in Fig. 1 in at least 7 information items:

[1]This article is based on a presentation given during the 4th International Disaster and Risk Conference IDRC Davos 2012 on "Integrative Risk Management in a Changing World - Pathways to a Resilient Society", held 26 - 30 August 2012 in Davos, Switzerland (http://idrc.info/home/).

- **Hazard Type**: a hazard is a potential source of danger or risk. Hazards can be of different nature (natural, man-made accidental, man-made induced in purpose) and can be categorized in many ways. The relevant information in the alert message is however the hazard type, i.e. a term that identifies the situation with a single word (or a closed expression).
- **Location at Risk**: the location at risk can be identified in many ways with different levels of granularity. For example, administrative areas can be used (country/region/locality), GPS coordinates to indicate centre and radius or a polygon that can be displayed in a map or known areas of interest.
- **Time**: the time refers to the expected hazard onset and can be easily encoded using date and time variables for very accurate message, whereas general terms can be used when the available information is not accurate enough. Additionally, the validity time of the alert message can be communicated.
- **Intensity**: information about the hazard intensity shall provide the recipient with an indication of the level of risk or potential impact. For specific types of hazards, some intensity scales are widely known, even if the exact definition of the different intensity levels is unknown to the majority of the population. An example of this is the Richter scale. The intensity dictionary can include the applicable intensity levels to specific hazard types, if they exist, and also incorporate general terms to indicate intensity.
- **Certainty**: indicating the certainty associated to the knowledge on the hazard onset is important to improve trust (Mileti et.al., Working Group on Natural Disaster Information Systems), to minimize the long term impact on trust and actual alert impact due to past false alarms. A similar information item could be indicating the striking likelihood.
- **Source**: it is a matter of trust that the recipient can recognize who (which authority) issued the alert message. Provided that, according to every country's organization in terms of disaster management, only a limited number of authorities are entitled to alert the population, it is feasible to envisage a list of authorized alert message issuers. Even, the same alert message should be endorsed by several authorities (Perry et.al., Mileti et.al.).

While it is unrealistic to think of a pre-defined alert message for each possible situation, it is realistic to envisage a limited dictionary for each information item in Fig. 1. By combining the applicable values of each information item to a specific emergency situation, the composition of alert messages for a very large spectrum of situations can be addressed. Table 1 provides some ideas on keywords and coding examples for each of the information items that should be present in an alert message.

3. Using alert message libraries

We propose that an alert library be a set of limited (but extendable) dictionaries, each of them covering a specific alert message information item, i.e. containing the keywords and codes applicable to that information item (as in Table 1). Of course, an alert message shall not appear as a telegram (terse, short messages), but should be composed as simple but complete sentences. The variety of languages present in Europe makes this issue complex as different languages have different syntax rules and semantics; therefore, some intelligence is required to cope with this variety. Let an 'alert message processing function' be an engine that gets as input the selected keywords and/or codes from the alert libraries and compose a coherent alert message out of these inputs. The process of composing an alert message by using alert libraries is depicted in Fig. 2. First, the user (authority) selects the applicable keyword (or code) for each information item out of the alert libraries, i.e. she/he configures the alert message; then the alert message processing function generates an alert message with the correct syntax out of the codes and keywords selected; the composed message is then delivered. With this method, several advantages can be foreseen:

- the way to compose an alert message is completely standardized (in terms of content and style)
- the same lexicon and structure are always used to compose alert messages
- jargon cannot be used if the libraries are defined without jargon
- typing errors are avoided

These advantages come to the cost of lower flexibility. Indeed, in a fully automatized system to generate alert messages according to standardized method and dictionary, one could argue that future (not foreseeable yet) crises cannot be coped with. However, alert libraries should not be understood as completely static entities. In fact, dictionaries can be (and should be) updated whenever required to enclose newly appearing crises and any relevant improvements.

Looking at long term solutions, a further step can be developed based on the use of alert libraries, exploiting the capabilities of state-of-the art receiving devices in terms of

Figure 1: Alert message content abstraction

Table 1: Alert libraries keywords and coding examples

	Explanation	**Exemplary value**
Hazard Type	Term indicating the type of hazard	Earthquake, Tsunami, Forest fire, Volcano eruption, Chemical explosion,Flash flood,Hurricane,etc.
Location at Risk	Term or code indicating the area at risk. This can be an administrative area (e.g. Country, Region, Locality), known risk areas, areas of interest (e.g. public buildings) or areas indicated y GPS coordinates.	Country, Region, Locality, Area of interest, GPS coordinates
Time	It refers to the onset time of the hazard and can be encoded using the format dd/mm/yyy – hh/mm/ss or in general terms, such imminently, soon, today, tomorrow, etc.	dd/mm/yy – hh/mm/ss, Imminently, Soon, Today, Tomorrow, Etc.
Intensity	It indicates the expected intensity with which the hazard will (or has) hit the location at risk. It can be indicated by know scale systems that are applicable to the hazard type (such as the Richter scale) or using general terms, such as "Severe, Moderate", etc.	Richter scale, Severe, Moderate, Light, Minor
Certainty	It shall indicate how sure the source is about the information provided. It can be expressed in general terms referring to likelihoods.	Observed, Very likely, Likely, Possible, Unlikely, Etc.
Protective Action	It indicates the protective action to be implemented by the recipients of the alert message.	Stay in, Close windows, Get out, Take shelter, Do not approach the area, Etc.
Source	It indicates the identity of the alert message source. It shall be the unequivocal name of a civil protection authority and can be encoded with a unique identifier.	Identifier

processing power and storage capacity. Let's assume now that the user (authority) configures the alert message by selecting the right options (keywords, codes) for each information item to match a specific emergency situation, but the alert message processing engine only configures and generates a machine-readable coded message, rather than a full textual message. Thus, only the coded message is transmitted over communications technologies, which significantly decreases the capacity requirements to transmit the (encoded) alert message. Assuming that the receiving devices store the alert libraries and have a local alert message processing engine, the receiving device can "decode" the alert message out of the received code and present the alert message in a comprehensive manner to the device owner in the right language, as depicted in Fig. 3, assuming that the encoding of each information item is universal. In a way, this would work similarly to a navigation device, which only receive GPS coordinates and requires the receiving device to store the relevant maps to display the location information correctly.

Additionally to the advantages identified above regarding understanding and trust to the alert message, this approach adds other advantages derived from the dramatic reduction in the required capacity to transmit the alert message: (i) lower cost to transmit the alert message and (ii) lower delay to receive the alert message. The first advantage is nice to have for the sustainability of alerting services. The second advantage can become very significant for rapid onset hazards and opens the door to the use of very low capacity systems to disseminate alert messages, e.g. using satellite navigation services to embed alert messages (De Cola, et.al.). This approach opens further possibilities regarding social inclusion, by client-based applications at the receiver device. First, the (citizen) can configure the application to compose and deliver the alert message in its preferred language. If alert libraries are standardized, this is only a matter of downloading the alert library for the right language. Second, the user can also configure the application to deliver the alert message in its preferred mode, i.e. text, speech, and even video. Multimodal approaches to deliver alerts (i.e. exploiting various modalities and their combination) have the potential to increase the likelihood that the alert information will be received (noticed and understood) by the target audience, including groups with special needs, i.e. increasing inclusion (Sullivan, et.al., Langdon, et.al.)

4. Exercise with end users in the Alert4All project

Within the EU-FP7 co-funded project, a workshop with end users was carried to exercise different aspects of an integrated system to disseminate alert messages to the population. Among others, an exercise was organized to let the participants experience two completely different paradigms to compose alert messages: the first based on letting them compose the alert message by inserting free text, the second based on the principles of using alert libraries as explained above. For this purpose, two graphical user interfaces (GUIs) were implemented to manage the alert dissemination system in a fictive scenario that was a concatenation of events in short time to add the stress component to the exercise. The participants had to send alert messages in three different languages to the fictive population using the free-text based system for the

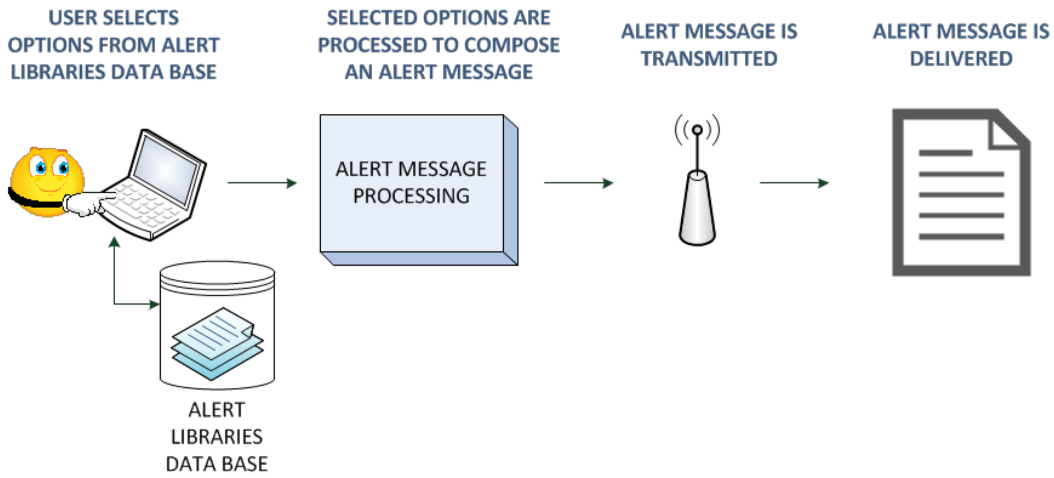

Figure 2: Using alert message libraries

first 3 events and the library-based system for the 3 last events of the scenario. For the free-text based system they were allowed to use online translators to cope with the multi-language requirement of the exercise.

With this exercise, the end users experienced that the alert library based system was requiring significantly lower time to deliver the alert message, especially for the low-capacity systems included in the exercise, than for the free-text based system. When using the free-text based system, the users were not paying attention to the actual content of the alert message, i.e. whether the required information items were included, and the messages were so extensive in some cases that they could not be displayed in the limited sized windows (i.e. they would not be completely displayed in one single message in a real device). This means that for the four teams in the exercise, the style and content of the alert messages significantly deviated from each other and some of them could only be partly displayed. This, according to the best practices identified in the literature, would jeopardize the understanding and trust (in the long term) of citizens, as the message content would strongly depend on the actual person operating the system at the moment of the crisis. Finally, the multi-language feature was excellently covered by the alert library-based system, as the operators only had to care about configuring the alert message and the system automatically created the message in the three requested languages. With the free-text based system, translations were not fully comprehensive, subject to online translator errors. Still; the preferred solution for end users was to have a library-based concept with the option to add free text to the alert message whenever required, e.g. when the libraries do not contain the right solution for a specific crisis. Further details on the exercise and the results can be found in (Mulero Chaves, et.al.).

5. Added value to integrative risk management and conclusion

This paper proposes a concept for a harmonized method to compose alert messages in terms of content and style with the aim at encouraging discussion in this area to promote the standardization of alert libraries. A harmonized method to compose alert messages for European countries

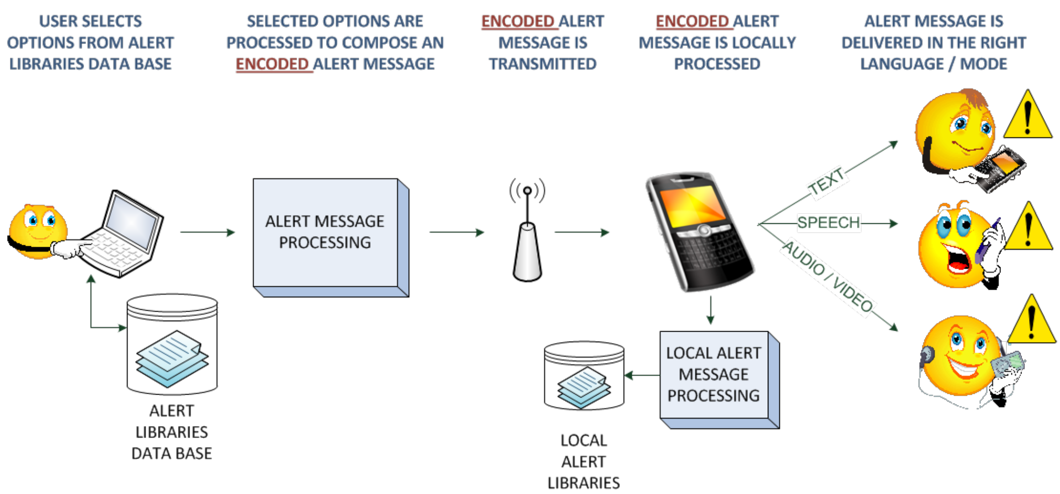

Figure 3: Advanced alert message concept based on alert message libraries

is very appealing to improve the level of understanding by the population of the alert message wherever they come from, wherever they are, given the variety of cultures and languages in European countries combined with a significant migration and tourism movements. Human errors, such as the use of complex words and sentences, jargon and even spelling errors can be avoided with this method, additionally to the harmonized style and alert message composition anywhere by any authority. By introducing advanced concepts, even additional advantages such as lower required capacity per message and lower alert message delivery delay can be achieved, allowing the dissemination of alert messages also through very capacity-limited communications systems. Embedding alert messages in the satellite navigation signal is very appealing given its robustness in front of major disasters and always increasing penetration of navigation-enabled devices, but is only possible if the alert message can be embedded in a very small message format.

An exercise carried out within the Alert4All project has provided evidence of the need to harmonize the methodology to compose alert messages, as the content, size and style of the alert message significantly differ depending on who is the specific person operating the alert dissemination system. Human errors such as spelling errors, complex sentences and words are not avoided in free-text based systems. In the exercise the users did not even make sure that the text they were writing would fit in the displayed window at the receiver side. Additionally, multi-language alert messages were ambiguous as the users did not have sufficient knowledge in the requested languages (English, Spanish and Portuguese) to compose by themselves coherent error-free alert messages (the participants of the exercise had the following nationalities: British, Spanish, Portuguese, Norwegian and German). In all these aspects, an alert-library based system showed significantly better performance at the price of less freedom when composing alert messages (it is however questionable whether this is actually a disadvantage) and assuming some intelligence and storage capabilities at the receiver side (which is not an issue for state-of-the-art devices).

Acknowledgement

The research leading to these results has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement n° [261732].

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Citation

Párraga Niebla, C.; Mulero Chaves, J.; Ramírez Cisneros, J.; Mendes, M.; Ferrer, M. (2014): The Benefits of Alerting System Based on Standardised Libraries. In: Planet@Risk, 2(2): 89-93, Davos: Global Risk Forum GRF Davos.