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Writing short alarm messages: A matter of education, training and practice

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ABSTRACT: The Netherlands has a new tool to alarm and inform the population in case of crises. NL-Alert can simultaneously draw people's attention and explain the crisis matter. The use requires determining of both the impact area and the alarm text. This raises questions about required knowledge and expertise to compose messages. Current experiences are mainly based on communication aimed at educating about potential future crisis. Composing a textual message in limited time to alarm the population is a different job. A good message meets three criteria: completeness (description of threat, location and action), relevance (receiver can determine if alarm is intended for him/her) and correctness given situation. TU Delft analysed messages composed by experts and laypeople on length, content, structure and readability. Results show anyone can compose an alarm message, the difficulty lie in decision on deployment and being able to gather information for the correct and relevant message content.

1 INTRODUCTION

In The Netherlands, authorities may use NL-Alert in case of an (imminent) disaster in which the population in the impact area need to be alarmed. Such an alarm should have the intention to change behaviour resulting in the population getting to a safe location or act safely in order to limit damage to people and properties. NL-Alert can be used in case of physical threats and social disruption, such as release of toxic smoke due to major fires, explosion hazards or flooding. Via NL-Alert Dutch authorities can inform people in the direct vicinity of an emergency situation, by sending a textual alarm message. Mobile phones in the relevant area to which the message is broadcasted can receive these automatically, provided that the phone is switched on, the NL-Alert channel has been activated and the telephone has reception. The messages are not sent by texting (SMS) but by means of cell broadcasting, which can be compared to a radio signal (Aloudat et al., 2007, Samarajiva and Waidyanatha, 2009). They are sent via one-way communication protocols via providers' transmitter masts. The messages are broadcasted via all Dutch mobile operators. NL-Alert will still be operating in the event of a network overload. It is not necessary to register and free of charge.

NL-Alert was launched on November 8th 2012 by the Dutch Minister for Safety and Justice nationwide. All safety regions in The Netherlands can dispatch messages from their emergency control room. Within seconds mobile phones in the specified geographical area will pick up the message. NL-Alert is currently positioned as a valuable addition to existing means, such as the siren, the emergency broadcasting stations and the crisis.nl website. The launch marked the start of a national public campaign: 'NL-Alert, immediate information in emergency situations'. This campaign should make the population aware of the new supplementary emergency alert system and the necessity to check if the setting of once mobile phone needs adjustment in order to receive messages. Since its launch, NL-Alert has been used in five incidents (December 2012, twice in January 2013 and twice in April 2013) until mid-April 2013. In February 2013 a nationwide control message was broadcasted together with the monthly test of the outdoor siren.

In multiple other countries, for example Japan (Seki et al., 2008), Chile, Israel (one2 many, 2012) and the US (Moore, 2010), the use of cell broadcast to notify the population became recently available or is considered. Most of these initiatives relate to early warnings for natural hazards. These services often include a mixture of technologies to alarm to the population. An important difference with the Dutch service is that most initiatives make use of automatically generated messages. This relates

especially to the early warning services such as earthquake and tsunami warning systems. Not all of these services include an action to get or remain safe. Especially the instructed action requires tailoring an alarm text based on the hazard source and location (Jagtman, 2012). In some initiatives not all mobile network operators broadcast the messages excluding a part of the population from receiving an alarm directly. In the US system WEA the cooperating operators and manufactures are made responsible for activation of the cell broadcast on mobile phones. The US population different from the Dutch does not need to check the settings of their mobile phone. On the other hand the number of WEA compatible devices is limited.

2 RISK VERSUS CRISIS COMMUNICATION

The Dutch law as in many other countries distinguishes three types of communication about threats and incidents: risk communication, alarming of the population and informing the population. In non-emergency circumstances, the government is responsible to provide information to the public in preparation for possible dangers. This is known as risk or hazard communication and done via for example risk or hazard maps, emergency instruction sheets and national campaigns. This task is completed by communication experts from municipalities and safety regions.

Alarming the population in case of an emergency is aimed at behavioural changes to minimise material and immaterial damages. This is traditionally the field of emergency rescue services and in particular the fire services. Apart from door-to-door notification they can decide to sound the outdoor siren or use sound trucks. Via these means the attention of the population present in the impact area should be drawn to the acute danger so they quite their current activities and take measures to get or stay safe. Deployment of the Dutch siren system occurs seldom and if done it was mainly in incident involving dangerous substances. In some case the policy is leading in alarming the population. Examples are crisis due to public disorder.

In the course of a crisis, other communication channels provide further details about the incident. Informing the population about the course of the incident falls under public care and focuses on the population threatened or feel threatened. The municipally and region in which the incident occurred is primarily responsible for this task. It is take care of by the (regional) policy team set up in case of emergencies advised by communication experts of the municipality or region. They may use for example press conferences, press releases, the emergency radio broadcaster, a special crisis website and their municipal website. Also, information can be distributed through regional and national radio and television news, current affairs programs and (house-to-house) newspapers. In addition, journalists can themselves search for information and report about their findings.

The means used to fill in the task to inform the people have no notification function. People hear messages through these channels only by chance or because they themselves searched for it. An outdoor siren or a sound truck on the other hand draws the attention to make people aware that there is an incident. The means for informing the population can provide more context and explanation to circumstances surrounding the incident and developments than is possible with traditional alarming means.

The new service NL-Alert to some extent combines these functionalities. The service intends to send a short textual message to alarm the population in the impact area. The message will describe the danger, the location and advice people what to do at that very moment. The service is a complement to the traditional available alarming means. It should be fast. The alarms must be so complete, relevant and correct for the situation (Jagtman et al., 2011). There is a debate about who has the knowledge to compose the text for a short alarm messages. Emergency services (fire, police and medical services) argue to have knowledge about the danger, the impact area and the required actions. Communication experts claim to know how effectively convey a text to the general public.

Currently, experiences with communication on incidents are limited to especially risk communication in nonemergency conditions: “in case ... happens, you should ....” and the information task relating to an incident. These latter reports are not always short. Moreover, the informing the population does not have the same target group, nor is it intended to get the population to change behaviour and it often starts later than the alarming of the population. Twitter has parallels with short alarm messages since a tweet should not exceed 140 characters. However, twitter is not able to draw once attention as alarming means can. This paper therefore discusses the expertise necessary to compose short alarm messages.

3 METHODS

Composing of text messages in a limited time to alarm the population differs from risk communication. First, while risk communication focuses on an “if ..., then ...” context, without an actual crisis, in the event of a threat or incident this will change to a “here and now” context. An alarm

message should be prepared under pressure so that it can contribute to the alarming task. One should moreover take account of circumstances from the specific source location and an impact area of that incident (Jagtman, 2012). In risk communication this is not the case, except the knowledge of sites where companies with hazardous substances are located. One however does not know at which site and when the next incident occurs.

To study what is knowledge and experience is required to compose an alarm message we compared massages written by field experts with messages created by laypeople. The comparison focuses on the length of the message, the content of the messages, the structure of messages and the readability. All of these contribute to comprehension of an alarm received and read by a citizen and the readiness to action by that person (Sillem and Jagtman, 2010). Data was collected via two different sources. Alarm messages composed by experts were collected in workshops, while alarm messages created by laypeople were collected as part of a web-based experiment.

Expertise is this field cannot be assigned to one specific professional. It is dived over a mixture of people. Participants in the workshop were therefore a variety of people who are professionally involved in emergency rescue operations for the Dutch authorities. We aimed for those people involved in warning and informing the population. The type of people involved depends on the source of the crisis. Therefore we included operational chief of the fire brigades and the police, crisis communication officers of the safety regions, spokesmen, advisers for dangerous substances or health issues and crisis communication employees of municipalities.

This paper includes the results of 15 workshops with experts held over the period December 2010—March 2013. Although all workshops aimed at composing alarm messages the context in which these were held differed. The workshops were part of a conference or contact day, for research purposes and for training of safety region employees. The duration varied from 45 minutes to two/three hours. The first workshop lasted a day. Each workshop started with a short introduction about service NL-Alert and an instruction on required elements in an alarm message. After the introduction groups of 2 or 3 experts received information about an incident and were asked to compose a message. During 13 workshops the messages were passed to another group who had to review and adjust on the message without the description of the incident. Before this second assignment a short instruction was give about the three criteria (completeness, relevance and correctness for situation). In the two workshops without the review assignment this instruction was given before composing the initial messages. Eighteen different incident scenarios were used, including fire near a fireworks storage facility, fire in the railway tunnel underneath Amsterdam Schiphol Airport, heathland fire, release of toxics while filling a depot, an accident involving a LPG-truck, extreme weather during an event and social disruption.

During the experiment people were first asked to judge 14 alarm messages which were composed in one of the workshops with experts. The judgment included length, content, readiness to take action and a grade (1–10) for the message. After judging the messages in random order, participants were asked to fill out a short questionnaire. In one of these questions participants were asked to write their own alarm message for an incident with the release of dangerous goods resulting in a toxic cloud near a railway station. Different from the experts, the laypeople were not instructed about the required elements for alarm messages, nor were they informed about the three criteria for an alarm message. Their 'knowledge' was limited to the messages they had judged during the experiment.

4 RESULTS

During the 15 workshops the experts composed 289 alarm messages. 204 of the messages concerned the first version. 87 messages were adjustments made during the review of messages made by another group of experts. The web-based experiment resulted in 716 alarm messages composed by laypeople. The length, content, message order and the readability is discussed in this section.

4.1 *Length of alarm messages*

The length of a message is determined by the number of characters including spaces and punctuation marks. Cell broadcast messages are dispatched in pages of 93 characters (GSMA, 2013, one2 many, 2012). Broadcasting multiple pages increases the change that the full message is not received. Moreover research (CHORIST SP3.D55 Deliverable, 2008) showed that people prefer to receive short alarm messages on a mobile device. The length of the messages per group are summarised in Table 1 and Figure 1. The average length of messages composed by experts is significantly smaller than the laypeople's messages ($F = 24.1$, $P < 0{,}001$, $df = 1004$). Messages created by laypeople vary more in length. Their messages are both shorter and longer.

One should be aware that experts were instructed while laypeople were not. The importance of authorisation, time/date stamp and content elements was addressed. Laypeople were only asked to keep their message short. During the workshops a form with a box per character was handed which provided an extra stimulus to experts to keep their

Table 1. Statistics of length of alarm messages per group.

	Experts	Laypeople
Minimum	54	21
1st quartile	93	99
Median	108	130
Mean	120	138
3rd quartile	139	168
Maximum	336	494

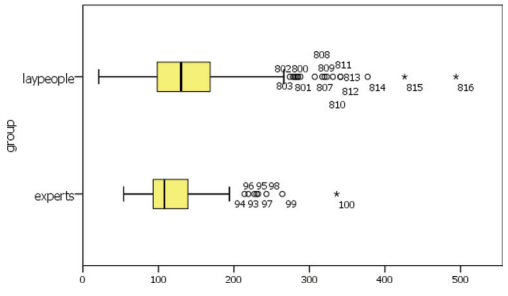

Figure 1. Length of alarm messages shown in boxplots.

message short. The experts were told to use fewer characters than the laypeople, namely 168 instead of 200. 88 laypeople (12%) exceeded their instructed length. 31 experts (11%) used more than the provided length on forms. Despite the differences, both groups were able to compose short messages.

4.2 *Message content*

An NL-Alert is received on a mobile phone and should be recognised as 'special' information. To distinguish the messages and to instruct the population about necessary actions an alarm message should contain (CHORIST SP3.D55 Deliverable, 2008, Jagtman et al., 2011):

- ID1: authorisation "NL-Alert" (recognise alarm)
- Risk: description of the incident (+ its danger)
- Location: site of the incident (+ impact area)
- Action: required actions to get of stay safe
- ID2: date + time stamp of dispatch moment.

Apart from these required elements a message could additionally contain an 'info' element. This element refers to sources such as a radio/TV channel, website or phone number for further information. It is not required for recognition nor for conveying instructions about the necessary actions. Moreover, in case of an early alarm these media do not directly provide additional information. In such cases the info element is not desired.

Table 2 shows which elements were included in alarm messages composed by the different groups.

Table 2. Element in alarm messages per group.

	Experts	Laypeople
ID1 authorisation	97%	16%
Risk	100%	94%
Location	81%	74%
[unclear location]	[95%]	[84%]
Action	97%	92%
Information	25%	33%
ID2 date + time	96%	3%

The authorisation element indicates that a government emergency message was received. It contributes to discrimination of the NL-Alert from other textual messages that one receives. Moreover can authorisation improve readiness to act (Wogalter et al., 1999a, Wogalter et al., 1999b). It contributes to convincing the reader that s/he is currently in danger (Bellamy and Geyer, 1990). Including the date and time the message was dispatched is necessary for the 'relevancy' check of the receiver. Not everybody will immediate notice that an alarm message was received. The sound and vibration of the mobile phone could for example be switched off, or not function while receiving a message. It could also occur that some people do not have their mobile phone within earshot. It could for example be in a bag, on another floor or left at home. When a person at a later moment notices the NL-Alert message, s/he can determine if the message is still relevant via the date and time stamp.

In all but one workshop the experts received a format to fill out their messages on which the authorisation and date/time stamp was specified. In one workshop the importance was only mentioned. During that workshop 13 messages were composed on which 8 had no authorisation (ID1) and 11 had no time/date indication (ID2). Laypeople were not explicitly instructed about the requirement of any of the elements. Information about the sender (ID1) and about the time the message was dispatched (ID2) only showed in a minority of the laypeople's messages. It is not known why this is the case. Possibly participants of the web-based experiment thought the tag "NL-Alert" and the dispatch time would be automatically added by the 'system'. The latter is also the case for the well-known short-message service (SMS). For cell broadcast this is however not the case, therefore such information should be added.

The required content elements, Risk, Location, Action, differed less than the identification elements. Experts included these more often in their alarm messages than laypeople; however the experts were instructed about the content before the exercise. Laypeople included these on their

own accord because they considered these elements important. The alarm messages by both the experts and laypeople included more often Risk and Action (92%–100%) compared to Location (74%–81%). For experts in the field of risk communication, a preferred action of a type of incident is in general communicated without location information. In case of crisis or emergency communication the location however is essential. An incident takes place at a source and may damage people and property in an impact area. In certain emergencies it is important to known from which source one is exposed to the incident to prevent the population to evacuate or leave in this direction. Wildfires and explosion dangers are examples of such cases.

The location element is moreover useful for the reader to determine the relevance of the alarm message. In this context it is noted that authority who uses cell broadcast never knows where the receiver is located. Although messages are broadcasted via cells in a geographical restricted area, by definition there is a difference between the impact area in which the population should be alarmed and the area where the potential receivers of the message are located. Mobile phone can have a connecting via cells located up to several kilometres away. This applies especially in rural areas. If one aims to reach all mobile phones in the impact area, the message should be broadcast via all cells to which these mobile phones are potentially connected. Please refer to Figure 2 for a simplified illustration. However, also people outside the impact area will be connected to these cells and can potentially receive the message. In case the size of the impact area is limited (for example around one or a few high buildings) relatively many people are alarmed unnecessary. The dilemma surrounding the size of the broadcast area and thereby alarming people for whom the message is not relevant increases if a message leads to undesirable side effects such as disaster tourism (people visiting the source location, who were not in the impact area). The reader should therefore use the Location element to determine if the alarm message is meant for him/her. Location information is also important for those who receive a message while bypassing the broadcasting area as a traveller. Car drivers can for example notice an alarm message after reaching their destination. The use of "Incident Y at Mainstreet, do Z" could lead to wrong conclusions, since multiple places have such a street. Another group are incidental visitors who are not familiar in an area. The Location element should not only be meant for locals but also take account of visitors. Mentioning "fire at Jaffalaan" (which is a street within the Delft University of Technology campus) will not be sufficient. Over 10% of the messages of both experts and laypeople included some location description which will not be clear for all readers.

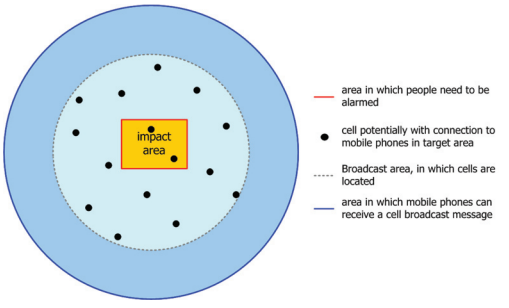

Figure 2. Target for alarm message, broadcast area and area in which messages can be received.

Apart from the standard elements, the alarm messages contained additional content which was supplementary to an element or the message as a whole. This could involve a not-to-take-action, addressing a specific audience in the impact area and a time indication when or where the next NL-Alert message may be expected. The not-to-take-action and the indication for a next message were included up to 5% of the messages made by both experts and laypeople. The target group is indicated in 30% and 17% of the messages by respectively experts and laypeople. Target groups include for example: people within a radius of 500 meters, visitors to an event, residents or (train) passengers.

Besides the authorisation element (ID1) one can emphasize the alarming nature by the use of words in capital letters, exclamation marks (!) or words that underline the alarm. In 9% of the messages by experts and 12% of the messages by laypeople are uppercase or exclamation marks are used in this way. Over a quarter of the laity drawn alarms contained additions that emphasize the character. Think of words like "NOW", "ASAP", "direct", "(life) threatening" and "hazardous substances". Experts make more use of this. Over half of their messages contained a passage that highlights the alarming character. They also used words like "explosion", "risk containment", "fierce". Note that risk containment specifically applied to a scenario around wildfires. This did not apply to the scenario of the laypeople. Although the experts were instructed about the importance to stress the alarming character of a message, experts have clearly had more attention for highlighting the nature of the message.

4.3 *Message structure*

For each alarm message the order in which the elements occur is determined. The messages made by experts and laypeople have in total respectively

44 and 76 different message sequences. The messages of both groups have the same most common sequences of the content elements:

– [Risk] - [Location] - [Action]
– [Risk] - [Location] - [Action] - [Info]
– [Risk] - [Action]

Note that the last sequence is not complete. It lakes a good specification of the location. As explained in the previous section, this may result in difficulties while the relevancy of the alarm message. The messages consist of a number of elements shown in Table 2. In a number of messages the element appear more than once (for example, two actions for the two different target groups). The message sequences are clustered by merging alarm messages with the same basic structure. Table 3 shows that the proportion per cluster with the exception of the most common cluster is quite similar. More than half of the laypeople's messages have a structure in which [Risk] is followed by [Location], and then [Action], possibly supplemented with [Information]. This sequence appeared in almost three quarter of the alarm messages by experts. In this cluster the experts made especially more messages with the structure [Risk] - [Location] - [Action] than laypeople did. The difference with messages by laypeople is not a different order, but especially the appearance of the incomplete messages in which only one element is named or only the risk and location are included. Since laypeople included the required elements less than experts did, the absence of one or two required content elements in the message structures appears more frequent laypeople's alarm messages. Despite the differences, the preferences in message sequences of professionals and laypeople have a strong resemblance.

4.4 *Readability*

An alarm message should be accessible to the entire population. To determine whether there may be obstacles in understanding the messages are analysed on language level. The language level is determined using the Lindhout's classification, which is based on two measurement scales of the language level: the Common European Framework of Reference for Languages (CEF) and the AVI-level (Analysis of Individualization Forms, used in Dutch primary schools). Lindhout links these two measurement scales to a quantitative score, the Fleach Reading Ease Score (Lindhout, 2010, Lindhout and Ale, 2009). The FRES value for each message was measured with the help of the online test on http://www.readability-score.com/. For interpretation of the FRES value: the higher the score the more accessible the text.

The first three columns in Table 4 show the coupling of the FRES values with the scales of language level according to Lindhout. The following columns provide the results of the language test for the alarm messages made by experts and laypeople.

The mean scores of reports by experts (54.2) and laypeople (52.4) barely differ and both are on the elementary language level A2. The total set of alarm messages produced by experts and laypeople do not differ significantly from each other ($F = 1.17$, $P = 0.28$, $df = 1004$). Further analysis shows that this is mainly caused by one message written by experts. The Dutch message text was: "11/11/11 grotebrand-chemischefabriekgaenblijfbinnensluitramenendeur-enradiofm12345" (in English: 11/11/11 Fire at large chemical plant go and stay inside close windows and doors radio fm12345). Notice the original Dutch version in its entirety does not include spaces. If one tests the readability this phrase is considered to exist of one single word. The FRES score in this case is well

Table 3. Clusters of common structures per group (E = Expert, L = Laypeople).

Cluster, basic structure	E	L	E	L
[Risk] [Location] [Action]	57%	31%	74%	53%
[Risk] [Loc] [Action] [Info]	18%	22%		
[Risk] [Action]	12%	13%	16%	18%
[Risk] [Action] [Info]	4%	6%		
[Location] [Risk] [Action]	3%	7%	4%	10%
[Loc] [Risk] [Action] [Info]	2%	4%		
[Risk] [Location]	2%	4%	2%	6%
[Location] [Risk]	–	3%		
only 1 content element	1%	5%	1%	5%
other	3%	6%	3%	6%

Table 4. Readability of alarm messages per group.

FRES	Lindhout classification (Lindhout, 2010)	Experts (N = 289)	Laypeople (N = 716)
>90	start reading (6–9y)/AVI 1–5	1%	1%
80…90	very easy/AVI 6,7	7%	3%
70…80	breakthrough, beginner/A1	10%	10%
60…70	easy (13–14y)/AVI 8,9	22%	18%
50…60	waystage, elementary/A2	28%	26%
35…50	threshold, intermediate/B1	22%	26%
20…35	vantage, upper intermediate/B2	7%	10%
–10…20	effective operational proficiency/C1	3%	4%
<–10	mastery/C2	1%	0%

below –10, and thus, characterised as extremely difficult. Without this entry, the average FRES score for the messages composed by experts raised from 54.2 to 55.9. Comparison of the results of experts and laymen without the above message shows that the language level is significantly different from each other (F = 11.8, P = 0.04, df = 1003). The language level of the alarm messages created by experts appears slightly simpler and therefore easier to read than the messages written by laymen.

Not only experts, also some messages created by laypeople were very difficult to read, CEF levels C1 or C2 (see for example left outliers in Figure 3). Apart from the lack of a single space, the complexity of these messages was caused by the frequent use of long words consisting of three or more syllables and also the omission of full stops and commas. This problem also applies to the other very difficult messages prepared by experts.

95% of the population in the Netherlands mastered the Dutch language at the CEF level A2 (Taalbureau via Lindhout and Ale, 2009). People can with some difficulty read texts to one level more difficult than their language level. In the Dutch case this means, massages of level B1 or easier are just readable for 95% of the population. The fast majority of alarm messages had a FRESS score of B1 or easier (90% by experts and 85% by laypeople) and are therefore readable for the Dutch population. As a comparison, from 43 safety related documents used in Seveso II companies to exchange safety information to their employees, Lindhout found that only 40 up to 68% of the documents were just readable for the audience (Lindhout and Ale, 2009). Although it is often said that "the government" or its employees produce inaccessible texts, this seems not the case for the total set of messages created by experts. Nearly all messages created by experts are legible for the population. The fact that an alarm message sent via cell broadcast should be a short message

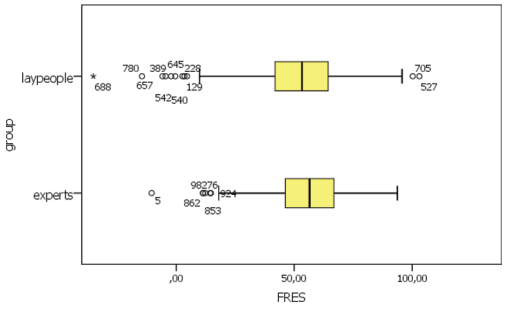

Figure 3. FRES value for alarm messages per group (1 message by experts <<–10 excluded).

helps to develop simple and readable messages. A limited number of characters avoid long words and phrases consisting of many words. Both contribute to readability. However, the author of a message should be aware of the use of spaces and the use of punctuation. Omission of both also in a short message results in messages which are difficult or very difficult to read.

5 CONCLUSION

Analysis of alarm messages composed by experts and laypeople shows that the messages of both groups meet the criteria, completeness, relevance and correctness for the situation. The required elements [Risk], [Location] and [Action] are included in at least three quarters of the alarm messages. A clear description of the location was found the hardest for both experts and laypeople. On the basis of this element, the recipient of an NL-Alert message should determine whether he or she is present in the potentially impact area and thus whether or not the alarm message is relevant for him or her. In comparison with established information known from risk communication, the description of the location for crisis or emergency communication is new. In risk communication, applicable in normal non-emergency circumstances, the attention is focused on the action perspective which is necessary in general for certain risks. NL-Alert is aimed at the early phases of a crisis to alarm the population and incitement to self-reliant behaviour. This requires the reader of an NL-Alert to appreciate a message an alarm. After notifying such a message, the reader should be able to determine the message is still relevant based on the timestamp and the location in danger. The latter puts location in a different perspective from risk communication. We will have to gained experience how the location information is clearly for various target groups included in the alarm text.

The messages are analysed on length, element included in the messages, structure and readability. Messages prepared by experts and laypeople do not differ substantially from each other. The messages of experts and lay people have an average of 120 and 138 characters. The structure of more than half the messages is the description of the danger (risk), followed by the location in danger, and finally the required action. The language level of 9 on the 10 messages is no problem for the Dutch population. The variation in the messages prepared by laypeople is larger than message by experts. Laypeople's alarm messages offer both shorter and longer messages. The language levels of messages show more outliers. It should be noted that the instruction for laypeople was

restricted to the instruction: "now write down an alarm message for the following situation. Try to keep this message as short as possible." Experts during the workshops were instructed on required elements and on the key criteria to test short any alarm message. The analysis shows that composition of the alarm text for an NL-Alert should not preclude the use of the new citizens' alarming and informing system. Anyone can learn to create a message.

6 DISCUSSION

Although composition of alarm messages is easy to learn through exercise and experience, the question arises: if there is specific expertise needed for the preparation of alarm messages. That is certainly the case but not in the formulation of the text, which was indicated by communication experts during the development of the Dutch alarming and informing system NL-Alert. To be able to create an alarm message during a crisis, it must be known:

- What the impact area is
- Which groups should be alarmed via the system
- What the required action(s) are for these groups to get or stay safe.

However, this requires specialised knowledge that is dependent on the incident and the location where the incident occurs. Thus, in one incident (e.g. accidents with dangerous substances and wildfires) the knowledge from fire advisors is required while in another incident (e.g. threat of social disruption) the knowledge of the police is leading. The challenge in deciding about deployment of NL-Alert and similar alarming services via new and traditional media is therefore to know what person or persons in the emergency response organisation area available to provide the necessary information required to compose an alarm message.

Regarding the impact area it was explained that the area in which an NL-Alert is broadcasted will never exactly cover the target area. Decision on the broadcast area is a balance between false alarming of those who are not present in the impact area and missing a part of the population who need to be alarmed. In the Dutch case, the rule of thumb for area selecting is to choose a larger area than the impact area. The change of reaching people who should be alarm has preference. In most of the Dutch safety regions, the alarm message and area is selected by the dispatcher in the control room after contacting officers at the incident location. The question arises to what the advisors for the content of the message must be aware of the selected area for broadcasting, particularly as this message will also be received and read by audiences for whom it is not intended. If such a group responds to the message by performing the required action in the message, they should not be jeopardised. For example if people located downwind of a wildfire receive an alarm to evacuate the forest, they should not be directed towards the fire. To overcome this problem it is necessary to include a clear location and if desired the area in danger or the safe area in the text message.

In The Netherlands the Ministry of Safety and Justice has been responsible for realising the implementation of the new alarming and informing service NL-Alert. The central government made arrangements with the Dutch mobile phone operators and contracted an intermediate party as broker. The broker realised the linkage from the regional emergency control rooms to the networks of the Dutch operators. The organisation to operate and use NL-Alert is left to safety regions since the Ministry cannot prescribe a strict operational procedure. Dutch safety regions differ in their emergency command structure and not all safety regions have the same advisors on picket. A strict prescription could result in some region not being able to broadcast an alarm message early in a crisis, for example within the golden hour. The choice to fill in the organisation decentralised however allows regional differences in procedures and emergency response personnel involved in deciding on deployment of the system, selection of the area and composition of the message. Some of the differences however result in a slightly different focus of the service mainly due to administrative responsibility. Some regions are for example more reserved about when to use the service than others. Such differences however could have impact on the receivers those who need to be alarmed. Since for alarming citizens it should not matter where they are within the country and whether they are visitors or residents. A NL-Alert must be experienced in the same way: in an acute situation where action of the population to get or remain safe is necessary.

REFERENCES

Aloudat, A., Micheal, K. & Yan, J. 2007. Location-based services in emergency management—from government to citizens: global case studies. *In:* MENDIS, P., LAI, J., Dawson, E. & Abbas, H. (eds.) *Recent advances in security technology. Proceedings of the 2007 RNSA Security Technology Conference.* Melbourne: Australian Homeland Security Research Centre.

Bellamy, L.J. & Geyer, T.A.W. 1990. Experimental programme to investigate informative fire warning characteristics for motivating fast evacuation. Watford, UK: Building Research Establishment; Fire research station.

Chorist SP3.D55 Deliverable 2008. Lessons learned by Delft University of Technology on Emergency Warnings. Delft: TU Delft.

GSMA 2013. Mobile network public warning systems and the rise of cell-broadcast. London: GSMA.

Jagtman, H.M. 2012. Design for safety: a new service for alarming and informing the population in case of emergency. *Third International Engineering Systems Symposium.* Delft: Delft University of Technology.

Jagtman, H.M., Sillem, S. & Ale, B.J.M. 2011. *Bouwstenen voor alarmberichten in het kader van NL-Alert. Rapportage over de ontwikkeling van berichtgeving voor burgeralarmering via cell broadcast, Delft*, TU Delft.

Lindhout, P. 2010. *Taalproblemen bij BRZO- en ARIE bedrijven, een onderschat gevaar? Een verkennend onderzoek naar het raakvlak tussen taalproblemen en zware ongevallen., Delft*, TU Delft.

Lindhout, P. & Ale, B.J.M. 2009. Language issues, an underestimated danger in major hazard control? *Journal of hazardous materials,* 172, 247–255.

Moore, L.K. 2010. The Emergency Alert System (EAS) and All-Hazard Warnings. Washington D.C.: Congressional Research Service.

One2Many 2012. White paper: Cell broadcast emergency alerts. Deventer: one2 many.

Samarajiva, R. & Waidyanatha, N. 2009. Two complementary mobile technologies for disaster warning. *The journal of policy, regulation and strategy for telecommunications, information and media,* 11, 58–65.

Seki, T., Okada, T., Ikeda, M. & Sugano, T. 2008. Early warning "Area Mail". *NTT Tehnical Review,* 6.

Sillem, S. & Jagtman, H.M. 2010. Self-reliance and advanced warning technology: how to support the human in danger. *PSAM10.* Seattle.

Wogalter, M.S., Dejoy, D.M. & Laughery, K.R. (eds.) 1999a. *Warnings and Risk Communication,* London: Taylor & Francis Ltd.

Wogalter, M.S., Kalsher, M.J. & Rashid, R. 1999b. Effect of signal word and source attribution on judgements of warning credibility and compliance likelihood. *International journal of industrial ergonomics,* 24, 185–192.