

# Rationale for Emergency Management Systems for Local Communities: A Needs Assessment

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## ABSTRACT

Information systems have great potential to support emergency management. However, development of such systems is difficult, due to the complexity of emergency management. The ability to be able to reveal the needs for support are essential for successful system developments. The emergency responders at the local community level are the main actors when it comes to emergency management. The objective of this paper is to explore the rationale for emergency management systems at the local community level. This is done by an extensive needs assessment based on 12 interviews with representatives for local as well as regional emergency organizations and 49 governing documents. The analysis uncovers ten areas where emergency management systems can enhance the ability of local communities' to manage emergencies.

## Keywords

Needs assessments, emergency management systems, local community.

## INTRODUCTION

Modern information technology has great potential to support emergency management. However, development of sufficiently efficacious emergency management systems is difficult (Turoff, 2002, Van de Walle, Turoff and Hiltz, 2009). In general, the success rate of systems development projects is low, much because of lack of understanding for the needs of stakeholders (Kasser, 2007). A major challenge in development of emergency management systems is to reveal the true needs of the emergency responders. The objective of this paper is to explore the rationale for emergency management systems at the local community level in Sweden. To meet this objective a rigorous needs assessments was performed based on 12 interviews with representatives from local and regional emergency management organizations and 49 governing documents.

Emergency management is a comprehensive activity which includes prevention, forecasting, preparedness planning, surveillance, response, post-emergency assessment, and restoration. According to Levchuk et al. (2004) command and control in emergency management includes four main responsibilities; (1) monitoring external events, (2) decision making, (3) executing tasks, and (4) communicate tasks and information with other organizations. Molino (2006) states that emergency managers must deal with the *Five Cs*, i.e., Command, Control, Communication, Coordination, and Cooperation. Further, emergencies are exceptions; events falling outside normal situations where conditions and demands can change quickly and unexpectedly (Turoff, 2002). Hence, emergency response organizations are confronted with unexpected situations, which require flexibility and improvisation based on the situation.

Haddow and Bullock (2006) state that emergencies need to be handled at the local level using existing resources that are situated close to the scene. In local community settings, emergency responders act in a network structure, where each organization to some extent is independent and different from the others (Pilemalm and Hallberg, 2008). Thus, these organizations need to be able to communicate and share information. Local emergency managers must be able

to collaborate with organizations at the local, regional and national levels. Further, emergency management requires coordinated engagements of several organizations, where different situations require different responses (Shen and Shaw, 2004). Efficient emergency management is also dependent on the ability to coordinate the activities performed by different organizations with diverse work cultures, personnel, expertise, and technical systems (Jungert, Hallberg and Hunstad, 2006).

Emergency response must be adapted based on the current situation and the availability of resources. Information systems have been recognized to have the ability to enhance emergency management by, e.g., improving situation assessment and sense-making, support decision-making, coordinate actions, and support the exchange of information (Jefferson, 2006). However, the introduction of information systems will not automatically lead to efficient emergency handling. The information systems need to be flexible to adaptively support the evolving and unpredictable emergency management process (Mendonca, Jefferson and Harrald, 2007). Since information systems supporting relatively stationary organizations and businesses are difficult to develop (Kasser, 2007), systems fulfilling the requirements of highly dynamic emergency-management processes are intrinsically difficult to develop.

The major challenge in systems development is to determine *what* to build, not *how* (Boehm and Papaccio, 1988). That is, the main difficulties are faced when determining the most emergent needs, transforming those needs to requirements, and identifying the corresponding system features (Sommerville, 1997). About 80% of all flaws in information systems have their origin in the specification of the requirements (Young, 2001). A foundation for adequate requirements specifications is to identify the most urgent needs of the users. However, it is difficult for the users to express their demands in a manner that professional system developers directly can use to construct the desired systems. The large costs and time wasted by continuously correcting the systems is mostly due to the mistakes made during the initial specification (Boehm and Papaccio, 1998).

## BACKGROUND

This section presents the area of needs assessments and the tools used to perform the study, that is, the critical incident technique, the voice of the customer table (VCT), affinity diagrams, and hierarchy diagrams. It also presents the context of Swedish emergency response at the local community level.

### Needs assessments

A major challenge in the development of systems is how to reveal the true needs of the users. Needs are difficult for users to express in a manner that professional developers directly can utilize when developing the desired system (Hallberg, Timpka and Eriksson, 1999). If the professional developers are unfamiliar with the context of use, it will be even harder to reach an understanding. Already in 1987, it was stated that the hardest single part of building a software intensive system is deciding precisely what to build (Brooks, 1987). Nevertheless the importance of performing adequate needs assessments is still often ignored or seen as an implicit part of business analysis and requirements engineering (Davis, 2005). Commonly, the understanding of the concept of *needs* is inadequate. Needs are not equal to features that are wanted or asked for. In software engineering, *needs* are commonly used with the same meaning as *user requirements* and *business requirements*. However, needs and requirements should be treated as two separate concepts with entirely different meanings. Requirements are directed towards the system to be developed, while needs exist among those who have use for the system. When the actual needs have been identified, they can be used as a source for the specification of requirements. In this paper, a need represents something that someone must have, or would benefit from having, in order to accomplish tasks, attain goals, or obtain a feeling (Witkin and Altschuld, 1995). Needs may already be fulfilled by existing features which must be considered when replacing these with new arrangements.

To carry out an adequate needs assessments demands major efforts, but is seldom given enough time and resources during information systems development (Young, 2001). However, the mistakes occurring in this early part of the development are the most costly to correct afterwards (Boehm and Papaccio, 1998). The first step of a needs assessment is to capture the voice of the stakeholders (Yang, 2007). Statements can express more or less anything that can be used to reveal needs. They can be expressed as, e.g., perceived problems, desires for change, and solutions that are believed to be useful. Statements can be collected in a number of ways, through interviews, surveys, workshops, participant observation, business models, governing documents, and by analysts exploring prototypes and scenarios together with stakeholders (Tague, 2005). To base the data collection on *the critical*

*incident technique* (CIT) has been found beneficial, focusing on those activities that are the critical ones to achieve the objective (Flanagan, 1954; Hallberg, Timpka and Eriksson 1999).

The second step of a need assessment is to interpret the collected statements to identify the implicitly expressed needs. This task can be performed by adopting a phenomenological approach or by use of the *Voice of the customer table* (VCT) (Tague, 2005). In the third step, the identified needs are thoroughly analyzed to identify and eliminate duplicates, although they may be differently worded. It is also important to determine if there are any gaps in identified set of need, that is, needs that have been missed in the preceding analysis, and to fill these gaps with the appropriate needs. To accomplish the gap analysis and to be able to handle large sets of needs, it is often required to categorize the needs, which can be performed by using, e.g., *affinity diagrams* and *hierarchy diagrams* (Tague, 2005).

**The critical incident technique, the voice of the customer table, affinity diagrams and hierarchy diagram**

The CIT was developed in the early 1950’s within the U.S. Army Air Force, where the technique was used to improve pilot selection and training (Flanagan, 1954). Using the CIT makes it possible to identify phenomena that work well in practical settings and those that do not. Thereby, the technique improves the knowledge of dilemmas or breakdowns. This knowledge can be used to improve processes and develop support for emergency management. The CIT has been found useful in several different types of settings, e.g. as an input for the development of information systems and to discover possibilities for improvement in service quality (Hallberg, Timpka and Eriksson, 1999). Data collection in CIT-based studies has often been carried out using interviews, but questionnaires have also been found appropriate in order to collect both qualitative and quantitative data.

The VCT is a table used to analyze statements in order to reveal the actual needs of customers. It can be useful to bridge the terminology gap between the user representatives and the professional developers. The VCT is important for qualitative analysis of the collected statements. It is an eight-column table; in the first column the captured statements are inserted, each for one row (Figure 1). In the last column, the extracted need can be filled in, hopefully with a correct understanding of what need the statement really implied.

Statement	Who	What	When	Where	Why	How	Need
We receive a relatively large amount of false alarms every day	Alarm receiver	To detect false alarms	All the time	Call centre	Avoid initiating unnecessary emergency response	...	<i>Support to verify alarms</i>

Figure 1. An example of how the VCT can be used.

Commonly, a large number of needs are identified. The same need could be expressed in several different wordings. The needs can also be at different levels of abstraction, which has to be handled. Duplicate needs should be identified and removed. Therefore, the needs are scrutinized and categorized using affinity diagrams (Figure 2), which are created in a bottom-up procedure (Tague, 2005). To begin with, the needs are grouped into categories consisting of related entities. If necessary, needs can be split into sub-entities in order to enable the elimination of partial overlaps. The needs on a conceptually higher level can serve as names for the categories formed during the first step. Thereafter, similar categories are grouped together until a top-node is reached.

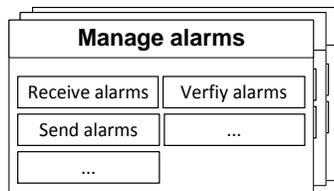


Figure 2. An example of an affinity diagram.

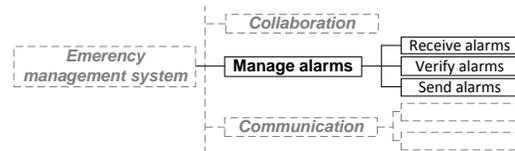


Figure 3. An example of a part of a hierarchy diagram.

Hierarchy diagrams can be used to display the needs and their relationships graphically (Figure 3). The diagram provides an overview of the needs, categories of needs and the relationship between them, which is useful for reviewing, restructuring, and identifying missing needs. The goal is to create a structure of mutually independent needs, where needs on the same hierarchical level are at the same level of abstraction. The hierarchy diagrams can also be used for structuring requirements.

## Study setting

The core of the Swedish emergency response model is the utilization of resources used in the everyday business of the involved organizations. These resources may be complemented if necessary. It is stated by Swedish law that emergencies should be handled at the lowest possible level of the societal structure. Thus, the local authorities obtain a key role. It is possible to complement the local resources with capabilities available at the regional and/or national level. In Sweden, there are six main organizations involved in emergency response and management at the local level of emergency response; (1) The Municipality Administrative Office (MAO), (2) The Fire Department, (3) The County Administrative Board (CAB), (4) The County Council/medical service, (5) The Police Force, and (6) SOS Alarm. Sweden is organized into 290 municipalities at the local community level. These municipalities in turn are organized into 21 counties at the regional level. The MAO and the Fire Department operate at the local community level, while the CAB, the County Council/medical service, the Police Force and SOS Alarm mainly have regional responsibilities, although both the Police Force and the SOS Alarm, in part, are organized nationwide.

The MAO has two compulsory responsibilities at the local level. The responsibility of *operations* implies that authorities and organizations are forced to maintain their regular activities even during emergencies. The responsibility of geographical area implies responsibility for coordination of emergency response in the local area, concerning planning as well as operation. The Fire Department is subject to the MAO, or to a federation of MAOs, and responsible for preventing, limiting, and handling accidents affecting humans, property, or the environment irrespectively of the cause of the accident. The CAB supports the local authorities in emergency handling and is obliged by the responsibility of area at the regional level. Moreover, the CAB should actively support collaboration and allocation of resources between its subordinate MAOs to the greatest extent possible. The County Council has to maintain preparedness for disaster medicine and traumatology. There is always a person on duty, responsible for coordinating the medical resources at both the local and the regional level. The Police Force investigates all emergency calls that the different Fire Departments in their jurisdiction are responding to in order to determine whether they have any criminal causes. SOS Alarm is responsible for handling emergency calls and coordinating ambulance transportations. It is a public service enterprise owned by the government, the county councils, and the municipalities.

## METHODS

This study included four activities; (1) Collect data, (2) Identify statements, (3) Determine needs, and (4) Determine the rationale for information systems support.

The objective of the first activity was to collect information about emergency management at the local community level. This was performed through 12 interviews and the identification of 49 relevant governing documents. The semi-structured interviews were based on a set of questions inspired by the CIT and carried out at the workplaces of the respondents. The questions addressed (1) the respondent's background, (2) the respondent's perception of what is problematic in their agency's management development, (3) the respondents' experience of what works well, and (4) what activities, in management development, are critical for a successful outcome. The interviews were recorded and thereafter transcribed. Thus, the outcome of the first activity was the interview transcriptions and the governing documents.

The objective of the second activity was to identify statements. Four researchers were involved in the analysis, where each interview transcription and document was analyzed by two researchers. Relevant statements contain information supporting the identification of needs of support for emergency response. The interview transcriptions and the governing documents were scrutinized in order to identify statements. The identified statements include, e.g., descriptions of the organizations and work procedures, actual or wanted situation of use, problems, goals, and visions. Consequently, the outcome of the second activity was a set of 553 statements.

The objective of the third activity was to determine the needs. The analysis utilized the VCT to support the transformation from statements to needs. Each statement was carefully analyzed to judge if one or several needs could be extracted. One researcher filled in the VCT and two other researchers reviewed and adjusted these initial VCTs. In cases where different interpretations of statements occurred, these were discussed until a consensus was reached. Hence, the outcome of the third activity was a set of 871 unsorted needs.

The objective of the fourth activity was to increase the quality of the wordings used to describe the 871 unsorted needs and to produce a structured set of needs. The first part of the activity was performed based on affinity diagrams and involved the categorization of the identified needs. The resulting categories were merged into new

categories at a higher level of abstraction until a coherent structure was found. During this analysis, duplicates among the needs were removed and the formulations of the needs were improved. The analysis was performed by four researchers iteratively until the quality of the needs and their structuring was satisfactory. Thus, the needs were reworked and the categories were altered, i.e., renamed, broken up, or merged, until the analysts agreed that the current structure was adequate. In the second part of the activity, the structured set of needs was presented as hierarchy diagrams and final adjustments of the categories were performed. During this final analysis, missing needs can be identified and inserted into the structure. The outcome of this activity was a set of categorized and structured needs that are the rationale for the development of emergency management systems for local communities.

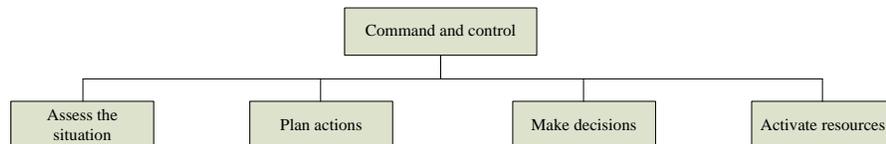
## RESULTS

The needs assessment was based on 12 interviews and 49 governing documents. The interviews were carried out with representatives for (1) MAO, (2) CAB, (3) The county council/medical service, (4) The police force, (5) The fire department, and (6) SOS Alarm. The 49 documents included laws, regulations, and organizational descriptions. The documents were provided by the interviewees and the Swedish Civil Contingencies Agency. In the study, 553 statements were identified during the initial analysis of the interview transcriptions and the documents. From the statements 871 needs were identified. These needs were categorized, duplicates were removed, some rephrasing occurred and the remaining needs were inserted in a hierarchy with ten high-level categories. These categories and the underlying needs constitute the rationale for emergency management systems at the local community level and are discussed in the following sections.

- |  |  |
|--|--|
| 1. Command and control                   | 6. Information security                            |
| 2. Collaboration                         | 7. Preventive measures                             |
| 3. Clarify involved organization's roles | 8. Manage alarm                                    |
| 4. Communications                        | 9. Evaluation                                      |
| 5. Information management                | 10. Acting in accordance with laws and regulations |

### Command and control

The need for support of command and control includes the ability to continuously (1) assess the situation, (2) plan actions, (3) make decisions, and (4) activate resources (Figure 4). In situations of emergency, it is vital to rapidly activate the command and control in order to enable quick responses. Further, there are needs to be able to manage responses to multiple incidents and for the personnel to be able to perform command and control tasks from their regular workplaces.

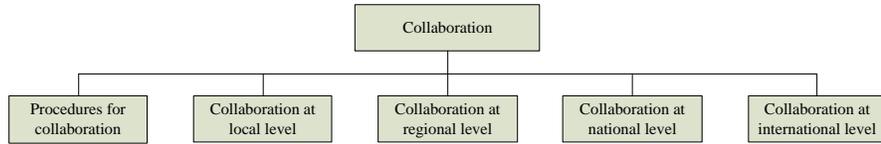


**Figure 4. The category Command and control**

The *assessment* of the situation includes assessing the event and possible developments as well as the availability, status, and capabilities of resources. The *planning* of operations and actions must partly be done jointly with other involved emergency responders. During the planning, it is important to align the available resources to the needs and to optimize the utilization of available resources. Thereby, there is a need to know what *resources* can be allocated for the emergency response. It could be necessary to request resources such as health care, ambulances, and rescue service personnel from neighboring municipalities. The *decision-making* must also be performed jointly, sometimes under time pressure. Further, there is a need for unified command and control of operations in local communities.

### Collaboration

Emergency management in local communities is to large extents collaborative. There is a need for forms and procedures for collaborations. Further, there are needs for support of collaboration at (1) local level, (2) regional, (3) national, and (4) international level (Figure 5).

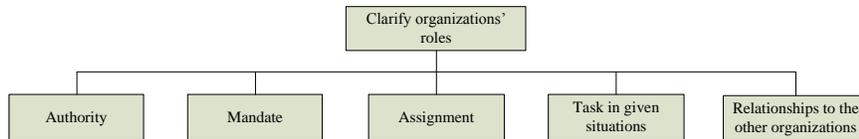


**Figure 5. The category Collaborations.**

There is a need for the collaborating organizations to clearly understand each other. Hence, unified concepts are preferable, although not always possible. Therefore, it is necessary to bridge between the different concepts used in different organizations. This need is amplified when the collaboration is supported by information systems. At the *local level*, there is a need for support of collaboration between (1) on-scene responders, (2) the command staffs of the responding organizations, and (3) on-scene responders and the command staffs of their organizations. Further, there is a need for support to involve NGOs and the private sector in the emergency response. The need for collaboration at the local level concern, (1) the planning of management exercises, (2) implementation of management exercises, (3) information management, (4) information from different agencies, and (5) utilization of common resources. To enhance the collaboration common procedures and unified decision-making structures are necessary. At the *regional level*, there is a need for support to collaborate regarding the usage of resources in order to handle shortages of resources. At the *national level* there is a need for support to collaborate with different authorities, the national emergency management, the Swedish Armed Forces, and voluntary defense organizations.

**Clarify organizations’ roles**

The collaboration between independent organizations induces a need to explicitly provide information about the respective organizations’ roles. It is necessary to be able to access information about the roles’ regarding their (1) authority, (2) mandate, (3) assignments, and (4) task in given situations. Further, the relationships to the other organizations should be provided. This need include the clarification of who is responsible for (1) providing information, (2) conducting the planning, (3) implementing operations, (4) documenting and analyzing experiences, and (5) revising plans (Figure 6).



**Figure 6. The category Clarify organizations’ roles.**

**Communication**

Since emergency management is a collaborative effort communication is essential. Hence, there is a need for support of the communication between (1) the units in an organization, (2) on-scene responders and command staff, (3) the involved organizations, (4) command staffs, and (5) the involved organizations and the public and the media (Figure 7). The communication need to be secure.

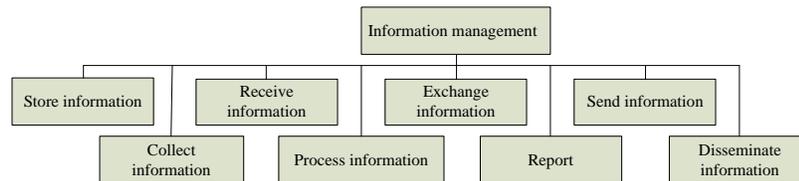


**Figure 7. The category Communication.**

**Information management**

In emergency management, it is necessary to handle large amounts of information. The need for support in information management includes (1) collect information, (2) receive information, (3) process information, (4) store information, (5) exchange information, (6) report, (7) send information, and (8) disseminate information (Figure 8). To *collect information* includes the need of support to (1) gather information rapidly, (2) obtain information regarding a given area, (3) acquire organization’s location information, (4) gather information about ongoing events,

and (5) coordinated the collection of information between organizations. The need *process information* includes to produce information used as the basis for (1) decision making and (2) official reports. Moreover, it is essential to be able to evaluate the quality of information and to maintain the operational picture. It is necessary to *exchange information* between, (1) emergency management organizations, (2) the county councils, (3) the command staffs, (4) municipal entities, and (5) authorities and private companies. The information exchange need to be based up on mutually agreed formats. The major reason to exchange information is to create and maintain a common operational picture and, thereby, enhance a common situational awareness. Several authorities demand formal *reports*. Hence, there is a need for support to prepare reports accurately. Information necessary to report includes (1) the situation at the scene, (2) extreme events, (3) events, conditions, and expected developments, and (4) actions taken and planned.

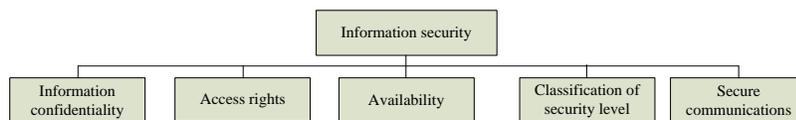


**Figure 8. The need of information management.**

There is a need to *send information* to (1) emergency management organizations, (2) in-house staff, (3) municipal emergency organizations, (4) emergency response vehicles, (5) CAB, and (6) the organization responsible for national status reporting. The information necessary to send to these entities includes (1) events, (2) operations, (3) efforts, (4) plans, (5) repository entries about events, (6) current ability/capacity, and (7) request for support from industry, organizations, volunteers, and countries. There is a need to send information as (1) photos, (2) map images, (3) document, (4) plain text, (5) location information, and (6) warnings. There are needs to receive confirmations that (a) people have read the information and (b) information has reached the person in charge. *Disseminate information* includes needs of ready-made plans for the dissemination. It is necessary to disseminate information on (1) the situation, (2) events, (3) ability to handle the situation, (4) advices, and (5) plans. Information need to be disseminated to (1) the public (2) the organization (3) private companies, and (4) other emergency management organizations. There is a need to disseminate unified messages in various languages and to coordinate information dissemination with the involved organizations to the public and to the media.

### Information security

It is necessary to deal with emergency management information in a secure manner. Information security includes (1) information confidentiality, (2) access rights, (3) availability, (4) classification of security level, and (5) secure communications (Figure 9).

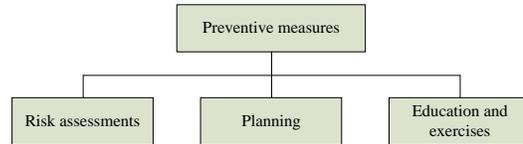


**Figure 9. The category Information security.**

*Information confidentiality* is needed in various situations. There is a need for support of *access rights* management, i.e., decide and keep track of who has the right to access which information. There is a need to ensure the *availability* of information to the authorized users. There is a need for support to be able to ensure adequate levels of *security* in the information handling. There is a need of support for information security management to be able to decide whether information should be classified as secret, manage tiered security depending on the situation, to manage permissions, manage public information, deal with confidential information, and ensure *secure communication* between organizations. There is a need to conduct risk assessments relating to information security.

### Preventive measures

There is need for support to prepare for and, if possible, mitigate future emergencies. Hence, there is need for support to take preventive measures including (1) risk assessments, (2) planning, and (3) education and exercises (Figure 10).

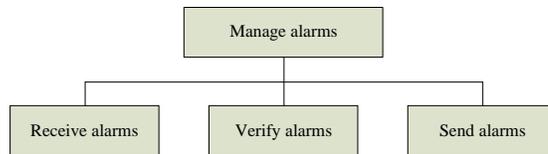


**Figure 10. The need of preventive measures.**

There is a need for support of *risk assessments*, which includes performing (1) vulnerability assessments, (2) threat assessments, and (3) consequence assessments. There is a need for support of collaboration when performing risk assessments. There is a need for support to plan operations, actions, and exercises. Further, there is a need for support to *plan* the organization, interaction networks of different situations, and collaboration in different situations. There is a need for support of joint planning. Those plans should be possible to use as checklists. Plans need to be based on experience and be able to adapt to changing predictions. There is a need for action plans dealing with all sorts of extraordinary events. There is a need to develop action plans based on risk analysis, including how resources should be used and allocated. There is a need to regularly *educate and exercise* the involved organization in emergency management. There is a need to exercise in order to improve collaboration, media contacts, and information management.

**Manage alarms**

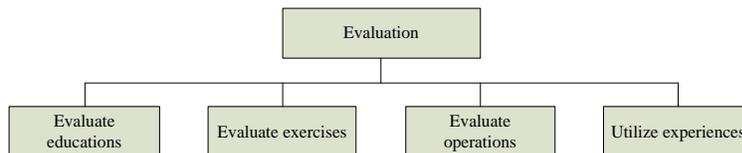
Alarms are the triggers to emergency responses. Therefore, there is a need of support to be able to (1) receive alarms, (2) verify alarms, and (3) send alarms (Figure 11). There are needs related to *receiving alarms* via different channels and in different forms, e.g., phone calls and data, and from humans as well as automatic surveillance systems. The ability to analyze the alarms to verify and ensure their accuracy is also needed. There is a need of support to send information on alarms to, e.g., (1) emergency services, (2) ambulances, (3) hospitals, (4) the police, (5) local authorities and emergency organizations, and (6) government emergency organizations. Further, there are also needs to be able to *send alarms* to the public and to persons in the danger zone. The alarms need to be received and sent in different formats.



**Figure 11. The category Manage alarms.**

**Evaluation**

To increase the ability to handle emergency there is a need of support for evaluation of (1) training, (2) exercises, and (3) operations. Considering operations, there is a need of support for the evaluation of the performance and outcome of (1) actions, (2) collaboration, (3) command and control, (4) resource usage, and (5) information management. There is also a need for support to utilize experiences by revisions of plans based on made experiences and the sharing of experiences with other emergency management organizations (Figure 12).



**Figure 12. The category Evaluation.**

**Documentation**

There is a need of support for documentation of (1) alarms, (2) events, (3) actions and operations, and (4) exercises (Figure 13). This includes the documentation of performance during operations and exercises.

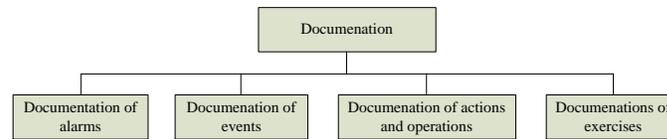


Figure 13. The need of documentation.

### Acting in accordance with laws and regulations

There is a need of support for how to know and ensure that the performed actions are in accordance with the applicable laws and regulations. There is a need of support for knowing what demands the applicable laws and regulations impose on the operations.

### DISCUSSION

Poor understanding of and respect for the user needs are known as one of the main causes of unsuccessful systems development (Kasser, 2007). Nevertheless, insufficient allocation of resources for the needs assessment is common (Witkin and Altschuld, 1995). In this paper, we set out to explore the needs for emergency management systems in local communities to determine the rationale for such support systems. The result of the study indicates ten areas that comprise the rationale for the development of information systems for emergency management, i.e., (1) Command and control, (2) Collaboration, (3) Clarify involved organization's roles, (4) Communications, (5) Information management, (6) Information security, (7) Preventive measures, (8) Manage alarm, (9) Evaluation, and (10) Acting in accordance with laws and regulations.

Currently there are available solutions, based on information technology, that are not fully utilized in emergency management. Still, resources are spent on inventing new solutions, rather than to study how existing technology and systems could be used. Performing extensive needs assessment is time-consuming and costly (Hallberg, Timpka and Eriksson, 1999), but so are technology-driven projects. The point made here is that needs-driven projects have a much larger likelihood to succeed in producing useful systems. When used in safety- and security-critical activities deficient systems becomes a hazard for people and property. In emergency response and restoration of community services and infrastructure, practitioners must perform critical activities, and have to rely on effective sharing and dissemination of critical information, on efficient, and reliable communication and on effective use of scarce resources (Muhren and Van de Walle, 2009; Bradler, Schiller, Aitenbichler and Liebau, 2009). Dysfunctional information systems that hamper the response and restoration could have devastating consequences. Those who lack knowledge about practitioners' needs and the preconditions for support within the emergency management area should not develop information systems for that purpose.

The method used to explore the rationale for emergency manage systems for local communities is to a large extent based on the CIT. Flanagan (1954) introduced CIT as phenomenology oriented approach to explore what is working well and what is not, without prescribing in detail how it should be performed. Hence, in contrast to the Grounded theory (Glaser and Strauss, 1967), the researchers have a predefined research question. CIT has shown to be useful in needs assessments, where the VCT is used for the identification of the needs. Hence, the VCT support the researchers in interpreting the statements of the stakeholders. Rigorous needs assessments result in less time spent on determining the correct requirements and less resources consumed by corrections of mistakes in already introduced systems. Data collection based on CIT and data interpretation using the VCT was found beneficial to determine needs in this project. However, to achieve a useful set of needs, the needs have to be refined in order to be consistent. This was achieved by using affinity and hierarchy diagrams (Tague, 2005).

The result of the study is a rationale for emergency management systems for local communities. Hence, how the information systems support for each emergency responder should be developed is not covered by this study.

### ACKNOWLEDGMENTS

This work was supported by the FOI research project *Quality-based development of command and control systems*, which is funded by the R&D program of the Swedish Armed Forces and due to grants from the Swedish Civil Contingencies Agency.

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