Soft Early Warning for Regional Security

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Abstract
In this paper we will discuss security in functional regions that are divided between two or more nations. Awareness and preparation requires some sort of warning mechanism making it possible for the people in the region to become aware and to prepare themselves for upcoming emergency situations. As both the disaster indicators and the crisis to come are both fuzzy and unknown, we will speak about Soft Early Warning Systems (SEWS). In SEWS each individual living in a region will act as a networked human anticipatory emergency sensor and actor. Our conception of such a regional security SEWS is given in the form of an idealised design called the netAgora portal. After discussing the broad lines of the netAgora design this paper will be focusing on the key role anticipatory modelling and simulation may play in a tool for developing a SEWS capacity for handling transnational complex emergencies and disasters.
Keywords: Soft Early Warning, Regional Security, Crisis Management, Preparation and Training, Anticipatory Modelling and Simulation.

1 Introduction

Security has lately become a top European priority[1]. In this paper we will restrict ourselves to physical security in geographical regions. Specifically the paper will discuss security in such functional regions that are divided between two or more nations. Here recent research indicates that the outcome of an emergency situation to a large extent is due to the awareness and preparations done before the crisis or disaster outbreak (Bolin and t'Hart, 2007). Awareness, however, requires some sort of warning mechanism making it possible for the people in the region to become aware and to prepare themselves for potential emergency situations. The purpose of this paper, hence, will be to increase the possibility of such awareness building. This goal will be achieved by introducing the concept of a soft early warning system (SEWS).

2 Threats and Challenges in the Territorial Concern

The Territorial Concern (TC) may be taken as a base concept for discussing regional and interregional security. A TC, as outlined in figure 1, being a community based

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[1] http://cordis.europa.eu/fp7/dc/index.cfm (2010-06-10)

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organisation for the design, construction, and maintenance of order and security within a geographical territory or region (a space). In other words, a TC is a homeostatic system, with the responsibility (the concern) to establish and maintain a satisfactory configuration of system components and processes and to keep a set of essential variables within critical levels (Holmberg, 1998).

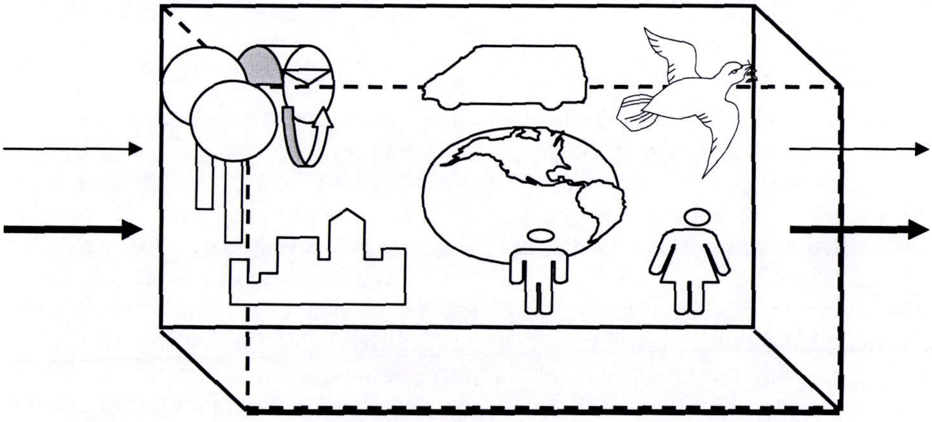

Figure 1: A territorial concern (TC) with flows, processes, and inhabitants.

The concept of essential variables is here taken as the base for security awareness and crisis preparation. This means that it will not be necessary to predict very rare and surprising accidents. It will suffice to identify what essential variables that may go outside its boundaries, within a smaller or greater area, and hence become a threat to human lives. The objective of the rescue work will hence be to restore those variables to their normal values.

Examples of such essential variables may include:

- Oxygen
- Water
- Food
- Shelter, body temperature
- Home care of elderly people
- Electricity
- Roads and rail roads
- Tele communications
- Health care

Another scenario includes situations there one or several of the ordinary rescue and security resources within an area, of some reason, have become inoperable. The challenge in these situations will be to find and allocate alternative resources.

A last case may be that the messages and indications that arrive to a rescue centre are vague, contradictory and difficult to interpret.

3 SOFT EARLY WARNING - A PROMISE

Soft approaches in disciplines such as computer science and systems thinking, is referring to the changeable situations as well as the conclusion that static models and methods is not appropriate to solve upcoming problems. Accordingly, "soft computing" (Lotfi, 1994) applies to a field within computer science which is characterized by the development and use of inexact, and in the beginning, unknown solutions.

Before soft computing entered the field, it was only possible to precisely analyze relatively simple systems. But former approaches could not deal with complex systems in a usable way. Hallegatte and Dumas (2010) are discussing advantages in using soft approaches in adaptation to climate change which also is an example of a complex problematic situation with a lot of unknown and uncertain variables to take in account for decision-makers. Findings from Openshaw and See (1999) are similar to the former researchers according to the applying of soft approaches to river level forecasting.

One of the first known **early warning** mechanisms implemented, and also an example of a biological early warning system, was the use of canaries in coal mining. As canaries often sing, they represented both a visual and audible **early warning system**. Carbon monoxide and methane killed the birds which stopped singing, before affecting miners. "Canary in a mine" has become a well-known phrase, representing a thing or a person that function as an alarm clock for upcoming crisis (BBS-news, 2010).

If we combine "soft" and "early warning system", we got a tool or mechanism that could be very useful when handling uncertainty in complex situations where some kind of warning is needed. **Soft Early Warning Systems**, SEWS, should be a natural part of the work with planning for security in urban regions. Such planning work should include practice and training as well as preparations and test of different scenarios.

Preventive security work (minimizing, limiting, and avoiding undesired occurrences and processes) should use a soft approach such as SEWS as an obvious attitude and a way to "think about" what is happening and upcoming consequences. In such **security SEWS** each individual living in a region acts and function as a networked human sensor (to be compared with the "canary in a mine"). Such security SEWS, could work both in "reality" and when training and preparing for different kind of catastrophes and undesired occurrences and/or processes are necessary.

For every possible occurrence, we must identify "what happened before" and "what triggered the occurrence to happen"? Important factors must be identified and scenarios described. For each occurrence we must identify critical factors such as oxygen is necessary for a skier trapped under an avalanche. Given a certain occurrence, what happens if one vital necessary factor fails? Could it be replaced? How time-critical is it before life-threatening injuries occurred? Identified critical factors or variables, how could they be numbered and priority? Given a certain critical factor – what are the corresponding action/actions? How time-consuming are the actions and could they be numbered and priority as well? Given many types of actions, how could they be combined and coordinated? It is not so critical to take care of a broken leg compared to deliver oxygen to a human being trapped under an avalanche.

How can a security SEWS support both real-life situations and training and preparation situations? We think such security SEWS could be used in several different ways.

Examples of use in real-time situations are:

- Given a certain situation, support for calling and activating of necessary authorities and resources.
- Prediction of undesired occurrences and processes, given that the "living sensors" are aware of the warning signals occurring before the undesired situation occurred.
- Historical data should be stored in the security SEWS in order to be used as a decision support when new similar situations occurs. Both the old data and new data will be compared and used in the new situation.
- Numbering and coordination of actions.

Examples of use in training and preparing situations are:

- As a support for identification and description of undesired situations. This could be used as scenarios when identifying undesired situations in real-time situations.
- Identification and numbering of critical variables as oxygen in the avalanche situation.
- Simulation of outcome depending on numbering of critical variables and how they are being taken care of.
- Production of urbanization plans in flood-prone areas (Hallegatte and Dumas, 2010).

The lists above are merely examples of the potential of security SEWS in undesired and critical situations such as flood, larger traffic accidents, and toxic spills. However, a security SEWS could also be a valuable support in situations when undesired effects of different kinds of planned actions are at hand and the effects should be minimized. This could be time-consuming larger transportation of for example wind turbines – affecting the traffic, larger extensive road works and so on. Accordingly, security SEWS should be a vital support for analyzing, coordination, and decision-support during undesired situations.

4 The Challenge to Soft Early Warning

Even if the goals and visions of a SEWS are clear and indisputable the implementation, however, is far from straightforward. Some of the main obstacles will hence be discussed here.

Equation 1 can be used in order to investigate those difficulties.

$$x = f(y_1, y_2, \ldots y_i) \quad (1)$$

Here the depending variable x stands for any of the critical variables identified above in section 2. The goal of SEWS is to keep those within limits and as stable as possible. The only challenge on this point being that the variable list is open ended, i.e., there may be many critical variables that have not yet been identified.

Coming to the function f, the situation becomes more complicated. In most cases f is unknown or at least not verified. This means that usually we are lacking sufficient knowledge about the mechanism behind potential threats against our living milieu and the critical variables which are conditioning a sustained life. In other words, we are lacking reliable models of the conditions making a sustained life on this planet possible.

Some properties of f, however, are well known. First, the function f is not linear. Hence, a small change in some or one of the independent variables may cause a great change in the dependant one. Further, small successive changes in an independent variable may pass unnoticed and with no obvious effects for a long time. Suddenly, however a limit is passed and the system transits from a stable to an unstable region, i.e. the system becomes chaotic.

A last remarkable property can be explained by Thom's (1977) catastrophe theory. Hence, a small change in an input variable can put the system "over the edge", i.e. causing what Thom calls a "catastrophe". The practical and much significant effect being that the way back to the original system state can be very long. Here an incremental change in one variable will have no effect. It will be necessary with great changes over long time in order to achieve that result.

The great challenge when coming to the independent variables $x_1,....x_i$ is to decide what variables or indicators to observe. As the number of possible variables is practically infinite it will in all cases be necessary to significantly limit the number of observed ones. On this point we think that Boundary Critique according to Ulrich's (1994) Critical Systems Heuristics could be most useful.

5 WEB Security Portal

A good basis for development of a Soft Early Warning System for regional security is the EU funded project Boundless Collaboration for Security. The project is going on from 2010 to 2014 and is a collaboration between Norway and Sweden.

In the GSS project a computer and net based integrated environment for mutual preparation and training for disasters and complex emergency situations will be developed, the Web security portal called netAgora. The netAgora environment will be all comprehensive with a disaster simulator, a scenario editor, and an assessment kit included in its core. It will support cooperation, coordination, training, preparation, and learning on individual, group, and organisational levels. The netAgora will further include support for an exchange of experiences, tools, and models of response to emergence situations within and between nations with a special emphasis on handling the cultural differences that may impede the emergence response. Main components in netAgora are shown in figure 2.

The Virtual Situation Room (VSR) is the interaction surface toward the user. Through this surface (GUI) the user has access to all the other resources of netAgora. VSR may be freely adopted to meet the specific requirements of different user categories. There is no theoretical limit to the number of users that may simultaneously be connected to netAgora.

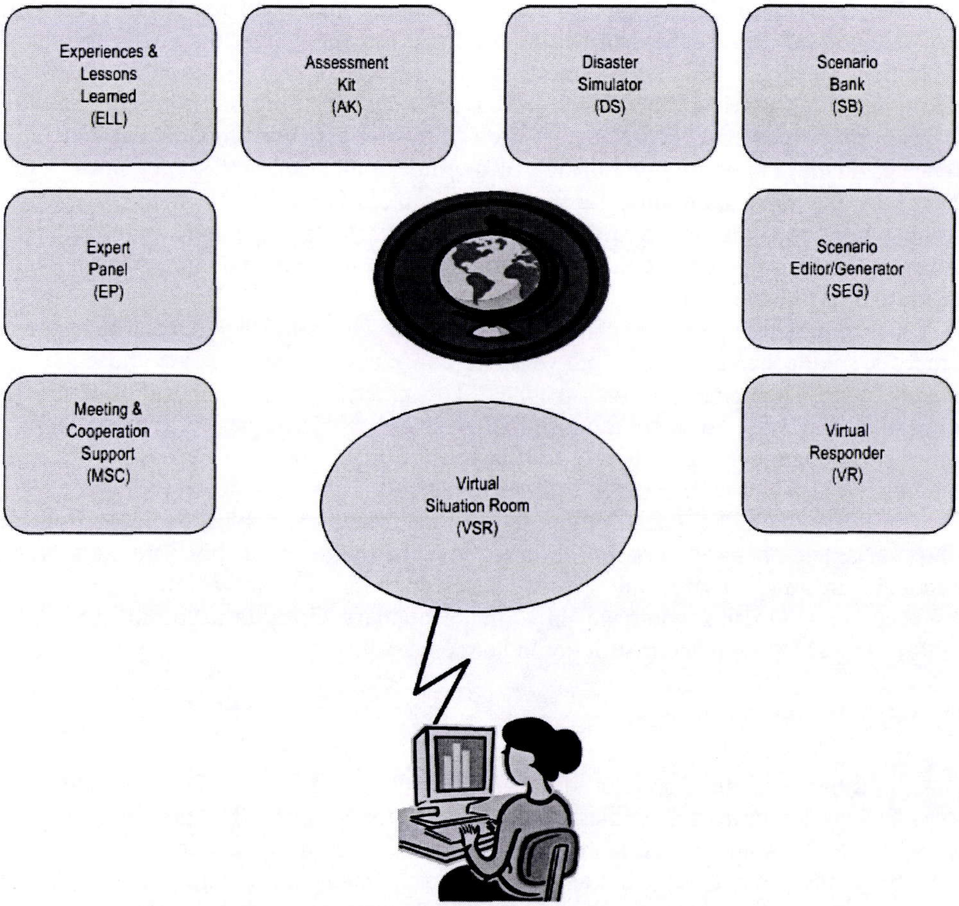

Figure 2: The netAgora environment.

The Virtual Responder (VR) is a system component, which simulate the behaviour of other responders. From the point of view of the player there is no difference between a virtual actor and a real actor. This means that in netAgora there are always several actors, real or virtual ones, which you as user have to coordinate and communicate with.

The Disaster Simulator (DS) is the core of netAgora. DS can calculate (simulate) the dynamic evolution of a set of crucial disaster variables and react on different user decisions and actions. The ability to handle geographical or spatial information (GIS) is a crucial faculty of the Disaster simulator. The user can select a scenario, i.e. disaster, from the Scenario Bank (SB) or set up a new one, or change an existing one, with help of the Scenario Editor/Generator (SEG). The Assessment Kit (AK) helps the user to evaluate the decisions and actions taken during the playing of a scenario.

Experiences and Lessons Learned (ELL), at last, is a knowledge bank with tested and verified disaster and crisis knowledge. Via the Meeting and Cooperation Support (MSC) the user can interact and discuss with other disaster responders and via the Expert Panel (EP) she or he can put disaster related questions to a group of disaster experts and disaster researchers.

In short, the main objective of netAgora is to provide, in one place, all the necessary resources and functions for best possible preparation, training, and learning in relation to crisis and complex emergency situations.

6 CONCLUSIONS

The outcome of an emergency situation is to a large extent due to the awareness and preparations done before the crisis or disaster outbreak. Awareness requires some sort of warning mechanism making it possible for the people in the region to become aware and to prepare themselves for potential emergency situations. For situations where the variables that indicate a disaster are known and measurable it is possible to set up some sort of early warning system. If, however, the uncertainty is considerable and the situation complex there is a need for a Soft Early Warning System.

The netAgora Web Security Portal can be a good help to increase the potential for Soft Early Warning thinking for the users of the system. Still the implementation of a full SEWS needs further development.

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