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Comments on “Extreme Event Decision Making”

I agree with most of what was said in the background paper. Partitioning an *extreme event evolution* in pre-event, event and post-event phases will be important when in sorting out the problems. If a correct model of the relevant systems is available and adequately used most extreme events can be predicted. However, they need not only be predicted. Crucial decisions have to be made at different points in time to eliminate, avoid or change the extreme event evolution so that its negative consequences are not extreme anymore.

Pre - extreme event phase

In the pre-event phase the detection of early warnings, important parameter changes and precursors are necessary to initiate the decision problem structuring process. In this phase *Decision detection research* is needed. What are the factors that make people aware of a possible decision problem? What makes people attend to an early warning? How sensitive are people to slow changes of important system parameters (with different magnitudes of random errors)? What role does the mental representation of the system play in this process? What roles do the values of an observer play in detection and interpretations of early warnings indicating that a decision will have to be taken soon?

It is not enough that someone perceives that a system is moving towards an extreme state for adequate decision making. It is also necessary that the person finds that it is possible and worthwhile to have a say in the evolution through calling attention to and affecting decisions and implementations of these decisions. What is the relationship between how a system is perceived (in terms of e.g., possible control, ease of control, effectiveness of control) and the detection of early warnings and decision problems?

While we know relatively little about decision detection processes, we know much more about decision processes through *Decision research*. Here, decision process models can be helpful because they can be used to model decision making in parallel with dynamic system changes.

It is of no use to make decisions if they are not implemented. *Decision implementation research* is therefore an area in need of attention as part of extreme event decision making. Interdisciplinary research including *Social psychology* and decision research would be needed.

Risk perception research is very important and there is a lot of knowledge in the area. Implementation research integrated with risk perception research will be important for understanding extreme event decision making.

Extreme event phase

This phase, in which hazard or accident management takes place has been documented empirically in several case studies. There is also fundamental research in problem solving, judgment and decision making relevant for the applied scene. (To exemplify, “Einstellung” , locking in on one approach of solving a problem when another approach is needed in a new context.)

Decision making under *Time pressure and stress* has been studied in the laboratory and real-life illustrations are available. This is obviously a highly relevant area for the extreme event decision making theme.

Post- extreme event phase

Many of the decisions needed in the post-event phase correspond to those in the other phases. However, there is one difference in that after the event one may ask: what was learned from the event evolution? How was it learned and how are future decisions affected?

I have worked in the areas of cognitive psychology, decision making, risk analysis and risk perception. Human factors work with relevance for the nuclear power industry that I have done brings my attention to the use of Probabilistic Risk Analysis (PRA) as a tool for modelling complex systems with a potential for extreme events. The PRA modelling is performed to serve as an input for safety related decisions.

The extreme event decision project also links to a project that I managed around 1980 called “The vulnerable society”. This was a future research project and in such projects the researchers often use scenarios. The scenarios are not primarily constructed to predict the future but, for example, to create extreme evolutions that can draw our attention to parameters that need careful treatment in societal decision processes.