2nd IFED Forum Lake Louise -- April 2006

Conclusions of the Forum

The theme of the 2nd IFED Forum "decision making involving spatially distributed systems" attracted 30 technical papers in various fields of engineering. These papers were grouped into various sub-themes:

- Spatial problem formulations in engineering decision making
- Structuring and analyzing complex systems
- Optimization involving spatially distributed systems
- Spatial aspects of hazard modeling (earthquakes, floods, hurricanes, …)
- Probabilistic modeling of spatially varying properties of solids, soils, …
- Spatial modeling of the deterioration of structures
- Models for assets integrity management
- Other topics in decision making and risk analysis

As per IFED tradition, the specific objectives of the themed forum were to outline current challenges related to spatially distributed systems, to discuss and to present possible solutions and applications, and to develop directions for future research in this specific field.

The second IFED event turned out to be an exciting forum. It was felt that it was very beneficial to have a narrow but well-defined theme with all contributors guided by the objective to arrive at some consensus about current and future developments in this field. The use of various new mathematical approaches and capabilities have allowed practitioners to attempt solving problems that could not be solved before in system reliability and decision making. The following is a brief summary of comments and conclusions arising from the forum.

The modeling of processes in space and time still faces many challenges. Dependencies and correlations are seen to be very important. But, generally speaking, the assumptions regarding dependencies are sometimes not very well stated. Research must go into validating such assumptions. Many papers mention a general lack of data available to validate models, but there may also be a lack of suitable techniques. In practice, a lot of 'single-point' analysis is still being used, involving the difficult trade-off of 'space for time". The lack of input parameters is often perceived as a true limitation. It is essential to really make an effort to pursue data to validate dependencies. Often we as a community fail in pursuing such data. We tend to passively use what we have and to be content with this situation.

Models should be such that they allow the building up of knowledge as well as information updating in space and time. Models must also allow for the inclusion of options in decision making. This has applications in repair, maintenance and inspection strategies involving spatially distributed systems. Real-time models in dealing with natural hazards and/or large technical systems must be pursued vigorously in the future.

Often the question arises: what is the marginal gain involved in adding and modeling dependencies? To what extent is model complexity justified? For instance in a 20-variable model of a soil, how robust/sensitive is the model to the assumptions needed for the 200 or so correlation coefficients. Also, cross-dependencies and cross-correlations are often not included. Another issue is correlation in the extremes and in the extreme events: how does it differ from dependencies in the central parts, and is there a useable relation between these?

The effect of dependencies on decision making is viewed to be extremely strong. Focus should be on the decision(s) that need to be made in a top-down approach rather than the traditional bottom-up approach. In the area of system modeling, spatial variability is neglected or omitted. System definition and identification of the scale of the phenomena governing the system are extremely important. System consequences in time and space (often simplified to fixed time, space) are also an important aspect of system modeling.

Finally, it is noted that as modelers we have many biases and interpretations different from those of the (final) decision makers. We can make ourselves more successful by bringing in these decision makers at an early stage. Also including lay people from the start is seen to be very beneficial.