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Organizational vulnerability of a crisis organization in the context of an asteroid impact: methodology and tools to identify its weak points and promote its resilience

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The feedback experience of some atypical and/or extreme events, like Fukushima or Katrina, shows how the Crisis Management Organization, represented by the Crisis Center, can be affected by these events. Analyzing these extreme events, which also include the case of an asteroid impact, one major conclusion is that public administrations and private industries do not define crisis plans for such hazardous situations but for “normal” ones like hurricanes, floods, toxic release, explosions etc. These emergency plans have similarities between them in terms of goals and organizational structures. In the case of detection and prediction of an asteroid impact, Crisis Center will be surely unprepared and the situation will result in a catastrophe. In order to face an extreme event like a small body impact, it is necessary to assess these different strategies of crisis organizations.

A Crisis Center involves different actors who find information, means, competences and procedures in order to reach their own objectives like the information deliverance to the other members of the Crisis Center and to the external operators, the deployment of means to evacuate the population, the management of life support networks etc.

Usually, Crisis Management Plans and the Crisis Centers organization are tested with the preparation of training sessions that involve all the stakeholders like the Civil Protection, the Municipalities, the Prefecture, the Army etc.

The improvements of these plans are based on the feedback experience from real or simulated events. However, the study of feedback experience according to real crisis shows that these plans do not guarantee an optimal performance of Crisis Centers and crisis management processes. Crisis Centers may become particularly weak and unable to fulfill their missions according to their own points of vulnerability. This fact underlines the importance of the implementation of a comprehensive approach for decision-making based on the assessment of the organizational vulnerability of the Crisis Center.

Because a Crisis Center can be considered as a complex system, due to the amount of interactions between the operators and the uncertainty of some decisions, the proposed methodology is primarily based on systems thinking and, more precisely, on System Dynamics. Our methodology is based on six steps:

1. The first step is based on the modeling of the organizational structure of the Crisis Center in order to explore its complexity. The Unified Modeling Language is used to produce the theoretical model of the organizational structure of the Crisis Center. This model describes the functions and resources of the Crisis Center according to its definition given by the Crisis Management Plan. It represents an approach particularly suited to understand the behavior of a system.
2. The second step is devoted to the modeling of the real organization of the Crisis Center: in this case, it is essential to compare the theoretical and real organizations in order to

identify the potential differences and to analyze the reasons of these differences. This step carries often many lessons about the organization and its operators and it gives information to identify the potential organizational failures.

3. The third step aims to identify the performance indicators of the Crisis Center: these performance indicators can be qualitative, semi-quantitative or quantitative. They give a synthetic representation of the state of the organization at a given period. For example, the amount and availability of the means for a given event, the availability of the operators, the time of mobilization, the quality of information etc. can be defined as performance indicators.
4. The fourth step consists in the implementation of the organizational structure and its performance indicators into a Multi Agent System (MAS) in order to simulate the behavior of the Crisis Center. This kind of software gives a dynamic approach to understand the behavior of a Crisis Center and can be used to support the decision makers to define or modify an organizational structure, to support training formations according to specific hazardous events (here, an asteroid impact) and to investigate the organizational performance of a Crisis Center after the management of a real event or after training session.
5. The results of the simulation are implemented into a scorecard: they show the causal relations between the performance indicators between them and between the Crisis Centers elements (i.e. sub-units). The analysis of the results gives information on the potential failures and their transmission to the elements of the Crisis Center. They help the decision maker to identify the weak points of its organization.
6. The last step consists in implementing a risk analysis with all the results of the proposed methodology in order to formalize them into a comprehensive frame dedicated to the decision makers and the other stakeholders in order to promote an organizational learning. Preliminary Risk Analysis and Bow-Tie Analysis can be employed to deepen the causes and consequences of the identified organizational failures.

This analysis will propose recommendations to the studied organization for improving the organizational structure of the crisis. This methodology is a decision support toolbox that can be used to help the managerial decisions and / or guide decision-making processes in organized systems.

A case of application of the methodology is given in this paper and is related to the Crisis Management of a probable impact of an asteroid in a dense urbanized area (more than one million inhabitants), such as what may happen in the case of the asteroid 2011 AG5 if its collision course to the Earth is confirmed and plans to prevent the impact fails (or are not decided). This example shows the significant contribution of the implementation of a methodology to study and assess the organizational performance of a Crisis Center. It also underlines the major importance of data exchanges between the decision makers.

Keywords : Crisis Center; Organizational vulnerability; Risk Analysis; System Dynamics; Crisis Management.