

## ICDSST 2016 on Decision Support Systems Addressing Sustainability & Societal Challenges

### SnowBall DSS: an ensemble Multi-Criteria Decision Support System encompassing cascading effects for disaster management

**Enrico Palumbo, Michele Osella, Giuseppe Rizzo, Enrico Ferro**

Istituto Superiore Mario Boella

Via Paolo Borsellino 61, Turin 10138, Italy

palumbo@ismb.it, osella@ismb.it, giuseppe.rizzo@ismb.it, enrico.ferro@ismb.it

**Giulio Zuccaro, Mattia Leone, Daniela De Gregorio**

Università di Napoli Federico II, LUPT-PLINIVS Study Centre

Via Toledo 402, Naples 80134, Italy

zuccaro@unina.it, mattia.leone@unina.it, daniela.degregorio@unina.it

#### ABSTRACT

The Fukushima Dai-ichi disaster has shown the importance of evaluating cascading effects in disaster management, as the impact of a triggering hazard may generate different sequences of events (event trees) that result in physical, social or economic disruption. SnowBall is a European research project<sup>1</sup> that aims at increasing the preparedness of the European Union to amplifying hazards in a crisis through foresight and decision-support tools. The SnowBall theoretical model proposes to assess the possible event trees generated by a triggering hazard in accordance with the conditional probability between two events. The probabilities are deduced from an *ad hoc* database [1] and literature review [2, 3, 4, 5], at global scale, and customization through experts judgement (elicitation), at local scale [6]. The impact assessment of a single chain of cascading events is treated as a typical 'scenario analysis', considering the cumulative damage on the elements exposed and their distribution on the territory [7]. A decision algorithm works on top of the event tree model and damage simulations on coupled grids and it is able to support the decision maker (DM) in comparing a set of mitigation strategies on the basis of their expected impacts and his/her priorities. The decision algorithm is based on two Multi-Criteria Decision Making algorithms [8], ELECTRE III and ELECTRE TRI (ELimination Et Choix Traduisant la Réalité) [9]. A single mitigation strategy is split into a set of different mitigation strategies, according to its position in the event chain. The algorithms then run without any ad-hoc modifications, producing a ranking and a class assignment among mitigation strategies. This approach supports the DM also in the choice of the best timing for the intervention, a crucial factor in a context where cascading effects are taken into account. The algorithm is based on an ensemble approach [10], which combines decisions over an array of possible impact scenarios, instead of only relying on the average impact scenario. In this way, the algorithm conveys the uncertainty about the effectiveness of mitigation strategies, through a set of ranking and class distributions. The results of the algorithm and of the models are stored in a common database and displayed in a dashboard, which enables the interaction with the user.

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**Keywords:** Decision Support System, Multi-Criteria Decision Making, Disaster Management, Cascading effects, Cumulative damage, SnowBall project, Ensemble methods

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