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contents

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Cover illustration: Daniel Gomer

Quake relief and response p14

Italian Civil Protection Directorate

Fire and rescue in Tehran p20

Tehran Fire Department

Civil response in conflict p58

Syria Civil Defence

Attacks on medical transport p70

El Salvador Red Cross

comment

The global picture has darkened

[illegible] Global Terrorism Index GTI [illegible]

Managing cascading effects

Olivia Soave and **Martin de Maupeou** describe a European project that has, for the last three years, been developing decision support tools to help crisis managers address cascading effects in a crisis

In a world of increasing interdependence, everything works in relation to something else. In such a context, awareness of dependencies that may affect our daily activity should something go wrong, is key to preventing and mitigating the chain of interactions that can amplify the negative effects of an incident. The 2011 Fukushima Daiichi nuclear disaster and the 2010 Eyjafjallajökull volcanic eruption in Iceland are among recent events that have contributed towards placing cascading effects on the agenda of the crisis management and research communities.

The Preparing for the Domino effect in Crisis Situations (Predict) project was launched in April 2014 to raise awareness on the phenomenon of cascading effects and to explore innovative solutions to address it. Since then, the members of the consortium have been working to improve understanding of the nature of cascading effects and to put forward new solutions to assess, prevent and manage their impact on the functioning of critical infrastructures.

A suite of decision support, foresight, prediction, and communication tools are under development. By mid-2017, the project will be able to deliver an innovative software solution, comprehensively combining this set of methodologies and tools, to support decision-making in crisis situations involving cascading effects.

Representing six European countries, the Predict consortium is led by The French Alternative Energies and Atomic Energy Commission (CEA), and brings together research and technology organisations, small and medium sized enterprises, major industrial market players and crisis management organisations as end users in the project.

A common picture of a crisis affecting multiple areas is needed to manage the unexpected

While international glossaries such as the UNISDR Terminology propose no specific definition of cascading effects, they can be defined as: "Failure(s) occurring when a disruption in one infrastructure causes the failure of a component in a second infrastructure, which subsequently causes a disruption in the second infrastructure" (*Rinaldi et al, 2001*). The impact of cascading effects on critical infrastructure is defined by the European Council Directive 2008/114/EC as: "An asset, system or part thereof located in member states which is essential for the maintenance of vital societal functions, health, safety, security, economic or social wellbeing of people, and the disruption or destruction of which would have a significant impact in a member state as a result of the failure to maintain those functions."

Extensive interactions with crisis management practitioners throughout the project have shown that in Europe some countries have been working on the issue of cascading effects and trying to develop processes and solutions for several years. Others are just starting this work and still need to acquire the relevant knowledge, training and tools for the management of cascading effects and to include them in their practice and plans. Responding to the cascading effect challenge, they need to have a common picture of a crisis affecting multiple sectors, allocate resources adequately, and eventually be able to manage the unexpected.

To meet these needs, the Predict partners are developing the integrated Predict tool suite, called the iPDT, a software solution that combines different decision support and information management tools with complementary functionalities:

- Foresight and prediction tools that model and simulate cascading effects to allow users to train for possible crisis scenarios, foresee possible domino effects and predict potential consequences;
- Decision support tools that assess the consequences of all potential actions on different sectors (vital needs, infrastructure, livelihood etc) to allow risk-based decision-making process by users; and
- Information exchange tools which rely on the dynamic process integration framework (DPIF) to support the exchange of information between the public and private sectors during a crisis.

The essential added value of the Predict solution is to put together these tools to provide crisis management practitioners with services focusing specifically on the management of cascading effects.

To orient the research and development work, Predict has developed as an end user centric project. By sharing where they stand on the issue of cascading effects and their operational needs in this regard, end users contribute to the definition of the project's requirements and validate its results. This continuous interaction is made through involving key end users in the consortium as partners and through regular workshops and exercises. These events aim to present the research undertaken in the project, so as to gather feedback from participating experts on the developed methodologies and tools in order to improve them.

The project's target end users are experts in charge of situational awareness and impact assessments, and decision-makers sitting in crisis rooms. These are drawn from the management staff of national and regional crisis management organisations, fire and rescue services, critical infrastructure operators, civil protection agencies and NGOs, such as the Red Cross. So far more than 80 people from over 40 different organisations from 20 European countries, as well as from European institutions and international organisations, have taken part in Predict events.

The development of the iPDT software will run until January 2017 and the major challenges for the consortium are to achieve both the technical integration of the tools composing the iPDT, and to ensure that this work will lead to a solution that is eventually applicable and useful to end users. Efforts are also ongoing to make the iPDT interoperable with existing systems used by national crisis management authorities, for example the Dutch crisis management system, LCMS.

Planned activities

In June 2016, live demonstrations were organised at a workshop in Paris and end users had the opportunity to play with some of the tools during hands-on sessions.

In parallel with the technical development activities, a series of three tabletop and full-scale exercises tested the latest versions of the Predict tools in the context of three realistic cascading effects crisis scenarios. These were: Flooding in the Netherlands; derailment of a freight train transporting chemicals at the Belgian-German border; and a maritime accident close to Helsinki Harbour that engendered a pollution crisis.

An important aspect of the project is its Europe-wide dimension, with one of its greatest added values being the exchange of best practice between European crisis management experts and researchers.

As crises have increasing crossborder effects, transborder co-ordination and training are key and will lead to better management of cascading effects. To this end, several activities have been carried out to explore synergies with related European research projects, to share results and maintain effective collaboration between different stakeholders. These efforts also aim to avoid redundancies, improve the quality of expected results and boost the overall impact of these projects. Representatives from related European projects have, therefore, participated in Predict activities, and members of the consortium attended several events, in particular the Domino II conference organised by the Dutch First Responder platform of IFV in September 2016 in the Netherlands.

For the Predict partners, the final milestones will take place in the first quarter of 2017 with a new workshop where end users will test the final version of the solution, and the final conference where the overall findings will be presented.

This conference will be the opportunity to engage with an enlarged audience of representatives from the crisis management, policy and research communities and will contribute to the wide visibility and impact of the project's results. CRJ

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