CascEff

Modelling of dependencies and cascading effects for emergency management in crisis situations

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CascEff in brief

- Instrument: FP7 – Collaborative project (SEC-2013.4.1-2)
- Start date: 1 April 2014
- Project web site: www.casceff.eu

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Main purpose of CascEff

CascEff will
• improve our understanding of cascading effects in crisis situations
Objective 1:

- Better understanding of the cascading effect in crisis situations by the identification of
  - initiators
  - dependencies
  - key decision points
Objective 2:

- Develop an Incident Evolution Methodology (IEM) and Incident Evolution Tool (IET) for predicting past, present and future crisis evolution leading to cascading effects.
Objective 3:

- Identification of human activities in the crisis
Objective 4:

- Improved incident management for present and future threats
Definitions: Cascading Effects

- Cascading effects are the impacts of an initiating event where
  - 1. System dependencies lead to impacts propagating from one system to another system, and;
  - 2. The combined impacts of the propagated event are of greater consequences than the root impacts, and;
  - 3. Multiple stakeholders and/or responders are involved

(for Reniers, G. and Cozzani V., 2013)

For more definitions see: D1.6: CascEff Glossary and Definitions
Main parts of the work (1)

- Studies and categorization of incidents with cascading effects.
- Decision making and key decision points in relation to incident management
- Human behaviour, communication and use of media during incidents.
- Existing tools and use of such tools today
- User requirements of a new IET
Main parts of the work (2)

- Development of the CascEff Incident Evolution Methodology (IEM) and Incident Evolution Tool (IET)
- Validation of the CascEff IEM
- Incident management: practices today, challenges and suggested improvements
- Improved incident management
Studies and categorization of incident with cascading effects

- A systematic and structured method
- describing and analysing past incidents involving cascading effects
- Description of propagations of effects between distinctly different systems
- Structured information from 40 past incidents
  - 16 cases studied in detail
  - 22 system categories

For more definitions see: D2.2: Review of previous incidents with cascading effects
Originating and dependent systems

1. Power supply
2. Telecommunication
3. Water supply
4. Sewage
5. Oil and gas
6. District heating
7. Health care
8. Education
9. Road transportation
10. Rail transportation
11. Air transportation
12. Sea transportation
13. Agriculture
14. Business & Industry
15. Media
16. Financial
17. Governmental
18. Emergency response
19. Public
20. Environment
21. Political
22. Food supply
Human activities and characteristics of incident with cascading effects

- Some characteristics similar to large-scale emergencies:
  - A certain level of complexity
  - Time pressure
  - Uncertainty

- Whether considered complex, stressful or difficult to comprehend:
  - Experience of the first responder
  - Ability to make sense of incoming information
    - Dependent on the support given
Incident management and decision making (1)

- Decision making is a dynamic process that is not necessarily linear.

- The complexity of an emergency is largely dependent on the design of responding organizations and their procedures, support tools, training and other issues of management.

- Achieving situational awareness could be more of a challenge during cascading events because effects may carry over into less familiar domains.
Incident management and decision making (2)

- Many groups of actors such as responders, NGOs, political actors and the public.
- Distributed both organizationally and geographically, placing certain demands on collaboration and communication.
- Decision making is a collaborative effort engaging many groups with different views on facts, decisions and actions.
- Need for common ground and shared mental models for decision making.
Incident management and decision making (3)

- It is the total ability of the constellation of actors that determines how successful incident management can be.

- Language, common operating procedures and communication protocols are potential issues.

- Countries often have procedures for escalating response, but
  - preconditions for escalation are often associated with the emergency being “large-scale”.
  - Cascading effects may also result from emergencies smaller in scale.
IET in relation to decision making

- Find key decision points
  - opportunities to affect the links between the originating system and the dependent system
- Cascading effects means spread to other system
  - involvement of new categories of professionals
- To limit consequences, most effective means could be:
  - appropriate organizations and structures
  - technologies and procedures for cross-organizational or cross-border information-sharing
- Strategic decisions need to be taken well in advance!
Communication and media (1)

- Crisis communication needs to be prepared to explain the rationale behind some measures, especially when measures may appear to be uncalled for.

- Print and broadcast media remain the most trusted and authoritative sources of information during crisis situations.

- The role of the news media has shifted from only focusing on its own production of news ("gate-keeping") to also publicizing and sharing relevant news content ("gatewatching").
Communication and media (2)

- Social media can assist in building resilience against future incidents by facilitating multi-directional information flows.
How to model cascading effects?

1. Detailed models of many interconnected systems that use advanced mathematics

2. Models that focus on a specific hazard to model the spread, vulnerabilities and consequences with high resolution.

3. Analyse relevant systems and related vulnerabilities on a higher level to find the vulnerabilities for different types of hazards and then determine dependencies between different systems.
Development of the IET

- Web based
- Developed in stages
- External Expert Advisory Board (EEAB)
- Use cases based on interviews, surveys, etc.
- National Focus groups
- Validation sessions
Requirements from end-users (1)

- The tool (IET) should be flexible, scalable, and useful for everyday purposes
- The IET should not just be an additional tool.
- The pre-incident phase, in terms of planning and preparation, was emphasized
- To focus on the incident as a series of originators and dependencies as well as the consequences of the cascading effects
Requirements from end-users (2)

- Incident management is about information management.

- The IET should advise the user on possible scenarios, allow dynamic description and predict cause-effect chains.

- The tool should assess vulnerability from a system perspective, model and illustrate the linkages between infrastructures.

- The IET should also help assessing the severity and importance of observed effects, help predicting risk in terms of secondary and tertiary effects.
Methodology approach (Set-up)

1. Identification of area and system potentially involved
   - Characteristics of systems

2. Identification of (potential) dependencies

3. Determination of real/remaining dependencies
   - Vulnerabilities
   - Endurance
   - Possible impact
   - Produced (outgoing) effects
Case

- Add systems
- Add functional dependencies
- Define Initiating event
Methodology approach (Results)

4. Temporal aspects
   - Propagation times
   - Buffer times

5. Impacts (per system and total)
Issues with modelling of cascading effects

- Much data is needed and it needs to be available
- Some data might be made available in an acute (crisis) situation, but not in a normal situation (for planning/preparation)
- Little time in the operation phase to collect information
- Situation and information might change in time
- Multi actor situation, where different actors have their responsibilities and their information, not always with a clear structure for communication, collaboration, decision making, information sharing, etc.
Possibilities (1)

- The IEM/IET can be useful even in the response phase if the relevant data is made available in advance.
- The IEM can be useful for dependency analysis, which often is an important part of compulsory risk and vulnerability studies.
Possibilities (2)

- The IET can support collecting and transfer of vulnerability and endurance properties of different systems.
- The IET could help to make information on cascading effects more objective, and support the alignment of the vision of different partners with different goals, different experience, different skills, etc.
Conclusions

- Relevant data not always available, but
- With relevant data, the IEM/IET can be useful in all phases of incident management
- The CascEff IET should be flexible, scalable and useful for every-day purposes
- The IEM can be useful for dependency analysis and for the collecting of relevant information
Contact CascEff

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Help us with the future development and implementation by answering a Market analysis!