LODE
Loss Data Enhancement for DRR and CCA management
The context


It is addressing one of the priority under the call, that is enhancement of Post-disaster loss and damage assessment to support risk mitigation measures and climate change adaptation. Being an UPCMP it is a practice oriented project aiming at achieving tangible results for civil protection authorities and for agencies in charge of risk mitigation.
Lode’s Partners and countries

1. Politecnico di Milano - POLIMI
2. Catalunya Regional Civil Protection - INT
3. Finnish Meteorological Institute - FMI
4. Centro Euro-Mediterraneo sui Cambiamenti Climatici - CMCC
5. National Scientific Research Council - CNRS
6. Umbria Regional Civil Protection - Regione Umbria
7. Earthquake Planning and Protection Organization - OASP
8. University of Porto - UPORTO
9. Forestry Institute - INZASUM
10. Agencia Estatal Consejo Superior de Investigaciones Científicas - CSIC
The contribution of some of us to the Technical Group on Loss Data led by the JRC is another important seed of this project. The discussions and the reports that have been produced insofar provide us with the notion of the state of art and what are the key gaps that still need to be addressed with a practical orientation towards needs and obligations of civil protection and authorities in charge of DRR and CCA.
Some results:
- Loss databases initiated and developed in some countries at least for some hazards
- We have developed in the context of Idea a methodological path from damage investigation → identification of key elements/factors to be collected and addressed for different uses → the development of a database (also in the context of a service carried out for the Catalunya Civil Protection)
The seeds of Lode

And we have started querying the database to use results for different types of applications.
Why loss data are important?

Following the First Report of the JRC Group: De Groeve et al., 2013 we understand that damage and loss data are important for a variety of purposes. We want to maximise their use to justify the effort in their collection but even more in their coordination.
Why loss data are important?

Enhanced post-disaster loss and damage data management

- Forensic investigation of disasters
- Information and data on items and types of damages that are insufficiently known
- Enhanced accounting capability

Enhanced accounting capability

- To support knowledge exchange and sharing with legislators and courts
- To develop incident analysis with the aim of learning lessons
- To assess (also through C/B) the effectiveness of risk mitigation measures

Develop statistically relevant datasets

- Improve understanding of higher order damage
- Compare scenario modelling results with the scenario that has occurred
- Develop more evidence based C/B analyses for DRR and CCA

To verify the impact of climate change on disasters’ trend

- To program necessary resources for compensation
- To tailor insurance programs and policies
- To apply the Sendai indicators

To support more resilient recovery and reconstruction

- Improve risk assessment models and modelling capacity
- To support more resilient recovery and reconstruction

Information and data on items and types of damages that are insufficiently known

- Forensic investigation of disasters
How different purposes and needs can be pursued

We need a damage data management that considers:
- Multiple sectors
- At relevant spatial scales
- At relevant temporal scales
A variety of damage that are important for prevention

Damage and loss due to natural disasters

- Direct tangible damage
  - To territorial and economic systems
    - Buildings
    - Artefacts
    - Assets
    - Facilities
  - To territorial and economic systems
    - People
    - Monuments and historic sites
    - Environmental assets

- Direct intangible damage

- Indirect tangible damage and loss
  - To territorial systems
    - Damage to lifelines
    - Malfunction of strategic services
    - Production loss (affected firms)
    - Backward/forward linkages, i.e. suppliers & customers

- Indirect intangible damage and loss
  - To territorial and economic systems
    - Psychological distress and trauma
    - Abandonment of cultural assets
    - Abandonment of landscapes

Gaps

- Correspondence between physical damage description and monetary values
- Need to recour to modelling for damage that cannot be fully surveyed
- Large effort of data coordination between different sectors
**Design**
- Population: 
  - Direct physical damage;
  - Outages

**Implementation**
- Pilot: Indirect damage
- Dem: All consolidated parts
- Stakeholders from regional, national, EU and international level

**Population**
- Pilot: Interaction with existent systems
- Dem: All consolidated parts

**Testing**
- Dem: All consolidated parts

**SHOWCASES**
- By scale:
  - Local
  - Regional
  - National
  - Cross border

- By type of event:
  - Floods
  - Earthquakes
  - Snow storms
  - Convective storms

- By sector:
  - All sectors
  - Specific focus

**STAKEHOLDERS**
- Public administrators
- Insurers
- Lifelines services providers
- Social platform managers
- Researchers
- Stakeholders partners
- Stakeholders from showcases areas
- Stakeholders from regional, national, EU and international level

**USES**
- Accounting
- Risk modelling
- Needs assessment
- Prioritization resources allocation
- Forensic
- C/B for reconstruction plans

**INFORMATION SYSTEM**
- Design: Direct physical damage; outages
- Pilot: Indirect damage
- Conceptualization: People, lifelines, buildings
- Pilot: Economic activities, cultural heritage

**Expression/verification of uses**
- Set of predefined and definable queries

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Stakeholders’ network

Every partner has to develop, establish and maintain a network of stakeholders that are interested in the project, pertinent to the tasks and with whom we can have meetings and invite them to the two workshops of the project.

At least 5, from different levels of government, different sectors, so that at the end we cover the map of aspects, sectors, responsibilities. This has to be done in a much more coherent and systematic way than was the case with the Idea project.
Every partner is responsible for the case studies indicated in the DOA. So:

- It make sense that at least one, but perhaps more than one stakeholders of the network are persons connected to the case studies.
- In this regard we need to consider again the case studies carefully, immediately verify if the stakeholders with whom we thought to work are still available.
- Otherwise we should consider alternative case studies, carefully considering the availability of data for the population of the database and the applications.

| ITALY | Umbria, Norcia | Earthquake | 30 Oct. 2016 | Local Regional | High impact for a moderate magnitude earthquake. Affected in a large region; an opportunity to collect post disaster data, investigate the damage to both single assets and systems; an opportunity to provide guidelines for reconstruction and repair according to the Sendai Indicators. The results can be applied in several medium sized cities with the same characteristics in Italy, France, and Spain. | No | Risk assessment; forensic; Lifelines and CI sector |
Case studies and applications

<table>
<thead>
<tr>
<th>Location</th>
<th>Event Description</th>
<th>Date</th>
<th>Region</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Umbria, Norcia</td>
<td>Earthquake</td>
<td>Oct. 2016</td>
<td>30</td>
<td>Risk assessment; forensic; Lifelines</td>
</tr>
<tr>
<td>Central Italy</td>
<td>Snowstorms</td>
<td>Jan. 2017</td>
<td>Local</td>
<td>Forensic; indirect damages; CI sector</td>
</tr>
<tr>
<td>Northern Italy</td>
<td>Series of Floods, caused by intense precipitation, levee break</td>
<td>2014-2016</td>
<td>Regional</td>
<td>Risk modelling; forensic; use of high resolution exposure; data, remote sensing; agricultural sector</td>
</tr>
</tbody>
</table>
Case studies and applications

Use of the case studies:

a. Using the data to **populate the database**. Structuring and managing the data is the responsibility of each partner who need to devote effort for this task

a. The case studies will be also the field for the **different types of applications** that have been foreseen:

- Accounting (responding Sendai and use for National Risk Assessment)
- Improving risk modelling: «validation» and identification of criticalities in existing models (for this we need pre-event risk assessments available or possible)
- Forensic investigation: as Forin/Perc/Accidents but also I propose forensic as such
### Case studies and applications

#### Accounting (responding Sendai and use for National Risk Assessment)

<table>
<thead>
<tr>
<th>Sendai Indicators</th>
<th>Vall d’Aran case</th>
<th>Unit measure</th>
<th>Umbria case (2012)</th>
<th>Unit measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target A: Substantially reduce global disaster mortality by 2030, aiming to lower average</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| A-1 | Number of deaths and missing persons attributed to disasters, per 100,000 population.  
(This indicator should be computed based on indicators A-2, A-3 and population figures) | 0 | 0 |
| A-2 | Number of deaths attributed to disasters, per 100,000 population. | | |
| A-3 | Number of missing persons attributed to disasters, per 100,000 population. | | |
| Target B: Substantially reduce the number of affected people globally by 2030, aiming to lower the average global figure per 100,000 between 2020-2030 compared to 2005-2015  |
| B-1 | Number of directly affected people attributed to disasters, per 100,000 population.  
(This indicator should be computed based on indicators B-2 to B-6 and population figures.) | 323* number/time | 300* number/time |
| B-2 | Number of injured or ill people attributed to disasters, per 100,000 population. | | |
| B-3 | Number of people whose damaged dwellings were attributed to disasters. | 10.273.400 | 12.950.000 |
| B-4 | Number of people whose destroyed dwellings were attributed to disasters. | 10.650.000 | 7420400* (28 M) |
| B-5 | Number of people whose livelihoods were disrupted or destroyed, attributed to disasters. | 50.939.341 | 50.030.341 |
| Target C: Reduce direct disaster economic loss in relation to global gross domestic product (GDP) by 2030  |
| C-1 | Direct economic loss due to hazardous events in relation to global gross domestic product.  
(This indicator should be computed based on indicators C-2 to C-6 and GDP figures). | 10.273.400 | Euro |
| C-2 | Direct agricultural loss attributed to disasters. | 10.650.000 | Euro |
| C-3 | Direct economic loss to all other damaged or destroyed productive assets attributed to disasters. | 4.200.000 | Euro |
| C-4 | Direct economic loss in the housing sector attributed to disasters. | 50.939.341 | Euro |
| C-5 | Direct economic loss resulting from damaged or destroyed critical infrastructure attributed to disasters. | 0 | 600.000 |
| C-6 | Direct economic loss to cultural heritage damaged or destroyed attributed to disasters. | 0 | 600.000 |
### Case studies and applications

**Accounting (responding Sendai and use for National Risk Assessment)**

<table>
<thead>
<tr>
<th>Sendai Indicators</th>
<th>Vall d'Aran case</th>
<th>Umbria case (2012)</th>
<th>Unit measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target D: Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D-1 Damage to critical infrastructure attributed to disasters. (This index should be computed based on indicators D-2 to D-5 )</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D-2 Number of destroyed or damaged health facilities attributed to disasters.</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>D-3 Number of destroyed or damaged educational facilities attributed to disasters.</td>
<td>10 number/time</td>
<td>39/2 days; 7/5 days number/time</td>
<td></td>
</tr>
<tr>
<td>D-4 Number of other destroyed or damaged critical infrastructure units and facilities attributed to disasters.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D-5 Number of disruptions to basic services attributed to disasters. (This indicator should be computed based on indicators D-6 to D-8 )</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D-6 Number of disruptions to educational services attributed to disasters.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D-7 Number of disruptions to health services attributed to disasters.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D-8 Number of disruptions to other basic services attributed to disasters.</td>
<td>4000 power outages/time</td>
<td>9 public facilities; 500 number Power outages/time</td>
<td></td>
</tr>
</tbody>
</table>

### Issues encountered:

- Problem with some units of measure suggested by the Sendai indicators Group, they do not reflect the way data are actually collected and what can be achieved (also in terms of level of detail);
- There are some aspects that are not covered by the indicators and units of measure but are actually collected and then could be used for monitoring progress
Case studies and applications

Improving risk modelling

**Pre-event forecasted damage**
- Hazard variables
- Exposed systems description (values)
- Vulnerability assessment (functions)
  - Modelled Physical damage to one or few sectors
  - Modelled losses to multiple sectors
  - Modelled impact on economy and resources
  - Probabilistic Risk Assessment
  - Deterministic Scenarios
  - Quantitative
  - Qualitative
  - Semi-quantitative

**Post-event estimated damage**
- Hazard features
- Exposed systems configuration
- Vulnerability conditions
due to
  - Observed Physical damage to one or few sectors
  - Observed losses to multiple sectors
  - Occurred Scenario
  - Quantitative
  - Qualitative
  - Semi-quantitative

Data and information for validation; knowledge regarding systemic and indirect damage occurring in complex systems across time and space
Case studies and applications

Improving risk modelling and developing C/B analysis using post-disaster damage data

<table>
<thead>
<tr>
<th>Year</th>
<th>Evento</th>
<th>Benefit [€]</th>
<th>Cost [€]</th>
<th>Net Benefits [€]</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>Corbara</td>
<td>19,402,414</td>
<td>1,285,714</td>
<td>18,116,700</td>
</tr>
<tr>
<td>2012</td>
<td>Montedoglio</td>
<td>10,712,108</td>
<td>1,314,286</td>
<td>9,397,822</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Evento</th>
<th>Avoided damage [€]</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>Corbara</td>
<td>2,901,440</td>
</tr>
<tr>
<td>2012</td>
<td>Montedoglio</td>
<td>6,993,625</td>
</tr>
<tr>
<td>2012</td>
<td>Industria/Comm.</td>
<td>9,507,350</td>
</tr>
<tr>
<td>2013</td>
<td>Montedoglio</td>
<td>-504,137</td>
</tr>
<tr>
<td>2013</td>
<td>Casanuova</td>
<td>4,728,998</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Evento</th>
<th>Volume [m3]</th>
<th>Lost Profit [€]</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>Corbara</td>
<td>70 M</td>
<td>2,000,000</td>
</tr>
<tr>
<td>2012</td>
<td>Montedoglio</td>
<td>25 M</td>
<td>714,286</td>
</tr>
<tr>
<td>2012</td>
<td>Casanuova</td>
<td>20 M</td>
<td>571,429</td>
</tr>
<tr>
<td>2013</td>
<td>Montedoglio</td>
<td>25 M</td>
<td>714,286</td>
</tr>
<tr>
<td>2013</td>
<td>Casanuova</td>
<td>21 M</td>
<td>600,000</td>
</tr>
</tbody>
</table>
Case studies and applications

Use of the case studies **for forensic investigation**:
- Forin/Perc/Accidents to learn lessons for: improved recovery and reconstruction; knowledge acquired to improve risk modelling
- Forensic as such, many interesting new aspects so perhaps we can think about investigating more in depth one or two cases. This however is a proposal

- Lessons learnt for reconstruction
- Improved risk modelling
- Resoning regarding expertise in the context of tort law
- C/B for ex ante and ex post mitigation measures
- Identifying key exposure and vulnerabilities
- Creating statistical series for sectors and type of damage for which we do not have them
- Better analysing risk factors and type of damages that are not sufficiently known

Forensic investigation of disasters
Information System

On the basis of the work that has been conducted for Idea and the Catalunya Service we need to:

- Identify what are critical data to collect or coordinate for the sectors for which we have declared we need to do so: cultural heritage, lifelines (in particular power, water, gas), economic activities.

- Develop a full ER diagram for each sector and subsector using the collaboration with the stakeholders.

- Develop the databases and the interfaces. Design the system so that a unique access can be provided to all databases and modalities of retrieving information for different applications.

- Include in the system components for which we have already an ER: agriculture, residential and communication. Consider the possibility to include people and public facilities.
It is important to understand the interface between the databases and the geospatial representation of:

- Individual data
- Results of queries that do not require further merging and integration with other data (for various applications to be done manually)
We need also to connect with the Risk Data Hub of the JRC considering that:
- It is proposed as a tool that connects between pre- and post- event damage assessment
- That it is comprised of one part devoted to historic loss data, named Risk Data Hub (RDH) Historical Event Catalogue, that is still under construction even though already advanced for some hazards.
The iterative approach is such that:
- We discuss with stakeholders to understand the state of the art and needs;
- We develop a first proposal;
- We implement the design of the tool;
- We test it and discuss with stakeholders the usability;
- We refine the design to achieve desired result.