



Modelling crisis management for improved action and preparedness

***Geophysical Hazards
Multi-Sector Impact - Assessment and Mitigation***

***CRISMA Business Day
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Giulio Zuccaro (AMRA), Mattia Leone (AMRA)



CRISMA - NHI: Natural Hazards DSS, multi-sector Impact assessment and mitigation

The Offer:

- **Simulation and Decision Support System** for seismic and other geophysical hazards, including: physical and economic impact assessment, evaluation of long and short-term mitigation actions, multi-criteria and cost-benefit analysis, time-dependent vulnerability analysis



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The targeted market(s):

- Clients/users (some examples):
 - National/Regional Civil Protection willing to **compare alternative scenarios** and impacts on multiple elements at risk by varying hazards intensity and location parameters
 - National Civil Protection called to a **decision on population's evacuation** in presence of a long-lasting seismic swarm or forecasting of other geophysical hazards (e.g. volcanic eruption, landslides)

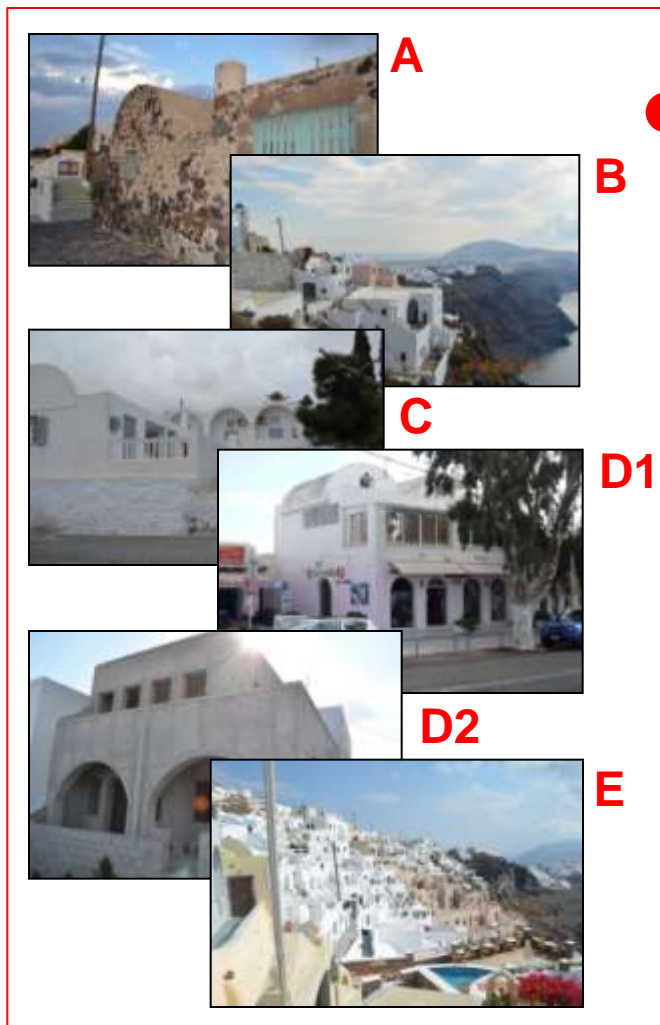
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The targeted market(s):

- Clients/users (some examples):
 - Public planning authorities called to **optimal resources allocation** for the implementation of mitigation measures (e.g. buildings retrofitting or transport network securing) in “peace time”
 - Insurance companies studying **economic impact of geophysical hazards**, comparing alternative scenarios by varying intensity and location parameters
- Geographical areas:
 - GLOBAL (through an “Integrated solution” offer)

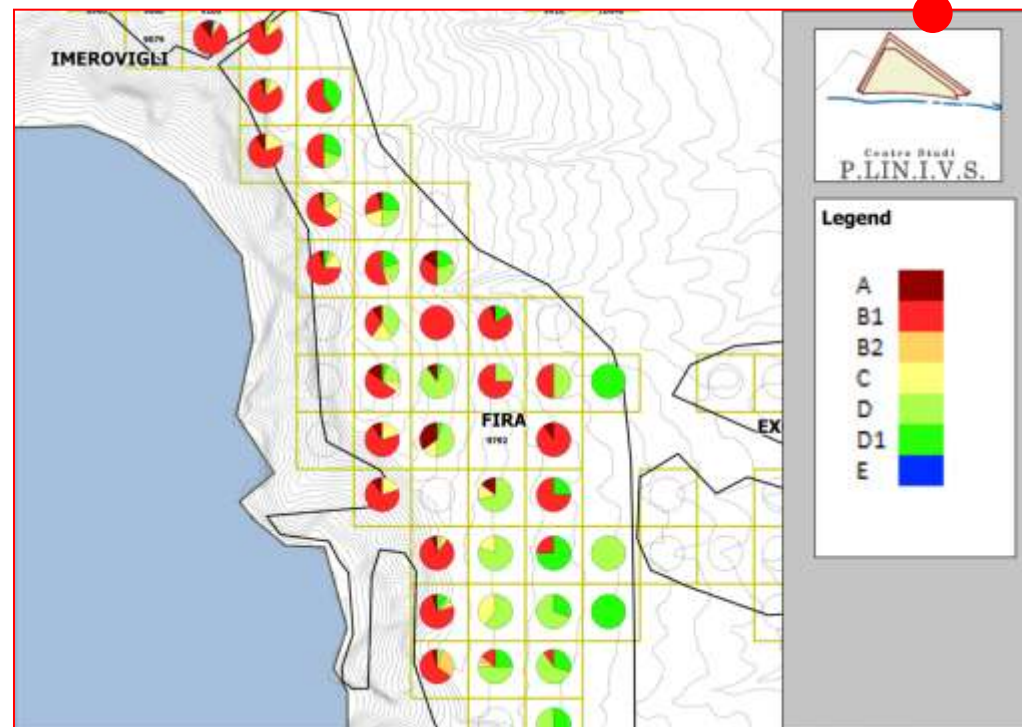
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➤ Customization of the integrated solution: Santorini (Greece)



Surveys on site and building vulnerability classes identification

Vulnerability distribution at municipal level



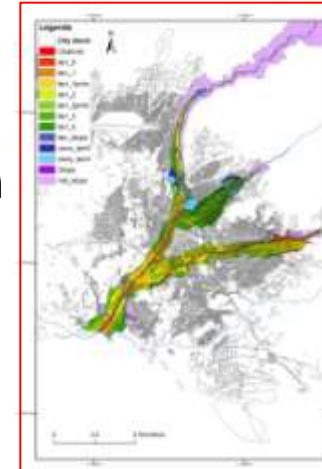
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➤ Customization of the integrated solution: Arequipa (Perù)

<p>1. Heterogeneity of the city block as interpreted from the building size and the prevailing land use</p> <p>100 %: totally homogeneous in size, shape, size and age of construction ?</p>	<p>2. Flowering density (gardens, parks) including number of buildings per acre and how clustered or adjacent the buildings are.</p> <p>100 %: no building, no built area.</p>	<p>3. Compact shape of the city block and irregularity of city block boundaries</p> <p>100 %: perfect square or rectangle.</p>	<p>4. Density of street network, inside and outside city blocks</p> <p>100 %: buildings are scattered throughout the city block, which is intersected by several streets.</p>
<p>75 %: heterogeneous size and land use but similar age of construction and standard of living</p>	<p>75 %: a few scattered building in the city block</p>	<p>75 %: the city block shows a compact shape but some irregularities or irregularities.</p>	<p>75 %: buildings are separated within the city block, which is intersected by several streets.</p>
<p>50 %: relatively homogeneous relatively similar land use but different building size and shape</p>	<p>50 %: partially built, interstitial buildings with open areas, car park or green areas</p>	<p>50 %: similar to the "75 %" type but the city block shows an irregularly shape</p>	<p>50 %: the city block shows low streets inside but it is surrounded by narrow streets.</p>
<p>25 %: homogeneous land use but heterogeneous in size and shape</p>	<p>25 %: buildings occupying >70% of the city block area, including some open areas, car park or green areas.</p>	<p>25 %: irregular shape with prominent irregularities.</p>	<p>25 %: the city block shows no street inside but it is surrounded by large streets.</p>
<p>0 %: homogeneous - similar building type, size and land use</p>	<p>0 %: totally built except for small parks or small car park</p>	<p>0 %: complex shape of city block with many buildings beyond its boundaries</p>	<p>0 %: densely packed buildings without adjacent streets (skewness, city center) or dispersed buildings (mostly found in the rural areas)</p>

Urban areas vulnerability carachterization

Vulnerability of recurring building components



Customized GIS data



Type	A	B	C	D	E	F	G	H	I	J	K	L
Roof slope	Pitched or rounded roof	One and two pitched roof	Flat roof	Flat roof	Flat roof	Rounded and flat	Flat roof	One and two pitched roof	Flat roof	Flat roof	Flat roof	Flat roof
Materials	Cement, concrete block	Tile, brick	Cement, concrete block	Ignimbrite	Cement, concrete block	Ignimbrite	Metal	Metal	Metal	Cement, concrete block	Tile, zinc, adobe	Tent
Size	Long and large: 300 to 1000 m ² (modern churches, water tank governmental buildings)	Medium size: 100 to 300 m ² (houses, building of variable age)	Medium size: 100 to 300 m ² (houses, building of variable age)	Medium size : 100 to 300 m ² (old building)	Large size: 300 to 1000 m ² (governmental buildings, large buildings, hotels)	Large size: 300 to 1000 m ² (Churchs or large, old buildings)	Very large: > 1000m ² (large shed or modern supermarkets)	Medium to large (industrial or commercial buildings of variable age)	Medium: 100 to 300 m ² (industrial or commercial buildings of variable age)	Medium: 100 to 300 m ² (houses, buildings of several periods)	Small: < 100 m ² (small houses and poor quality buildings)	Large : 300 to 1000 m ² (School, restaurant)
Maintenance	Finished and well maintained	Finished and very well maintained	Finished and well maintained	Finished and relatively well maintained	Finished and well maintained	Finished and very well maintained	Finished and very well	Finished and relatively to well maintained	Finished and relatively well maintained	Unfinished and unmaintaind: poor conditions	Unfinished and unmaintaind: poor conditions	Finished

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Key functions:

- *Impact assessment (physical impact model + economic impact model)*
 - **Variation of hazard key parameters** (e.g. for earthquakes: magnitude, epicenter location, depth; upload of shake map or manual input)
 - **Physical impact assessment** (deads, injured, homeless, building losses and building damages; transport network interruption; GIS-based scenario visualisation)
 - **Economic impact assessment** (direct + indirect costs)

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Key functions:

- ***Short term mitigation action (1/2) - variation of exposure for different elements at risk (e.g. population evacuation)***
 - Selection of **alternative choices** (no action, voluntary and mandatory evacuation, selection of different areas to be evacuated)
 - Selection of **different event timelines** (varying time of major event and point of analysis, influence of media and perceived minor shocks affecting on population behaviour, variation of key evacuation parameters as day of evacuation peak, maximum % of people evacuated)

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Key functions:

- *Short term mitigation action (2/2) - variation of exposure for different elements at risk (e.g. population evacuation)*
- **Comparison of physical impact** in case of mitigation/no mitigation options (variation in deads, injured)
- **Comparison of economic impact** in case of of mitigation/no mitigation options (direct + indirect costs)

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Key functions:

- *Long term mitigation action (1/2) - variation of vulnerability classes for different elements at risk (e.g. buildings retrof.)*

- **Selection of alternative choices** (set-up of alternative retrofitting scenarios, e.g. territorial area selection, type and number of buildings subject to mitigation, desired level of seismic retrofitting for each vulnerability class, energy retrofitting option)

- **Comparison of physical impact** in case of mitigation/no mitigation options (variation in deads, injured, homeless, building losses and building damages)

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Key functions:

- *Long term mitigation action (2/2) - variation of vulnerability classes for different elements at risk (e.g. buildings retrof.)*

- **Cost-Benefit analysis** in case of mitigation/no mitigation options (direct + indirect costs)

- **Multi-criteria analysis** in case of mitigation/no mitigation options (indicators selection and weighting)

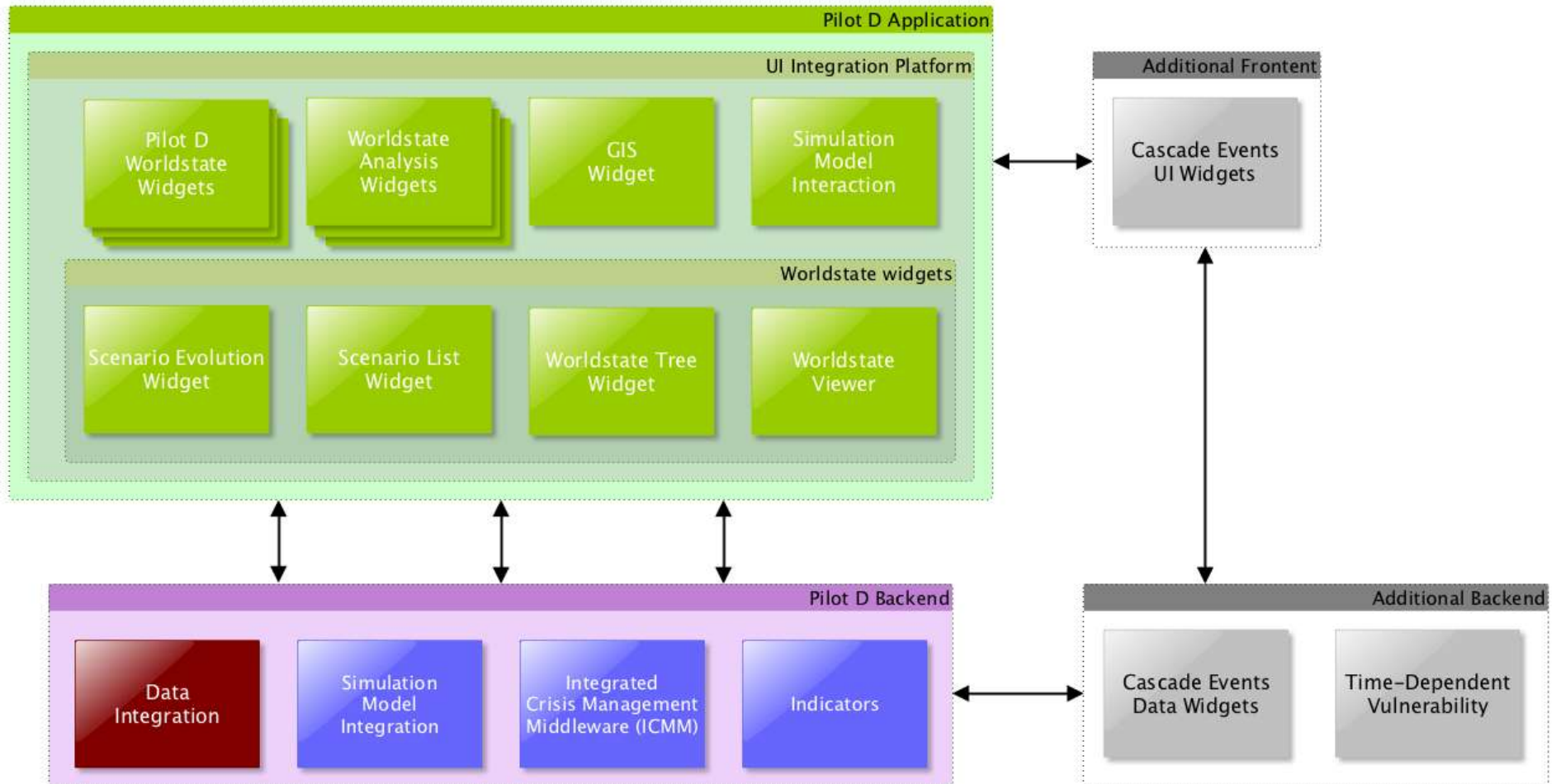
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Key functions:

- *Time/Damage dependent vulnerability analysis*
 - **Variation of hazard key parameters** (e.g. for earthquake: magnitude, epicenter location, depth; upload of shake map or manual input) for each event in the sequence
 - **Automatic update of building inventory and vulnerability classes**
 - **Cumulative damage assessment** from a sequence of hazards (deads, injured, homeless, building losses and building damages; transport network interruption; GIS-based scenario visualisation)

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Link with the CRISMA Framework:



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➤ **Added-Value on the market:**

- **User-friendly** Web-based application
- **Customization and calibration** of the tool according to client's needs
- **Integration** of client/external models and tools in the Crisma Framework
- Management of **multiple natural hazards** through a single tool

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➤ Added-Value on the market:

- **Simulation of cumulative damage** from a series of hazards through time/damage dependent analyses
- Simulation of impact variation due to **mitigation measures** implementation
- Advanced **Cost-Benefit** Analyses
- Advanced **Multi-Criteria** Analyses

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➤ Demonstration material:

- *DEMO available at <http://crisma.cismet.de/pilotD/webapp/>*
- *Tutorials*
- http://www.plinivs.it/crisma_video/Impact%20assessment.mp4
- http://www.plinivs.it/crisma_video/Short%20Term%20Mitigation%20-%20Evacuation.mp4
- http://www.plinivs.it/crisma_video/Long%20Term%20Mitigation%20-%20Building%20Retrofitting.mp4
- http://www.plinivs.it/crisma_video/Multi%20Criteria%20Analysis.mp4
- http://www.plinivs.it/crisma_video/Time%20Dependant%20Vulnerability%20.mp4

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➤ Contact:

▪ **AMRA / PLINIVS-LUPT**

▪ *Giulio Zuccaro (zuccaro@unina.it)*

▪ **Cismet**

▪ *Sascha Schlobinski (sascha.schlobinski@cismet.de)*

Thank You!

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