A SYSTEMATIC FRAMEWORK FOR GIS-BASED NATURAL HAZARD ASSESSMENT

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The use of databases and GIS for natural hazard assessment has accelerated over the last decade especially in academia and the international development arena. Implementing a GIS-based hazard assessment in industry is often constrained by time, budgets, and availability of base data. These constraints often require adaptations to an ideal GIS-based framework. This poster outlines this ideal framework and highlights some common deviations from it. The framework is comprised of five milestones. Moving from one milestone to the next implies that the quantification of Hazard and Risk are better understood and more accurate. Not all milestones need be completed at once. Completion of successive milestones may occur over time as more data becomes available or more resources are acquired.

The framework is built upon the geotechnical and hazard assessment standards and terminology defined by Cruden and Varnes, 1996, and Soeters and van Westen, 1996. The terms Danger, Hazard Inventory, Hazard Susceptibility, Triggering Potential, Frequency, Hazard Potential, Hazard Assessment, and Vulnerability are used to help define the objectives, scope, and limitations of each milestone. For example, for a given study area, absolute Hazard Assessment may not be obtainable because the frequency of the hazard is not quantifiable at the proposed project scale. In this case quantification of Hazard Susceptibility may be a more realistic and affordable goal.

Databases are valuable tools for systematically storing information in a central location. They facilitate the sharing of and retrieval of information, help with data quality control, and are often used for analysis. Choosing between a database or GIS tool for hazard assessment depends, in part, on the spatial relationship between the hazard and the element. GIS is typically used for map based analysis when one or more hazards can impact a single element. Either tool should also be designed to store hazard inspection information because hazard inspections programs are commonly implemented after hazard and risk has been quantified and prioritised.

A project typically starts with defining the types of Dangers to be assessed. Due to the inherent structure of a database or GIS, it is important to adopt a set of defensible definitions at the project start. Without a common set of standards and definitions data collectors and analysers will find it difficult to collect unbiased information and conduct systematic and objective analysis of the data in later steps of the project.

The second milestone is developing a hazard inventory - one of the most valuable components to a hazard assessment. Although it does not permit any forecasting on its own, the inventory is used to gain an understanding of the hazard mechanisms, causal factors, and calibrate any predictive assessment models developed in future milestones. An inventory should include, at a minimum, the hazard type, magnitude, activity, and a georeferenced location. An ideal approach to building a hazard inventory includes a records and file review, remote sensing, ground truthing, and helicopter inspection. Building the inventory in this order allows confirmation of data collected in the previous task (i.e. airphoto interpretation helps confirm hazard documented in the files) and minimises the use of the more expensive ground truthing and helicopter inspection tasks. In reality, the project resources, weather, and client schedule will often modify the hazard inventory building process. Most of the project resources are used for building the inventory.

The quantification of Hazard Susceptibility is typically the third milestone in an ideal Hazard Assessment project. Causal factors, such as slope angle and geology for landslides, are identified from the Hazard Inventory or from professional experience, and combined in a database/GIS to produce a Hazard Susceptibility Rating or Probability. The classification of hazard mapping techniques, as proposed by Aleotti and Chowdhury 1999, helps practitioners select a hazard assessment technique that best suits the project goals, available data, and budget. For example, GIS-based index overlay techniques are more suited for national and regional scale studies and are useful for producing qualitative hazard susceptibility maps. Probabilistic-based assessments are more applicable for data intensive, large-scale projects and are useful if the quantification of absolute hazard and risk are the goals.

The fourth milestone in the Framework is to incorporate Hazard Triggers, such as precipitation intensity, seismicity or human activity. Triggers are combined with Hazard Susceptibility in the database/GIS to help quantify Hazard Potential (if the absolute hazard frequency is not known), or Hazard (if the absolute hazard frequency is known). The frequency of the hazard can also be estimated by analysis of the hazard inventory or evaluation of multitemporal airphotos or satellite images.

Finally, in the fifth milestone, if the hazard behaviour can be the assessed once it is triggered and the locations of the of the elements are known, then a vulnerability assessment within the database/GIS can be conducted. The scale of the study (selected in the first milestone) predominantly governs the level of sophistication of the vulnerability assessment.

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