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Development of a methodology for an objective territorial analysis of vulnerability for a comprehensive risk approach: application to the greater Lyon

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The urban community of Lyon (greater Lyon) requires a high vigilance against risks, because of the inherent characteristics of its territory. Indeed, with the presence of two major rivers (the Rhone and Saone), many streams with torrential behavior, a terrain favorable to the accumulation of water in low places and steep slopes, the risk of flooding by overflow or runoff and the risk of landslide are numerous. In addition, greater Lyon gathers many petrochemical companies on its territory, aggravating the technologic risk.
The study therefore proposes to conduct a vulnerability assessment based on a standardized area. In addition, the different stakes do not have the same importance or value in the territorial organization of greater Lyon (the damage of the bus shelters seems less detrimental to the functioning of the community than the damage of subways). Thus, it will be proposed to weight them with an analytic hierarchic process (AHP) in order to assess the vulnerability of each stakes.
Saaty's AHP is a theory of measurement criteria for a given situation, based on the derivation of relative priorities from pairwise comparisons of alternatives homogeneous sharing a common attribute (Saaty, 1994). This approach borrows from the systemic approach (focusing on the functioning of the total) and the deductive approach (inter-party) to structure a complex situation in the different elements that can interact with each other, in order to quantify to assign their values to their impact on the overall system. This quantification of the values of different elements is based on the experience and judgments of experts, to eventually get the "priorities" of the various components (Saaty, 1980).
Saaty's AHP is based on four main steps:
- A detailed description of the studied system where several elements and criteria are proposed to characterize, synthesize the situation and break the complex problem.
- Construction of hierarchies to organize the elements and criteria to address the problem, and this in a structured and in the most complete and comprehensive manner as possible,
- An assessment and a formal calculation of priorities and the relative importance of the elements, based on the verdict of experts, then an aggregation of their responses. In semi-headed interviews, the experts will decide on the elements that seem relatively more important than others by binary comparison
- A validation of the consistency of the answers given by experts and an aggregation of their results.
The results can prioritize the various issues and elements of the Grand Lyon, previously listed in the hierarchical structure, with functions of vulnerability. The function of vulnerability (Equation 1) shows the great importance of the human (77%) stakes. The vulnerability of environmental targets is 17%, while material issues represent only 5% of the overall function.

Global vulnerability = 0, 772 x Human vulnerability + 0,173 x Environmental vulnerability + 0,055 x Material vulnerability (Equation 1)

To complement the functions of vulnerability and move into a phase of practical use and display the relative importance of issues with a GIS, quantization factors for all identified targets have been established in order to harmonize geographical surface, line or point. Finally, we get a detailed description, uniform and objective of human, material and environmental vulnerabilities, as well as the overall vulnerability of the territory of the Grand

Lyon.