

# Abstract

This doctoral thesis is highly relevant to water supply and sewerage entities interested in adopting holistic ways in order to establish intervention priorities in their networks, attending to a company's policies global vision, and not only to the structural performance of the pipes.

The main objective of the present research is to provide a flexible decision support methodology that includes a way to capture the expert knowledge and its related uncertainty, and to allow an assessment of the most relevant local criteria, inside the process leaded to establish interventions needs for individual pipes and network sectors, making use of fuzzy logic as the mathematical core that frame the approach. Other goals that complement the one mentioned above are focused on the execution of a detailed review of the elements that can have influence in the pipe deterioration process, on the examination of inspection and assessment protocols, and on the critical analysis of different decision structures, that in opinion of the author of these thesis, that can be relevant in the context of this study.

The proposed methodology, directed to estimate intervention priorities, is based on the use of fuzzy logic as fundamental axis, and in the definition and analysis of decision spaces to relate relevant criteria. The problem of incorporating the uncertainty that the expert have when characterizing each criterion is suitably addressed by means of the construction of fuzzy mathematical functions, as well as with the conformation of fuzzy aggregation matrixes. The approach allows simplifying the process by the definition of decision units, and reduces or entirely eliminates the necessity of using importance weights by the establishment of a way to relate multiple decision spaces.

As the main contribution of this doctoral research, the structure of the decision methodology by fuzzy logic and its integration with the decision space analysis are introduced. In addition, a case of study to illustrate the use of the methodology is included. This example is referred to a Spanish Mediterranean water supply network. The results are presented at a level of individual pipes, calculating a priority

value for each of 10485 pipes that integrate the population sample, and at a level of network sectors, for 10 zones of the systems. Through different sensitivity analysis, strengths and weaknesses of the proposed methodology have been identified.

Other contributions included in the present thesis, which take special importance in this context, are expressed in the performance of four different methodologies through identical number of study cases (for both supply and wastewater systems); the introduction of a set of guidelines for integrating databases associated to infrastructure asset management; an approach of a basic actuation plan to execute intervention processes in companies that manage systems of any size, that includes a decision support tool based on fuzzy logic; and the exposure of a simple informatics program in which the proposed methodology is systematized, and that can be useful as an example for the entities in order to develop a more robust and customized package.