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> Diego Alfonso Pirajan Hernandez Assessment of Structural Failure Risk Index of water distribution pipes using Bayesian Belief Networks

1 Abstract

Water distribution networks account for the most expensive component in water supply systems, and failure of water mains in these networks is responsible for high costs every year. Furthermore, water losses due to pipe rupture affect the already decreasing availability of water. Understanding the causes behind these breakages and having the ability to predict them is essential to mitigate these problems. Literature review on this topic showed that there is a wide variety of factors that cause structural pipe failure, the main being: pipe age, pipe material, pipe diameter, pipe length, and soil corrosion. These and additional factors were considered to create a BBN model to predict the Structural Failure Risk Index. The model was later used on a synthetic water distribution network consisting of 40 pipes. The BBN model predicted structural failure risk in 18 pipes to be "Low", "Medium" in 12, and "High" in 10. A hypothetical case where all pipes with "High" structural failure risk were replaced by brand new PVC pipes reduced pipe failure risk significantly but not completely due to the presence of additional adverse conditions such as "Low" soil quality or "High" external loads. Model outputs showed constancy and reasonable results and can aid decision-makers and managers in water companies take the correct preventive measures such as replacement, maintenance, retrofitting, among others.

Keywords: Bayesian belief network (BBN), Structural Failure Risk Index, pipe failure, pipe age, pipe material, corrosion, Python, CPT, water distribution networks, soil quality