Causality, Bayesian Belief Nets, Complex System Modelling and Water Management

Presenter: Dr David Roser
Program Manager in Environmental Microbiology
CVEN, Water Research Centre

Abstract:

Scientists and engineers routinely view the world as networks of inter-related causes and effects and respond to these thought models according to logic, decision priorities etc.. However, until recently from descriptions of causality were not well defined systematically within scientific methodology. Indeed many statisticians were and apparently remain antagonistic towards the idea of causality, or at least it being amenable to more systematic mathematically rigorous analysis. This conceptual gap became evident when software engineers attempted to develop Artificial Intelligence based on an understanding of the ways people reason about how the world around them operates.

One subsequent response was that developed by Judea Pearl and colleagues, the development of a formal directional (cause > effect) algebra combined with the use symbolic/conceptual diagrams, in effect a mathematical language for describing and using cause > effect. Out of this grew from the 1980s onward a generic formal system for modelling how systems have or do behave (various forms of cause > effect logic), might behave in the future (“counterfactual” reasoning = what-if scenario exploration) and how people or machines might respond to this knowledge (“intervention” = management). This combination of reasoning together with algebra+diagrams led to programmable Directed Acyclic Graph technology, better known as Bayesian Belief Nets, a term apparently coined by Pearl. Coming from an engineer’s perspective they developed in effect a language and programming approach to describe, define and document cause and effect which could be applied to systems analysis of any kind.

Short Bio:

Dr David Roser researches, consults, publishes and is qualified in, the fields of environmental pathogen (mainly water-borne illness) risk assessment and management (water, wastewater and solid wastes), microbial ecology, and environmental planning. He currently publishes and researches in the areas of drinking water, recycled water, natural bathing waters, and biosolids. He has extensive experience working with water managers in local government, health departments, water companies and other government agencies undertaking microbial risk assessment and management for them.

He is currently working with A/Prof. Stuart Khan and Mr Guido Carvajal Ortega on developing new and adapting risk assessment techniques for water recycling using Bayesian Belief Net technology.