



## **BBN, A Tool to Make LOPA More Effective, QRA More Transparent and Flexible and Therefore to Make Safety More Definable!**

**Hans Pasman and William Rogers**

Mary Kay O'Connor Process Safety Center,  
Texas A&M University, College Station, TX 77840

### **ABSTRACT**

Quantitative risk analysis is in principle an ideal method to map one's risks, but it has limitations due to the complexity of models, scarcity of data, remaining uncertainties, and above all because effort, cost, and time requirements are heavy. Also, software is not cheap, the calculations are not quite transparent, and the flexibility to look at various scenarios and at preventive and protective options is limited. So, the method is considered as a last resort for determination of risks. Simpler methods such as LOPA that focus on a particular scenario and assessment of protection for a defined initiating event are more popular. LOPA may however not cover the whole range of scenarios possible, and bad surprises may emerge. In the past few decennia, Artificial Intelligence university groups, such as the Decision Systems Laboratory of the University of Pittsburgh, have developed Bayesian approaches to support decision making in situations where one has to weigh gains and costs versus risks. The crux of the Bayesian approach is learning from the past. The Bayes method builds on existing data and absorbs new knowledge to improve the result. Updating and diagnosis are essential ingredients of Bayesian Belief Nets, BBNs, which are extended to Influence Diagrams, IDs, to support decisions. BBNs belong to the family of acyclic digraphs such as Fault Tree, Event Tree, Bow-tie, and Master Logic Diagram, but BBNs are more suited for scenario building through their flexibility in combining failing components with conditions, operations going on, merging events, and cascading events, while remaining transparent. The software removes the calculation load and allows focus on scenario and event physics. This paper will describe details of the approach and will provide some examples of both discrete random variables such as the probability values in a LOPA, and continuous distributions, which can better reflect the uncertainty in data. The Pittsburgh GeNie software is free for personal use. It can be used at different levels of detail depending on the problem at hand. It is built for Excel, so the results can be further used in spreadsheet and in applications such as Precision Tree decision analysis.