Towards a framework for developing a Real-Time Risk Assessment and Decision-Making Tool

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Process safety in the industry is managed through a solid process safety management system which involves the assessment of the risk associated with various processes throughout the life cycle of a facility. Risk levels tend to fluctuate due to several time varying risk factors (performances of the safety barriers, equipment conditions, staff competence, incidents history, etc.). Current practices for quantitative risk assessment (e.g. Bow-tie analysis, LOPA, etc) have brought significant improvements to the management of major hazard facilities, they are static in nature and fail to take into account the dynamic nature of risk, and thereby improving risk based decision making.

In an attempt to improve risk management in process facilities, the process industry put significant effort over the last decade in the development of process safety key performance indicators (KPIs or parameters to be observed). They serve to continuously measure or gauge the efficiency of safety management systems and reduce the risks of major incidents, such increasing the source of information that could potentially be used to assess risks in real-time. The use of such KPIs has proved to be a major step forward in the improvement of process safety in major hazards facilities. However, there still seem to be no clear links between the multiple KPIs measured at a process plant and the quantitative measure of risk levels at the facility.

Exxon Mobil Research Qatar has partnered with the Mary Kay O’Connor Process Safety Center – Qatar (MKOPSC-Q) to develop a methodology that establishes a framework for a tool that monitors, in real-time, the potential increases in risk levels as a result of pre-identified risk factors, which include the use of KPIs (leading or lagging) as observations or evidences, using Bayesian Belief Networks (BBN).

In this context, the paper presents a case study of quantitative risk assessment of a process unit using BBN. The different steps of the development of the BBN are detailed, including: translation of a Bowtie into a skeletal BBN, modification of the skeletal BBN to incorporate KPIs (loss of primary containment (LOPC), equipment, management and human related), and testing of the BBN with forward and backward inferences. The outcomes of the dynamic modelling of the BBN with real time insertion of evidence are discussed and recommendations for the framework for a dynamic risk assessment tool are made.