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# Bayesian Network Based Dynamic Operational Risk Assessment

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## ABSTRACT

The oil/gas, chemical, petrochemical, food, power, papermaking and other process industries consist of numerous equipment and unit operations, thousands of control loops, and exhibit dynamic behavior. Process plants are subjected to different types of risks in daily operations, which include process risks, risks due to reactivity, toxicity and mechanical hazards, fire and explosion risks. Failure to manage or minimize hazards can result into serious incidents. Therefore, it is very important to identify hazards, perform risk assessments, and take proper initiatives to minimize/remove hazards and risks; else a catastrophic accident may result. Dynamic characteristics such as stochastic processes, operator response times, inspection and testing time intervals, ageing of equipment/components, season changes, sequential dependencies of equipment/components and timing of safety system operation also have great influence on the dynamic processes. Conventional risk assessment methodologies generally used in oil/gas and petrochemical plants have limited capacity in quantifying these time dependent characteristics. Therefore, it is important to develop method that can address time-dependent effects in risk calculation and provide precise estimation. This study proposes a risk assessment methodology for dynamic systems based on Bayesian network, that represents the dependencies among variables graphically and capture the changes of variables over time by dynamic Bayesian network. This study proposes to develop dynamic fault tree for a chemical process system/sub-system. The developed dynamic fault tree is then mapped in the Bayesian network and the dynamic Bayesian network is further developed to demonstrate dynamic operational risk assessment. A case study on a level control system is provided to illustrate the methodology's ability in capturing dynamic operational changes in process due to sequential dependency of one equipment/component on others.