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Choosing the Right Risk Assessment Method: What Works, What Doesn't, and Why

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ABSTRACT

Risk assessment is a fundamental element of major hazards management, yet in practice there is frequent misalignment between the risk assessment method selected and the decision it is intended to support. Techniques such as bowtie analysis, Layers of Protection Analysis (LOPA), Fault Tree Analysis (FTA), and Quantitative Risk Assessment (QRA) are widely used across the process industries, but are often applied beyond their appropriate scope or misunderstood in terms of their strengths and limitations. This can result in outcomes that add limited value, obscure key risk drivers, or fail to support credible demonstration that risks have been reduced so far as is reasonably practicable (SFAIRP).

This paper draws on practitioner experience across multiple industries and hazard profiles to examine where commonly used risk assessment methods are, and are not, fit for purpose. It discusses the types of hazards, industry contexts, and required outputs for which bowtie, LOPA, FTA, and QRA are best suited, including hazard understanding, barrier management, risk ranking, decision support, and risk tolerability demonstration.

Common failure modes are explored, including reliance on qualitative bowties to justify risk decisions, inappropriate use of LOPA where initiating event frequencies or independence assumptions cannot be supported, and application of QRA in situations where uncertainty and data limitations outweigh its apparent precision. The paper also highlights situations where increasing analytical complexity provides little additional insight and may detract from effective risk control.

An integrated, proportionate approach is presented that positions bowtie analysis as a foundation for structured hazard understanding and barrier identification, with targeted LOPA applied to selected scenarios where additional rigour is required to support decision making and SFAIRP demonstration. The approach emphasises transparency, traceability, and alignment between the method used and the question being answered. Anonymised examples are used to illustrate how appropriate method selection influences outcomes, stakeholder confidence, and regulatory engagement.

The paper concludes with practical guidance for practitioners and leaders on selecting and integrating risk assessment methods that are fit for purpose, supporting more consistent, defensible, and effective management of major hazards across industries.

KEY WORDS

Risk Assessment, Bowtie, LOPA, QRA, Fault and Event Tree, SFAIRP/ALARP

BIOGRAPHY

Matthew Mitchell is a Chartered Chemical Engineer and Registered Professional Engineer of Queensland with broad experience in process safety and major hazards management across Australia and New Zealand. He has worked directly with operating companies, in both MHF and non-MHF contexts, on hazard identification, consequence modelling, risk assessment, control measure management, and the practical demonstration of SFAIRP/ALARP. His experience includes consulting and facilitating multidisciplinary workshops and reviews, supporting organisations from concept design through to operations with practical, defensible process safety outcomes that inform real decisions.

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