

***Alternative Methods for
Incorporating PRA Concepts Into
the Safety Decision-Making Process***

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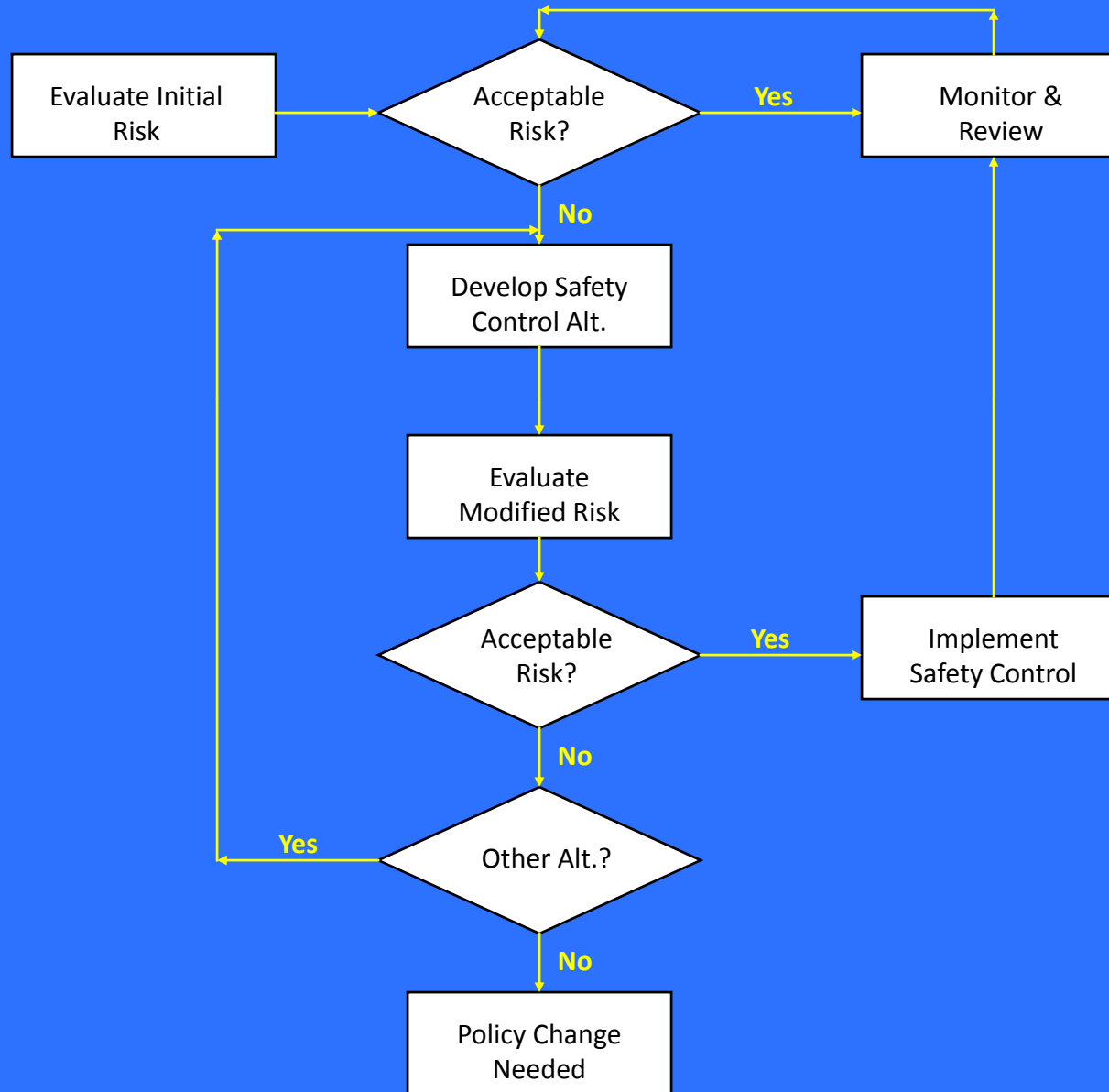
Workshop on Risk Assessment & Safety

Decision Making Under Uncertainty

Washington, DC

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Risk and the Safety Decision Making Process

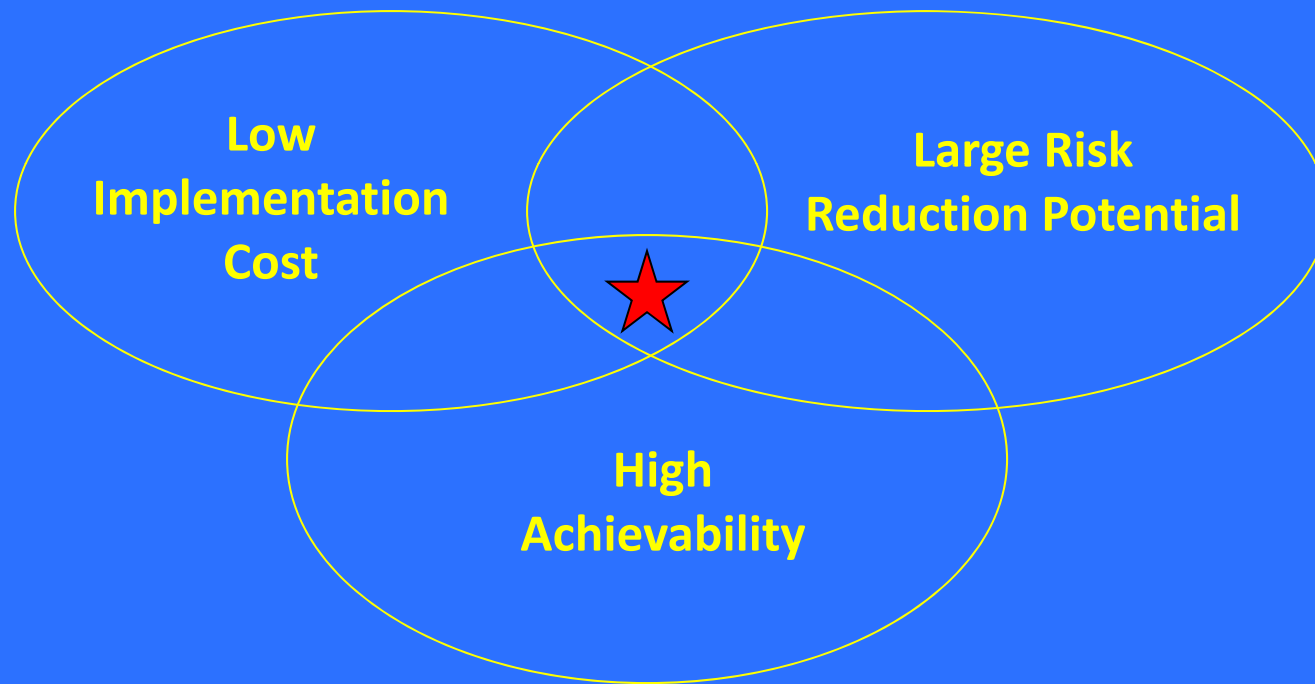


Decision Making Framework

- **Type of safety decision**
- **System characteristics**
- **Potential threats**
- **Performance measures**
- **Decision criteria**



Seeking Effective Safety Controls



Probabilistic Risk Assessment (PRA)

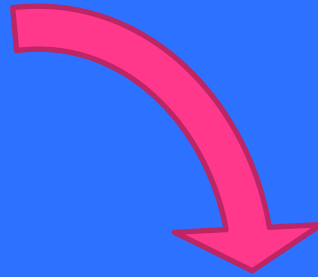
- Define risk categories
- Develop scenarios of *reasonably foreseeable events* in each category
 - What can go wrong?
- Assign frequency of scenario occurrence
 - How likely is it?
- Determine impacts of each scenario
 - What are the consequences?
- Use likelihood and consequence to estimate risks



Reasonably Foreseeable Scenarios

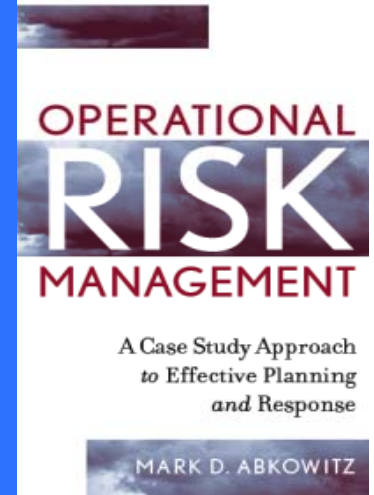
Risk Categories

- Product/service quality
- Customer relations
- Financial management
- Information systems
- Supply chain
- Distribution
- Infrastructure & equipment
- Employee health & safety
- Security
- Social, political, economic
- Community & environment
- Natural hazards



Risk Factors

- Design & construction flaws
- Deferred maintenance
- Economic pressures
- Schedule constraints
- Inadequate training
- Not following procedures
- Lack of planning & preparedness
- Communication failure
- Arrogance
- Political agendas



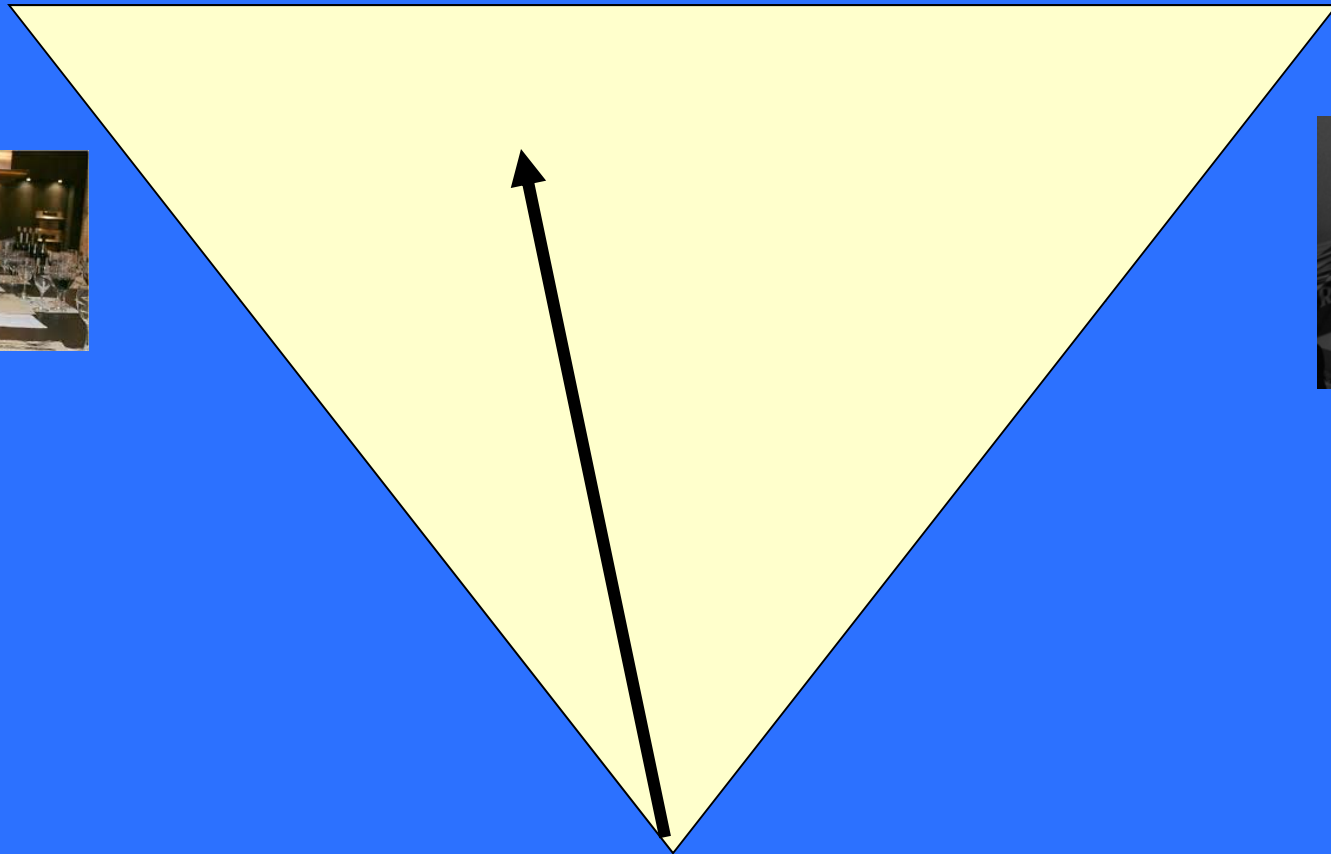
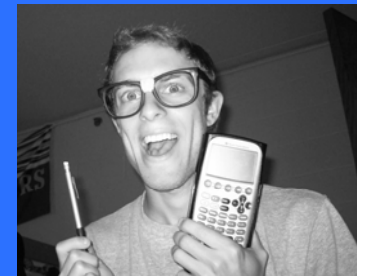
Potential Consequences

- Acute fatalities & injuries
- Long term human health effects
- Environmental degradation
- Property damage
- Business & community interruption
- Clean-up, remediation & disposal
- Increase in enforcement activities
- Demand for new regulations
- Loss of public confidence



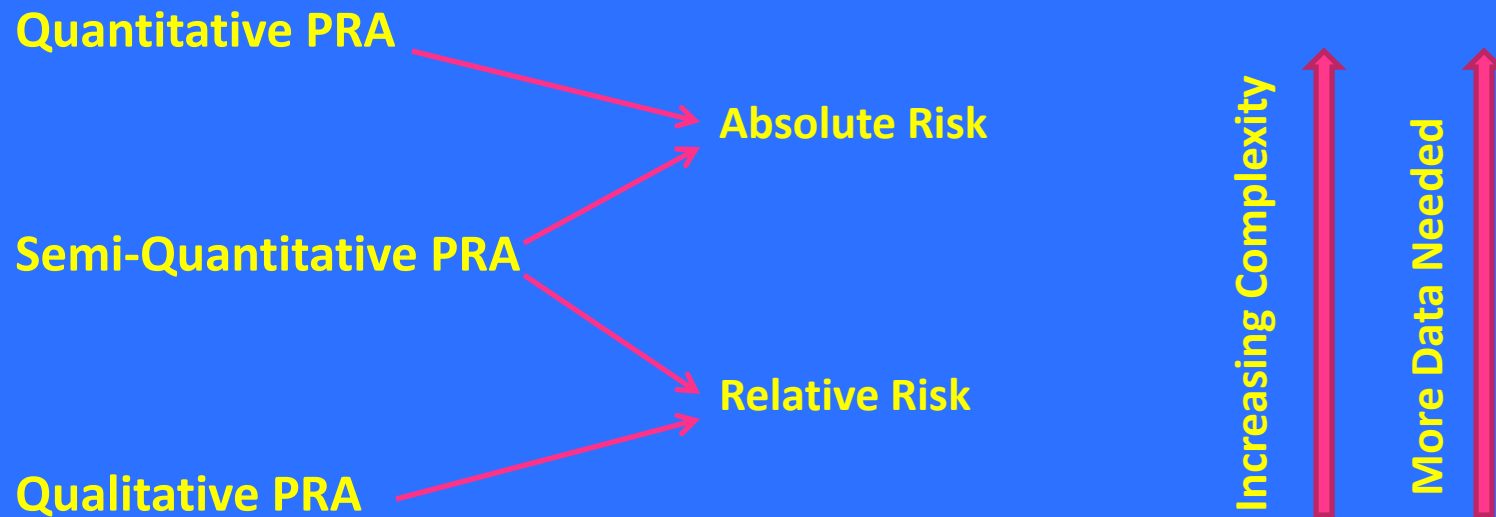
Qualitative

Quantitative



The PRA Spectrum

PRA Methods, Uses & Requirements



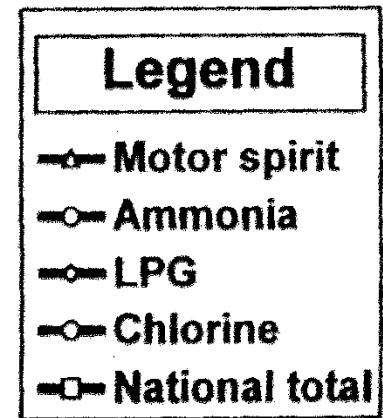
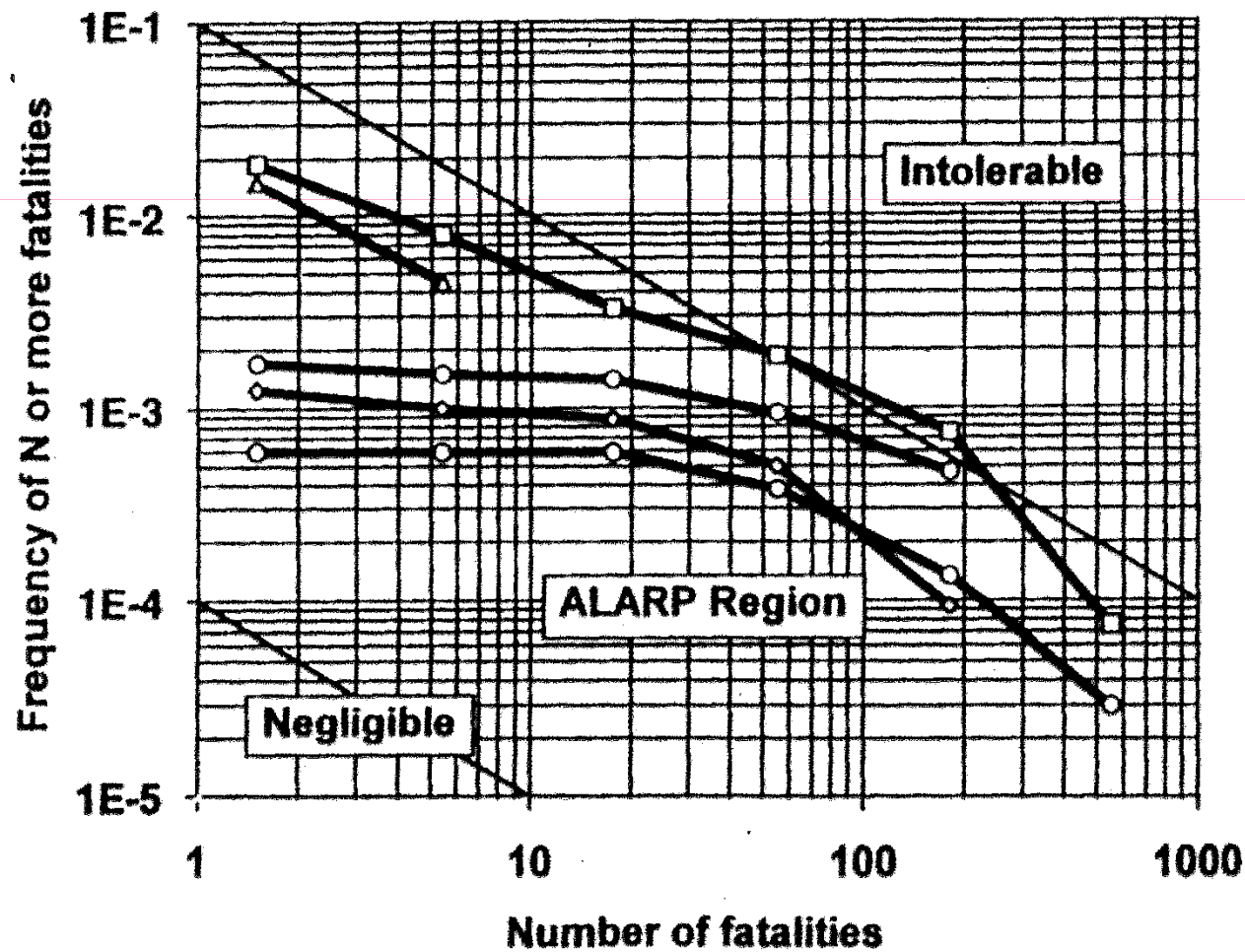
Relative PRA Results

Likelihood

Very High	High	High	Very High	Very High
High	Medium	Medium	High	Very High
Medium	Low	Medium	Medium	High
Low	Low	Low	Medium	High
	Low	Medium	High	Very High

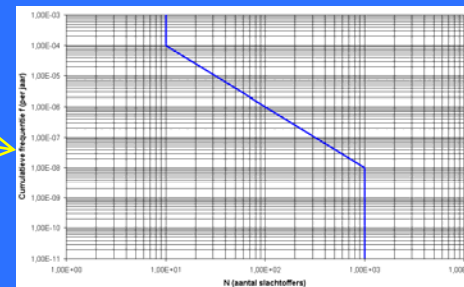
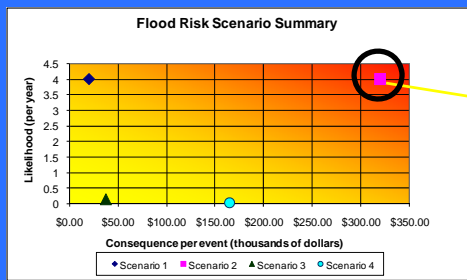
Consequence

Absolute PRA Results



Hybrid PRA

- Uses qualitative PRA approach to preserve limited resources.
- Utilize results to decide where more quantitative PRA is warranted.



How Safe Is Safe Enough?

- **Is our operational safety as low as is reasonably practicable?**
 - Establish benefit/cost of various risk reduction strategies
 - Implement improvements until reaching threshold for minimum return on investment
- **Should we be continuing this operation?**
 - Establish a threshold risk (e.g., chance of being struck by lightning)
 - Has our risk appetite been exceeded?



Be Careful What You Ask For!

- A more sophisticated PRA is not always better.
- It depends on the number of model parameters and data requirements.
- One can end up with more assumptions and greater uncertainty than with a simpler approach.
- Even if the approach is valid, can the risk assessment results be presented in a meaningful way to the decision-maker?



Wrap-Up Comments

- A variety of PRA methods exist, ranging from highly qualitative to highly quantitative techniques.
- The preferred approach depends on a number of factors:
 - level of concern for the problem
 - system complexity
 - data quality
 - available resources
 - type of output desired
- A variety of PRA approaches can be o.k. as long as they are holistic and systematic.