Introduction to Risk Analysis

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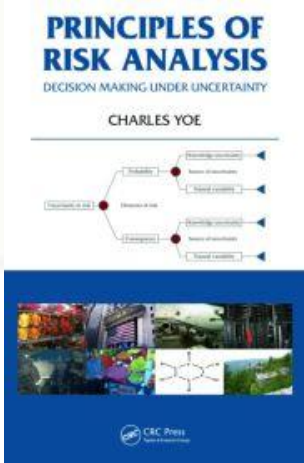
Risk Analysis and Industrial Hygiene

- "Risk analysis methods and tools are important resources for articulating scientific knowledge to those who make decisions regarding public and occupational health." Synergist April, 2012
- "Risk analysis is a framework for decision making under uncertainty."

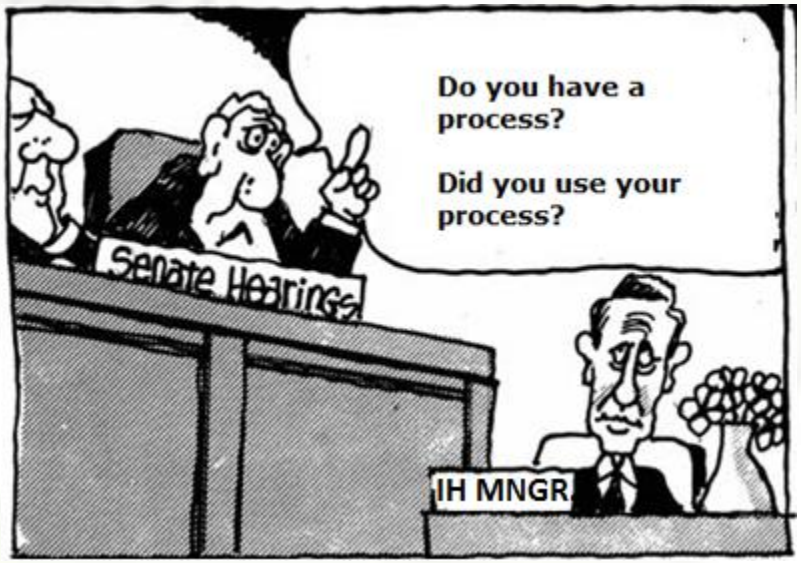
  Me March, 2013



The Point

Risk

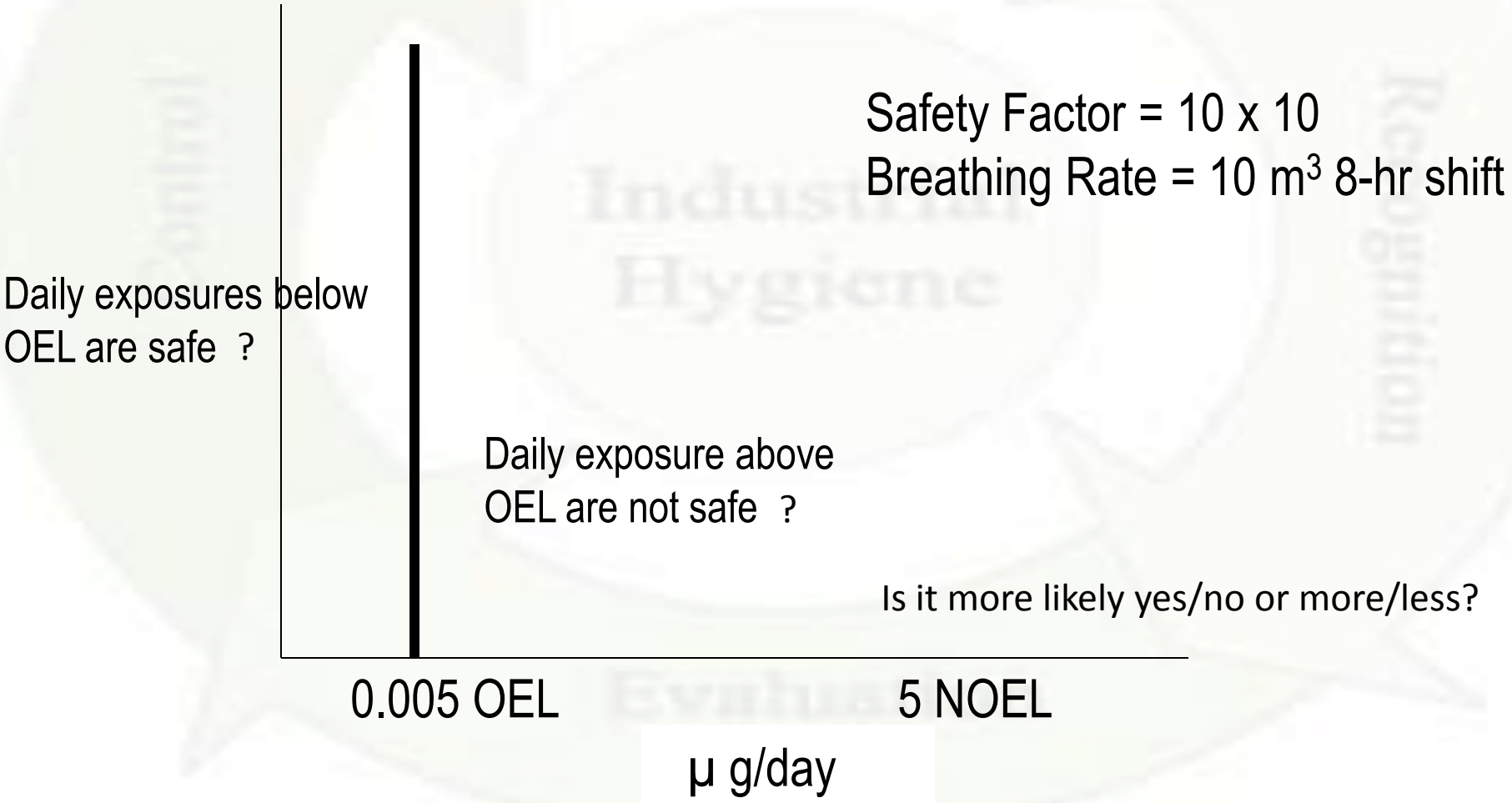
Managing Risk



Risk Assessment ≠ Safety Assessment

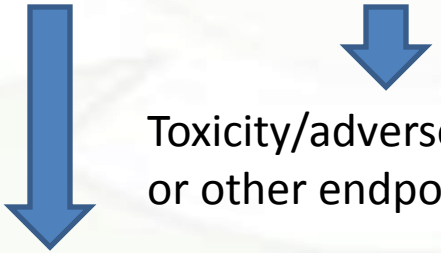
- The public wants safety
- Safety is a subjective determination
  - Chemicals used under reasonably foreseeable conditions should not adversely affect humans and the environment
  - Someone must decide what safe is
  - Subjective decisions rarely satisfy everyone
- Risk is a more objective concept

OEL = NOEL/Safety Factor x Breathing Rate



Risk

- Risk is a measure of the probability and consequence of uncertain future events
  - Risk = Probability x Consequence
- In industrial hygiene
  - Risk = Likelihood x Severity



Toxicity/adverse effects on humans, environment or other endpoints

Exposure = e(frequency, duration, magnitude, pathway/route)

“Flavors” of Risk

- Risk includes
  - Exposure to losses (hazards)
    - Risk managers avoid risks
  - Potential for gain (opportunities)
    - Risk managers take risks

Uncertainty Leads To Risk

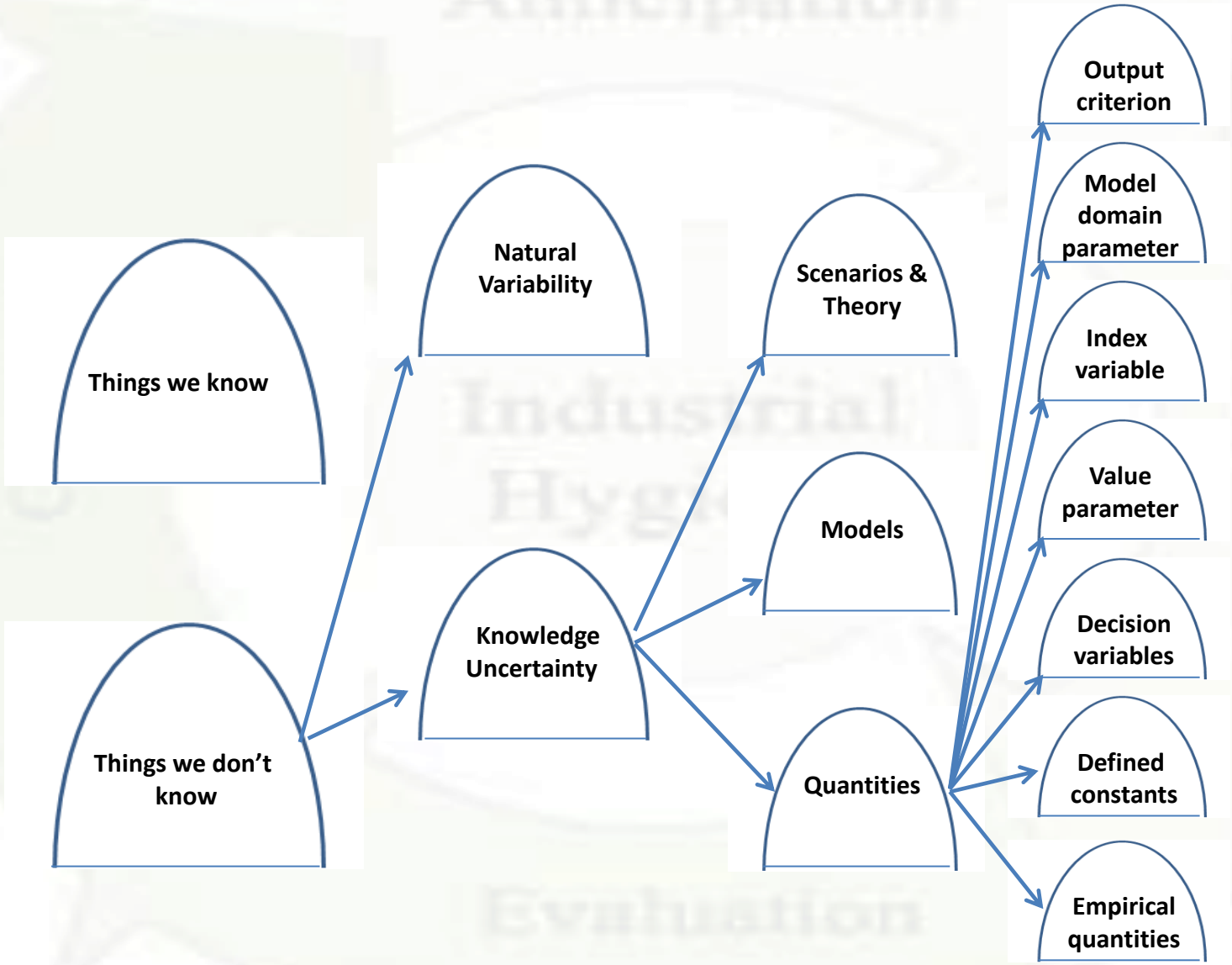
Macro-Level (Values)

- Increasing social complexity
- Rapidly increasing pace of change
- Global effects

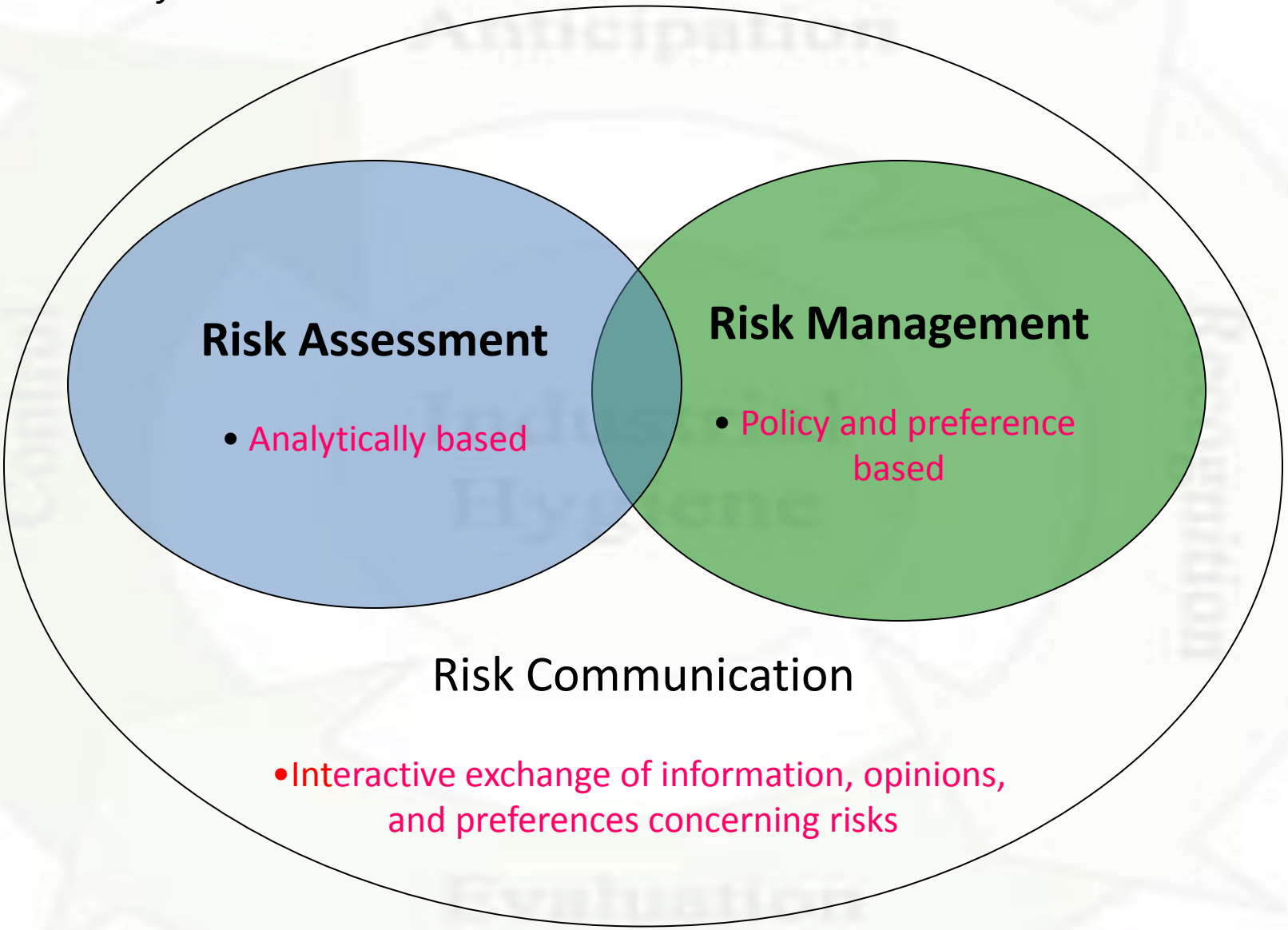
Micro-Level (Facts)

- Knowledge uncertainty
- Natural variability

Micro-Level Uncertainty



Risk Analysis->Decision-Making Under Uncertainty



Why Use Risk Analysis?

- To protect human, life and health as well as other endpoints
- To ensure a more reliable flow of workplace outputs and therefore desirable outcomes
- To improve decision making under uncertainty
- Traditional standards based approaches are no longer enough—problems persist
- National and global communities are embracing risk analysis

Risk Management

- What is the problem?
- What questions do we want risk assessment to answer?
- What can be done to reduce the impact of the risk described?

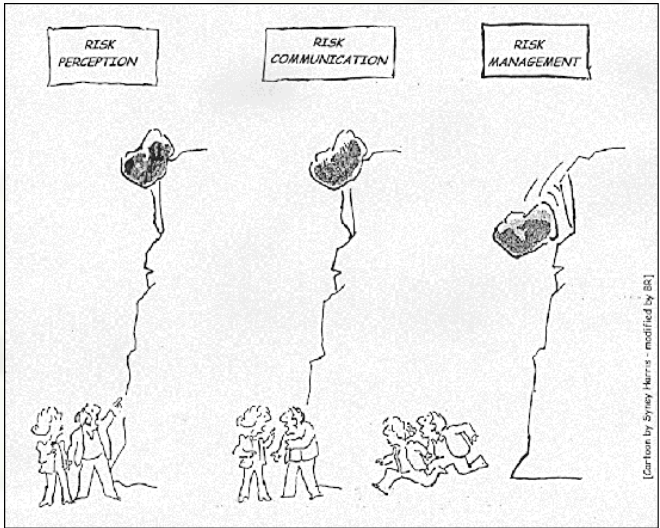
- What can be done to reduce the likelihood of the risk described?
- What are the trade-offs of the available options?
- What is the best way to address the described ?
- Is it working?

The Risk Manager's Job!

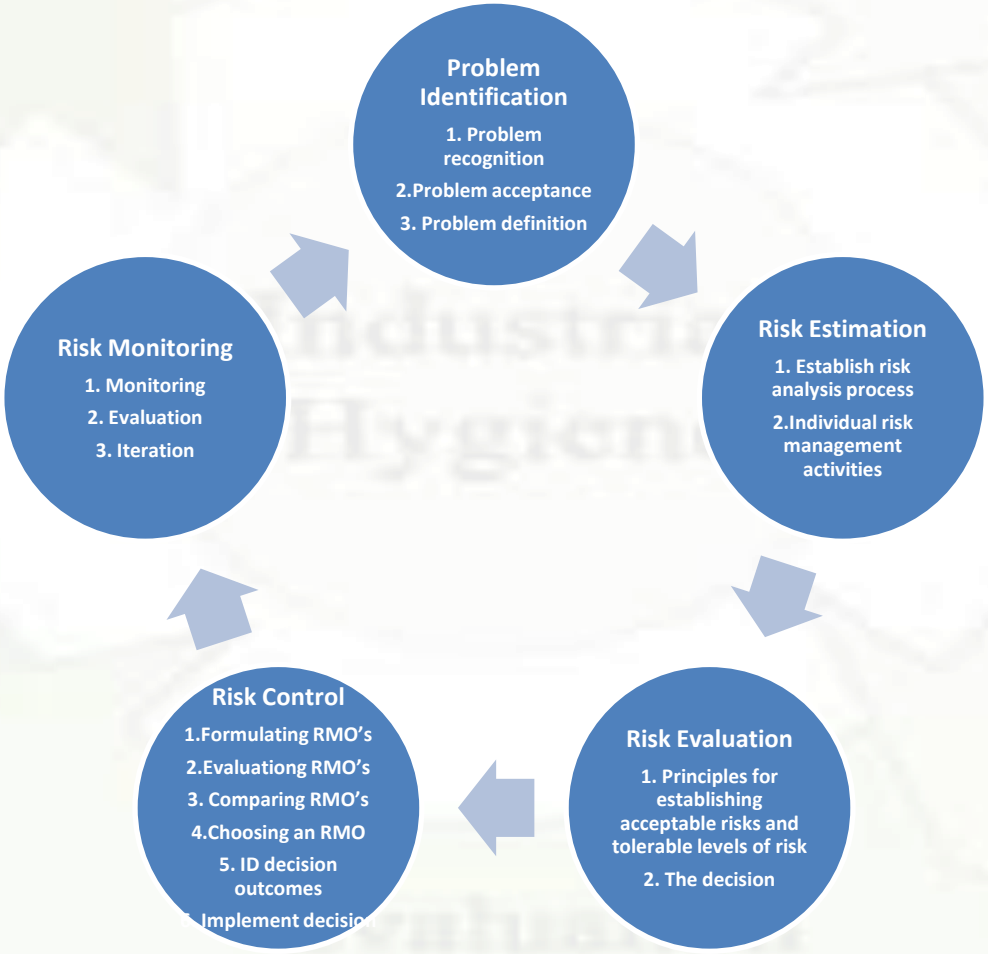
- Risk managers are responsible for risk analysis; they identify or validate problems
- Risk managers need scientific information to make decisions under uncertainty
  - They ask questions, which when answered yield the information needed to make decisions

The Risk Manager's Job!

- Risk assessors answer the questions and characterize the uncertainty in their answers
- Risk managers mitigate risks that are not acceptable and take risks that are prudent
- Risk managers make sure that risk communication takes place



Risk Management Process



Who Are the Risk Managers?

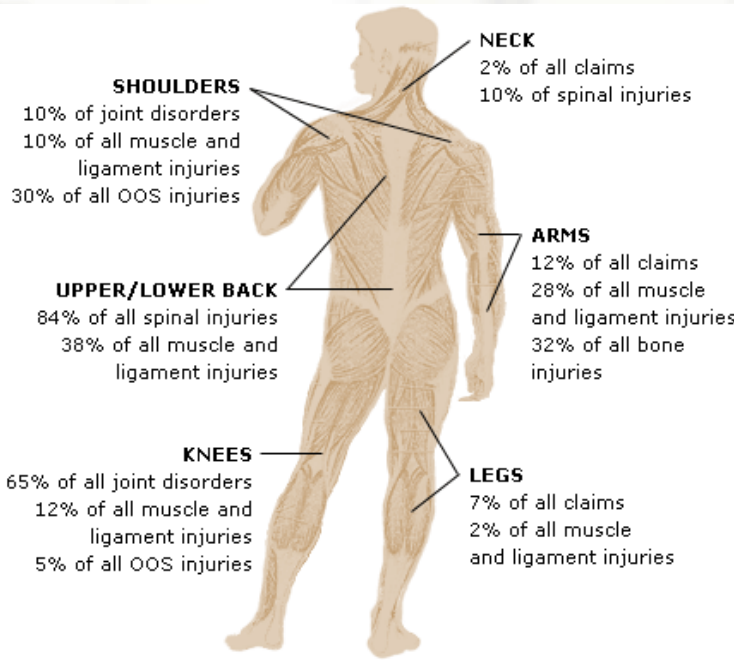
- OSHA? State? Company? Workers?
- There need to be many risk managers
- Who “owns” what part of the risk?

Risk Management Strategies

Risk Management Strategies	
Accept the risk as is?	
Risk Reduction	**Risk Taking**
Risk Avoidance	Risk Creation
Risk Prevention	Risk Stimulation
Risk Mitigation	Risk Promotion
Risk Transfer	Risk Sharing
Risk Retention	Risk Ignoring

Risk Assessment

- What can go wrong?
- How can it happen?
- How likely is it?
- What are the consequences?



Risk Assessment Model

An analytical and scientifically based process consisting of the following steps:

Look for the Hazard or Opportunity

Identify the hazards that can cause harm or the opportunities for gain that are uncertain.

Consequence Assessment

Decide who or what may be harmed or benefited and in what ways. Gather and analyze the relevant data. Characterize the consequences and their uncertainty qualitatively or quantitatively.

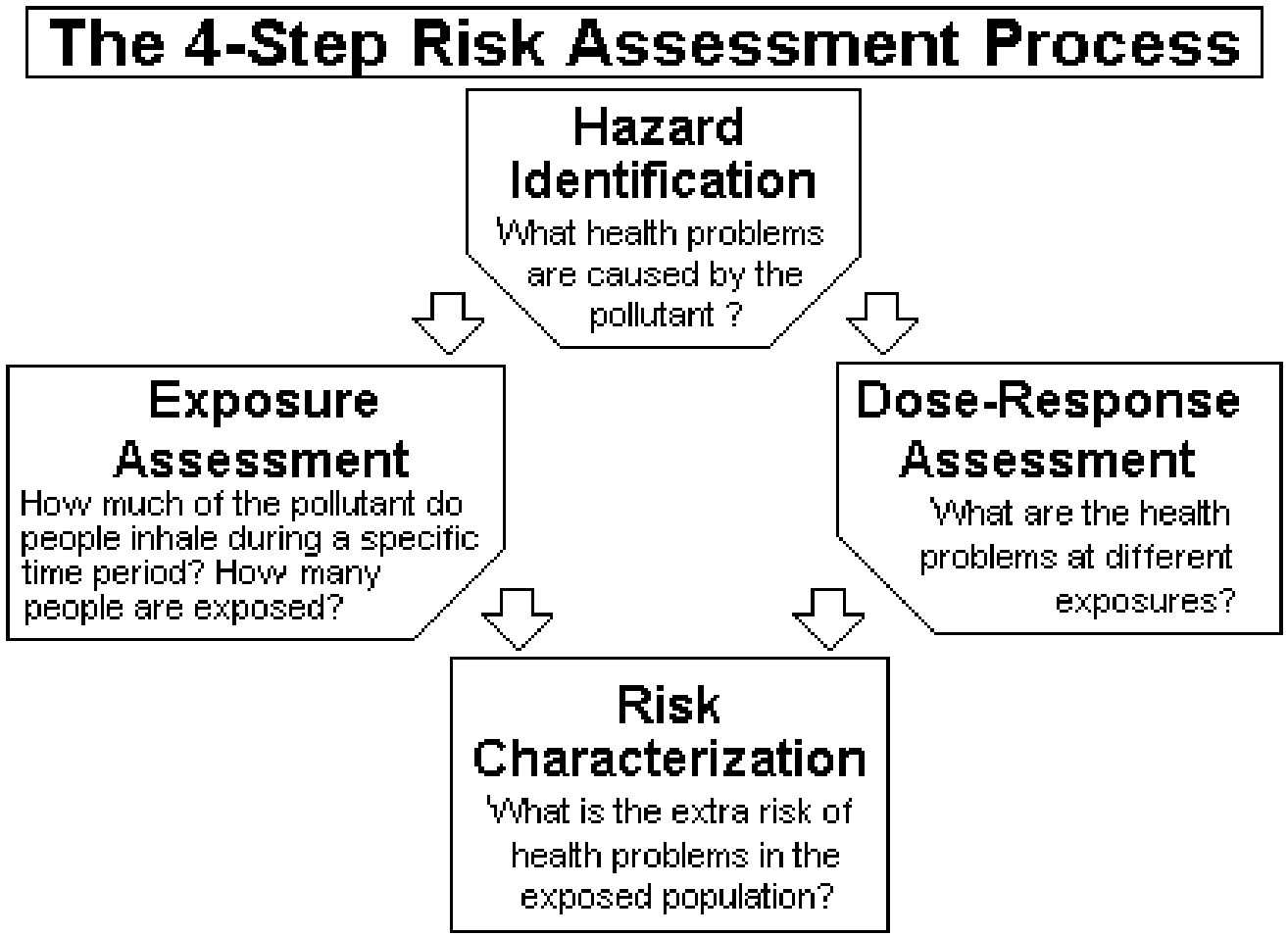
Likelihood Assessment

Assess the likelihood of the various adverse and beneficial consequences. Characterize these likelihoods and their uncertainty qualitatively or quantitatively.

Risk Characterization

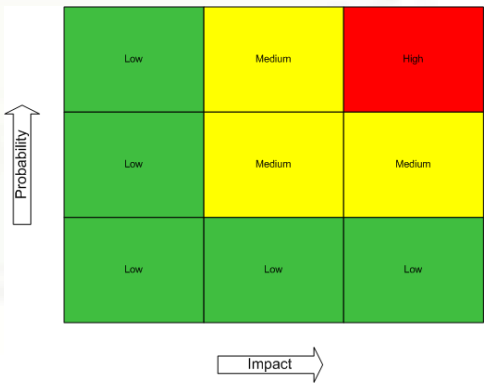
Estimate the probability of occurrence, the severity of adverse consequences, and the magnitude of potential gains, including attendant uncertainties, of the hazards and opportunities identified based on the evidence in the preceding steps. Characterize the risk qualitatively or quantitatively with appropriate attention to baseline and residual risks, risk reductions, transformations and transfers.

EPA (Toxic Air Pollutants)



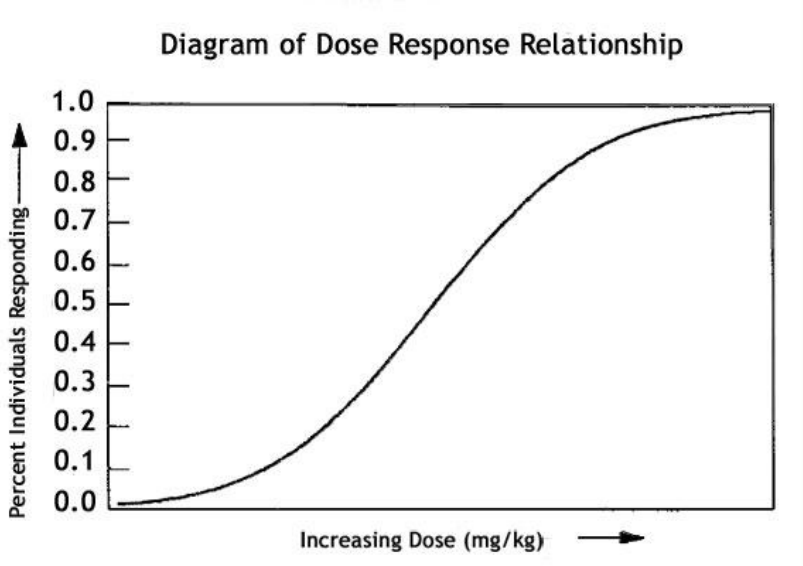
Qualitative Risk Assessment Methods Toolbox

- Increase or Decrease Risk
- Risk Narratives
- Evidence Mapping
- Screening
- Ratings
- Rankings
  - Enhanced Criteria Ranking
- Operational Risk Management (Risk Matrix)
- Develop a Generic Process
- Qualitative Assessment Models
- Multi-Criteria Decision Analysis



Quantitative Risk Assessment

- Safety Assessment
- Scenario Planning
- Scenario Analysis
  - Deterministic Scenario Analysis
  - Probabilistic Scenario Analysis
- Sensitivity Analysis
- Uncertainty Analysis
- Modeling
- Vulnerability Assessment



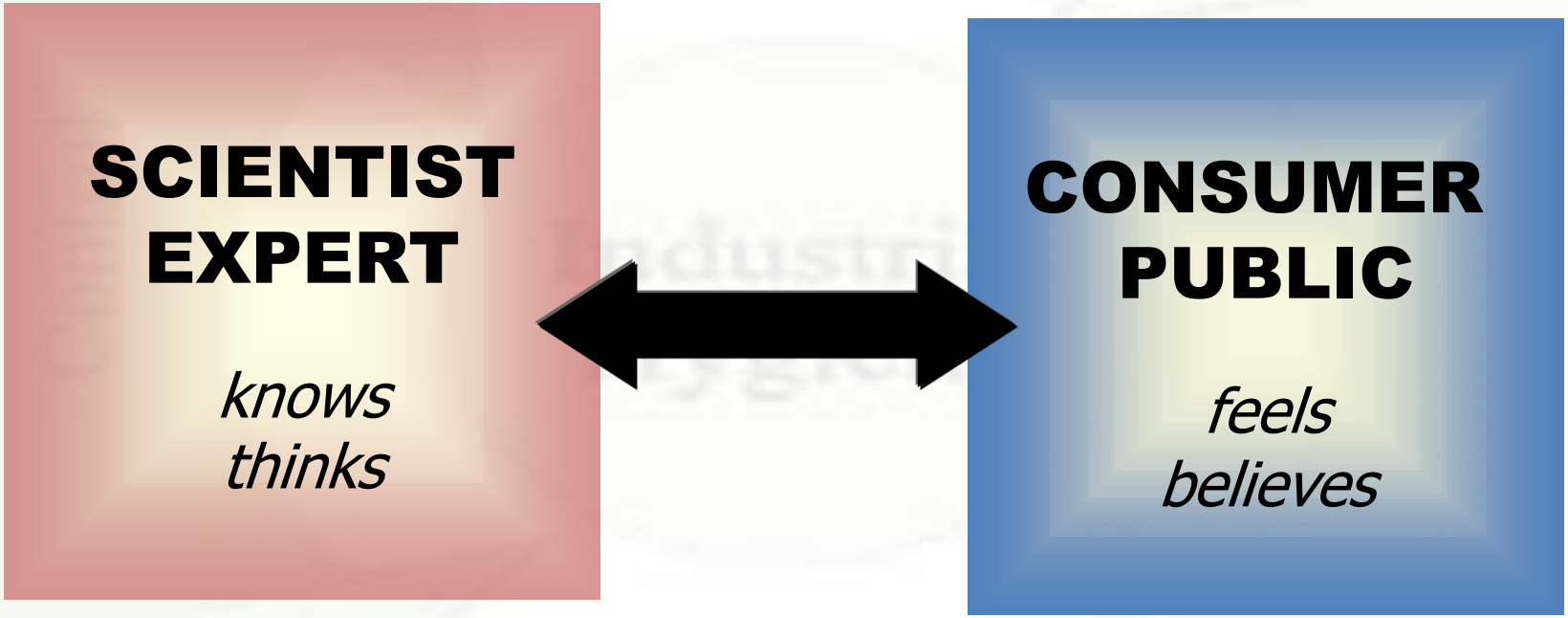
Risk Communication

- Why are we communicating?
- Who is our audience?
- What do our audiences want to know?
- What do we want to get across?
- How will we communicate?
- How will we listen?
- How will we respond?

Risk Communication Goals

- Tailor communication so it takes into account the emotional response to an event.
- Empowers stakeholders and public to make informed decisions.
- Prevent negative behavior and/or encourage constructive responses to crisis or danger.

Scientist - Consumer Disconnect



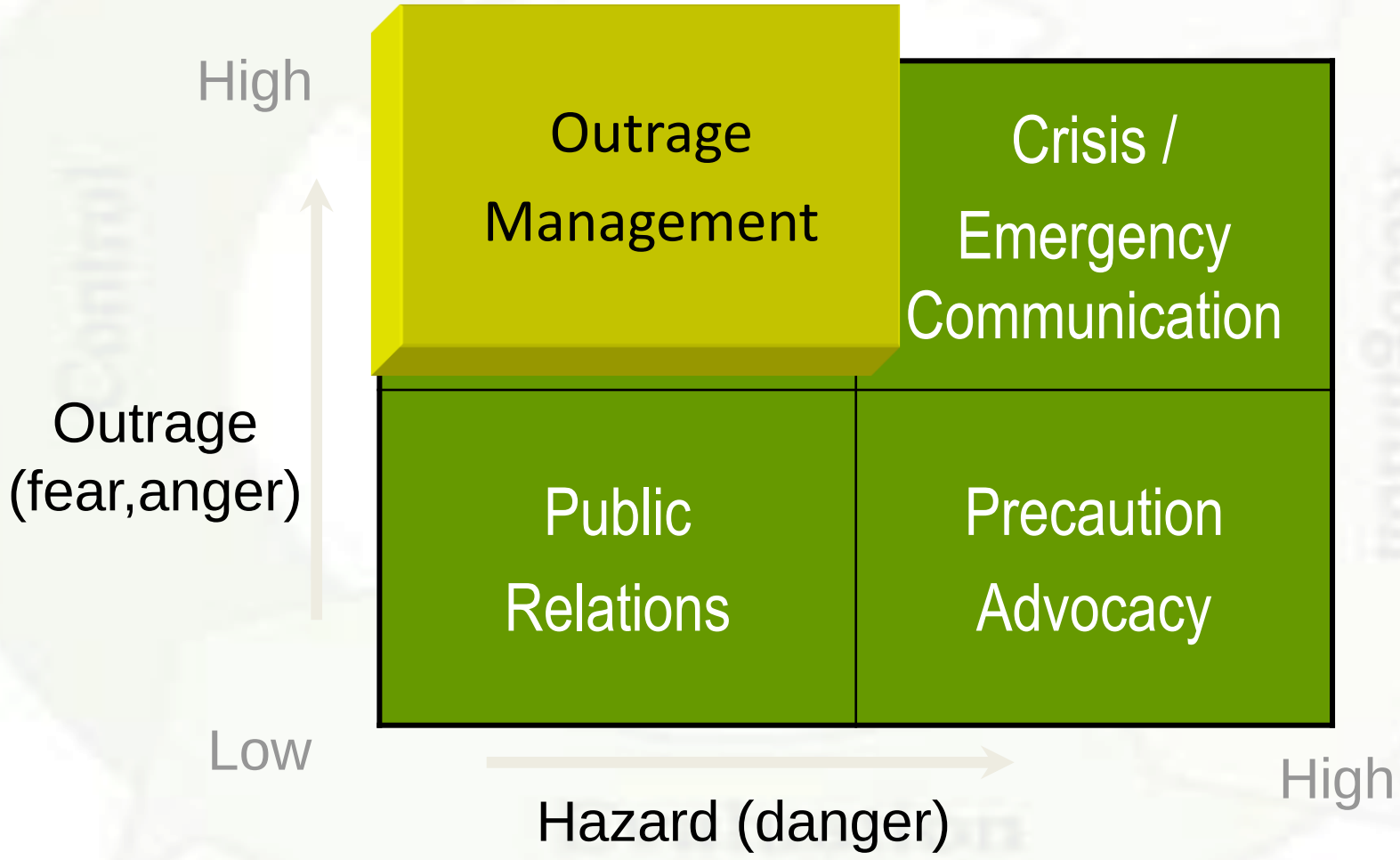
Fact-based:

hazard, probability

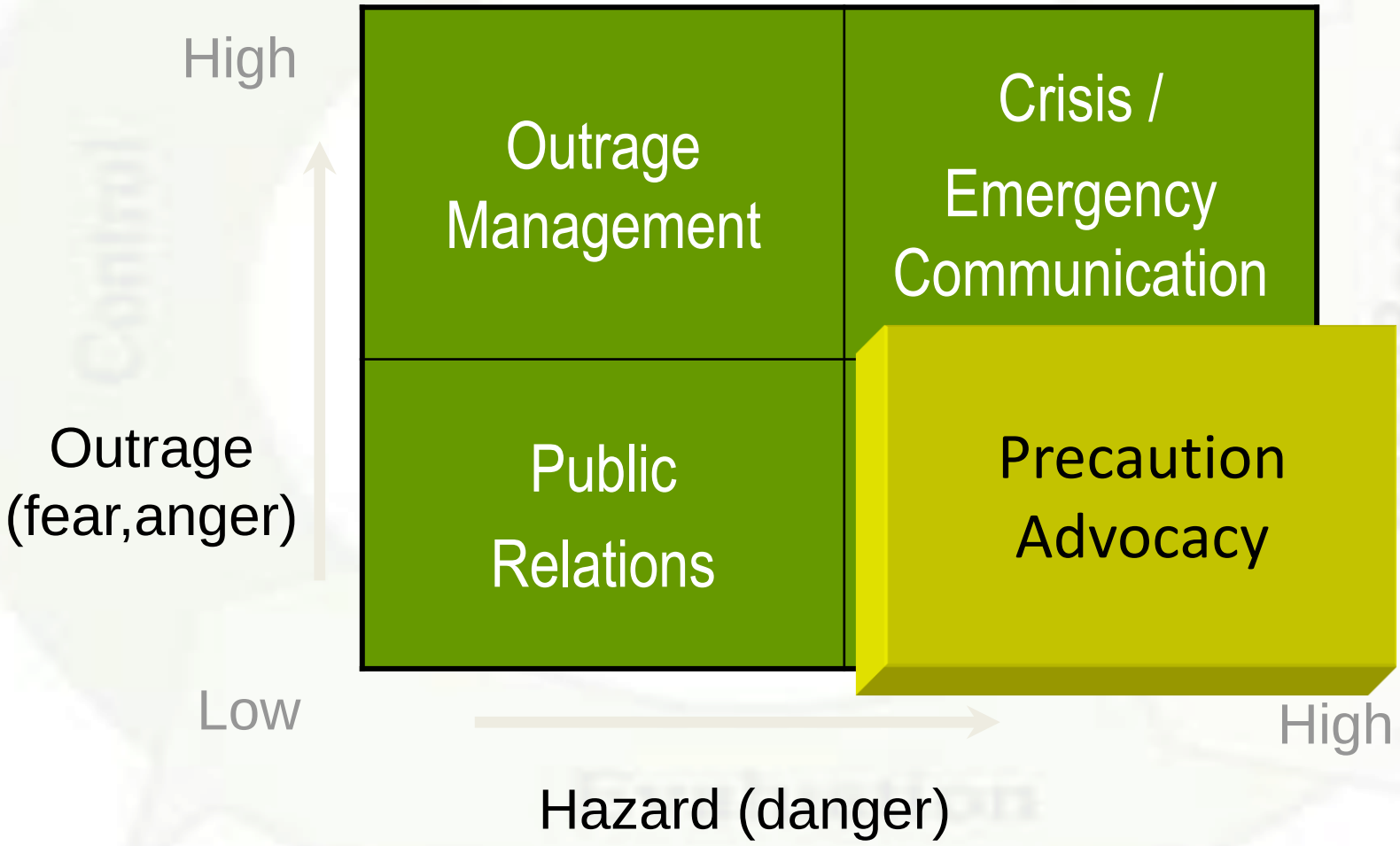
Value-based:

consequences, value

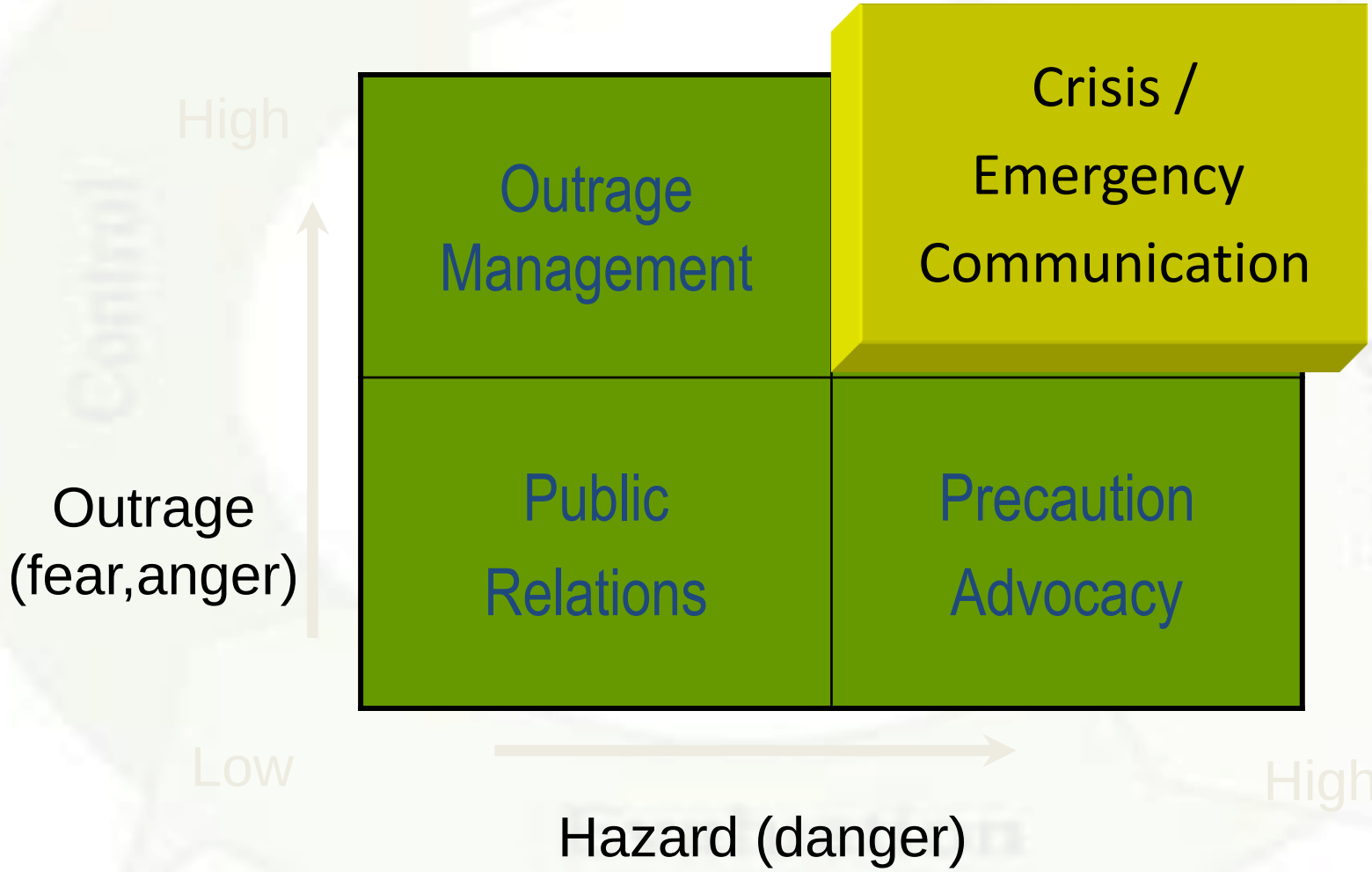
Goal: Reduce outrage so people don't take unnecessary precautions



Goal: Increase concern for a real hazard to motivate preventive action



Goal: Acknowledge hazard, validate concern, give people ways to act



Take Away Points

- Risk analysis comprises three tasks—risk assessment, risk management, and risk communication
- Risk management is decision making under uncertainty that depends on
  - Science & values important to stakeholders
- Risk assessment is evidence gathering
  - Separates what we know from what we don't know
- Risk communication will vary with the circumstances of the risk