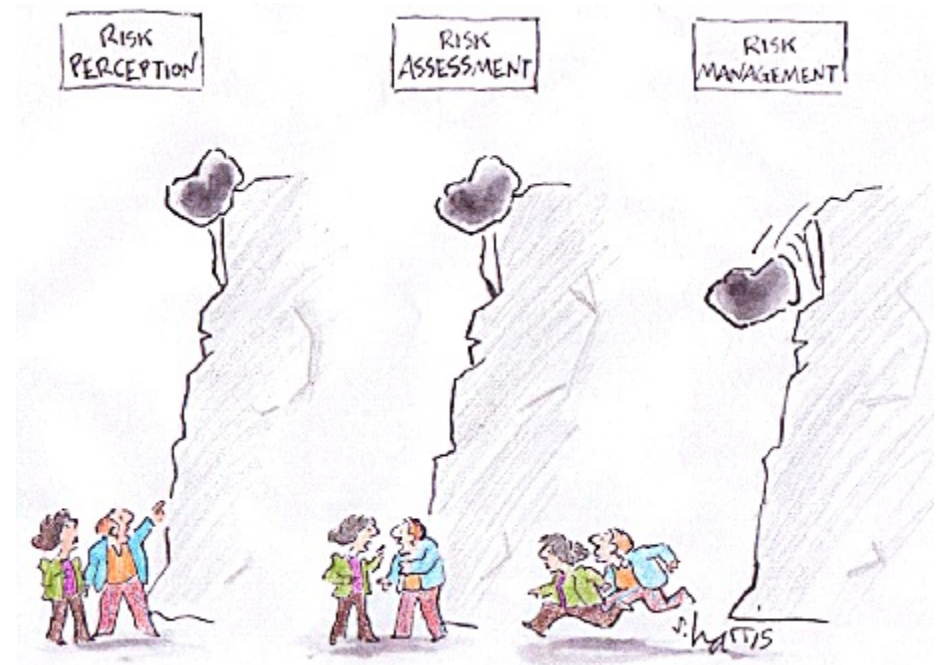# RISK

2. Risk
- definitions
- risk perception
- risk assessment
- risk management

(With content from Professor Wei Zhou, MANE)

1. DEFINITIONS

'risk   [*noun*; from old Italian(?) *riscare* to run into trouble]

- the possibility of incurring misfortune, loss, or injury: PERIL

- something or someone that creates or poses a hazard

"ASIDE FROM A CRAZED SHEEP NOW AND THEN, THIS IS A VERY RISK-FREE PROFESSION."

Which is safer?

A. Nuclear power

B. Roof-top solar

Which is safer?

   A. Nuclear power

   B. Roof-top solar

The risk?   I start an argument that creates
more **heat** than light

More viewpoints:

Take calculated risks. That is quite different from being rash.
– General George Patton

Stupid risks make life worth living.
– Homer Simpson

RISK: there is a risk that all of the oxygen will leave this room.

2. PERCEPTION OF RISK

Lake Nyos in Cameroon. 1,700 fatalities.

The concepts of "risk"

- an unwanted event which may or may not occur
- the cause of an unwanted event which may or may not occur
- the probability of an unwanted event which may or may not occur
- the severity of consequence of an unwanted event which may or may not occur

3. RISK ASSESSMENT

The "risk triplet":

    1. What can go wrong?

      2. What is the likelihood?

        3. What are the consequences?

Typical Observed Error Rates
– use of Software

Source of Data	Errors in:		Distribution of Errors
	Character	Field	
Inheritance	2-5%	10-25%	50%
Preparation	2%	10%	40%
Transcription	0.06-0.5%	0.3-2.5%	
Entry	0.004%-0.03%	0.02-0.15%	
Software			10%

Software Accuracy (and Confidence)

Comparing calculations based on identical input data	Number of Significant Figures
Single-precision (32 bit) floating point value	7 - 8
Single-precision arithmetic results (approximate)	6
Same code under different computer architecture, operating system, and compiler	4
Same code under continual enhancement	1 - 2
Different codes that do the same thing	1

Examples of Risk Issues for Design Projects

Risk Issues

– Inaccurate / incomplete
  CAD models

– Tasks competing for
  inadequate funds

– Parts cannot be found
  or purchased

– Tasks competing for
  inadequate time

– Poor tolerances on
  system components

Consequences

= System cannot be
    assembled

= Run out of money

= Don't finish on time

= System does not meet
    specifications

Probability of Occurrence

Estimated by expert judgment or from data drawn from previous experience and events.

Probability of Occurrence

Estimated by expert judgment or from data drawn from previous experience and events.

Question: did you experience delay
               in your mini-project?

A. Yes
B. No

Probability of Occurrence

Estimated by expert judgment or from data drawn from previous experience and events.

Question: did you experience delay
in your mini-project?

A. Yes
B. No

Probability of delay ≈ #A's / total polled

risk = severity of the event

$\times$ probability of occurrence

Probability of Occurrence
Likely $\gtrsim$ 80% chance
Probably   20 to 80% chance
Unlikely $\lesssim$ 20% chance

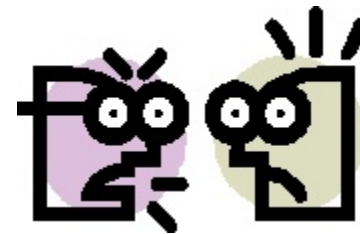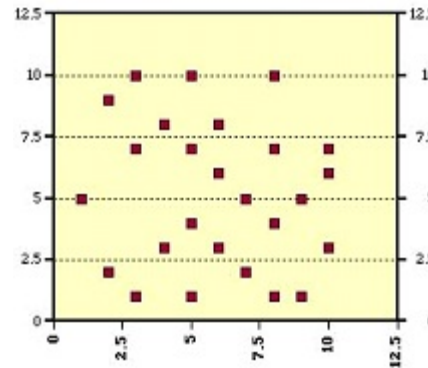Severity of Impact
High (5)   –   a major show stopper
Moderate (3) – project proceeds forward with impacts
                on quality, cost and time
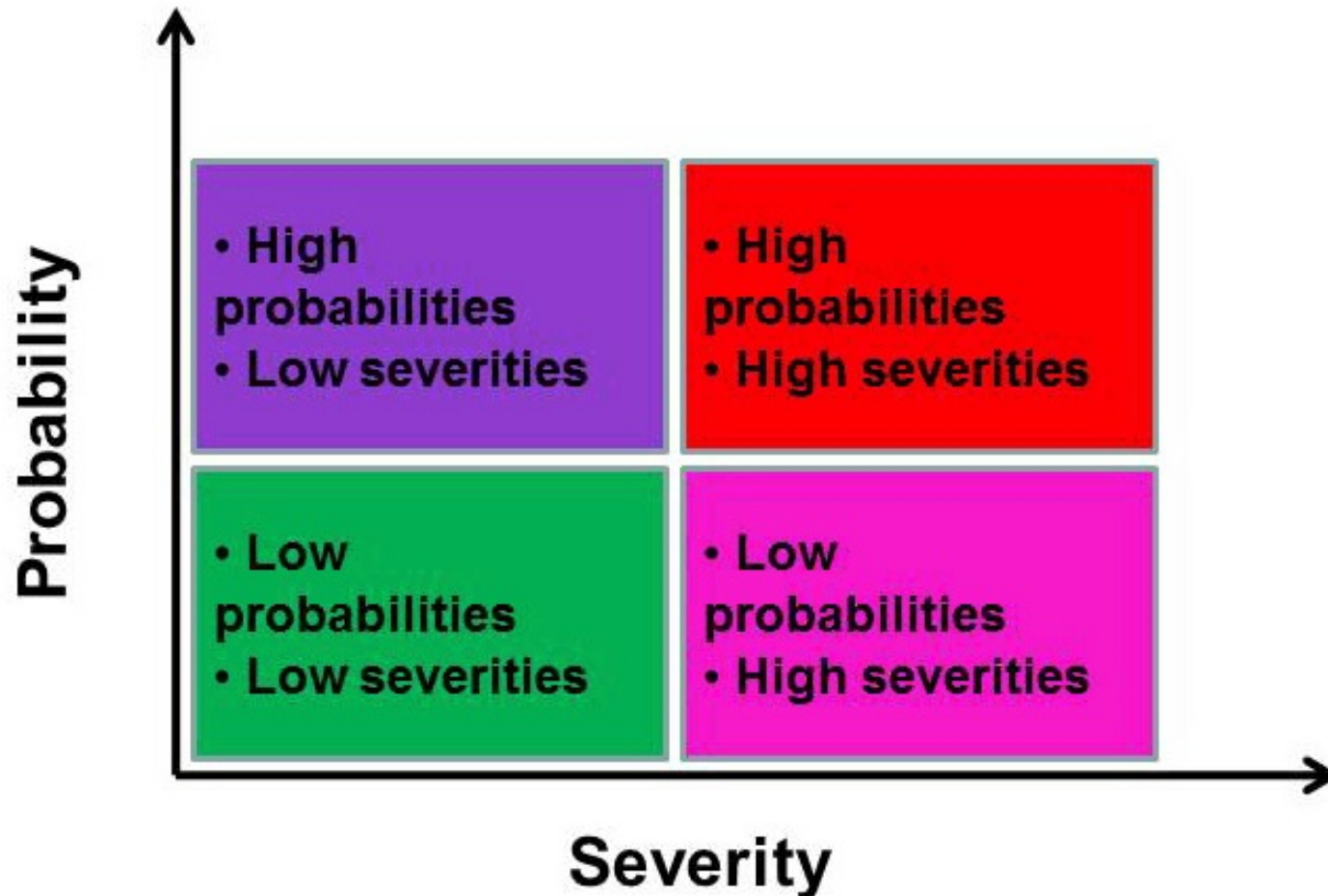Low (1)   –   minor impact on quality, cost and time

Sources of Parameter Uncertainty

- Measurement errors

- Systematic errors
- Sampling errors
- Unpredictability
    – e.g., chaos

- Linguistic imprecision
    – e.g., using adjectives

Risk Assessment Outcomes

Probability (vertical axis) vs Severity (horizontal axis) quadrant chart:

- Top-left (purple): • High probabilities • Low severities
- Top-right (red): • High probabilities • High severities
- Bottom-left (green): • Low probabilities • Low severities
- Bottom-right (magenta): • Low probabilities • High severities

4. MANAGEMENT OF RISK

1. What can be done?

2. What options are available and
    what are their associate trade-offs
    (costs / benefits / risks)?

3. What are the impacts of
    current decisions on future options?

Risk Management Options
risk-based decision-making

Risk

Absolutely unacceptable

Compare costs benefits risks

Broadly acceptable
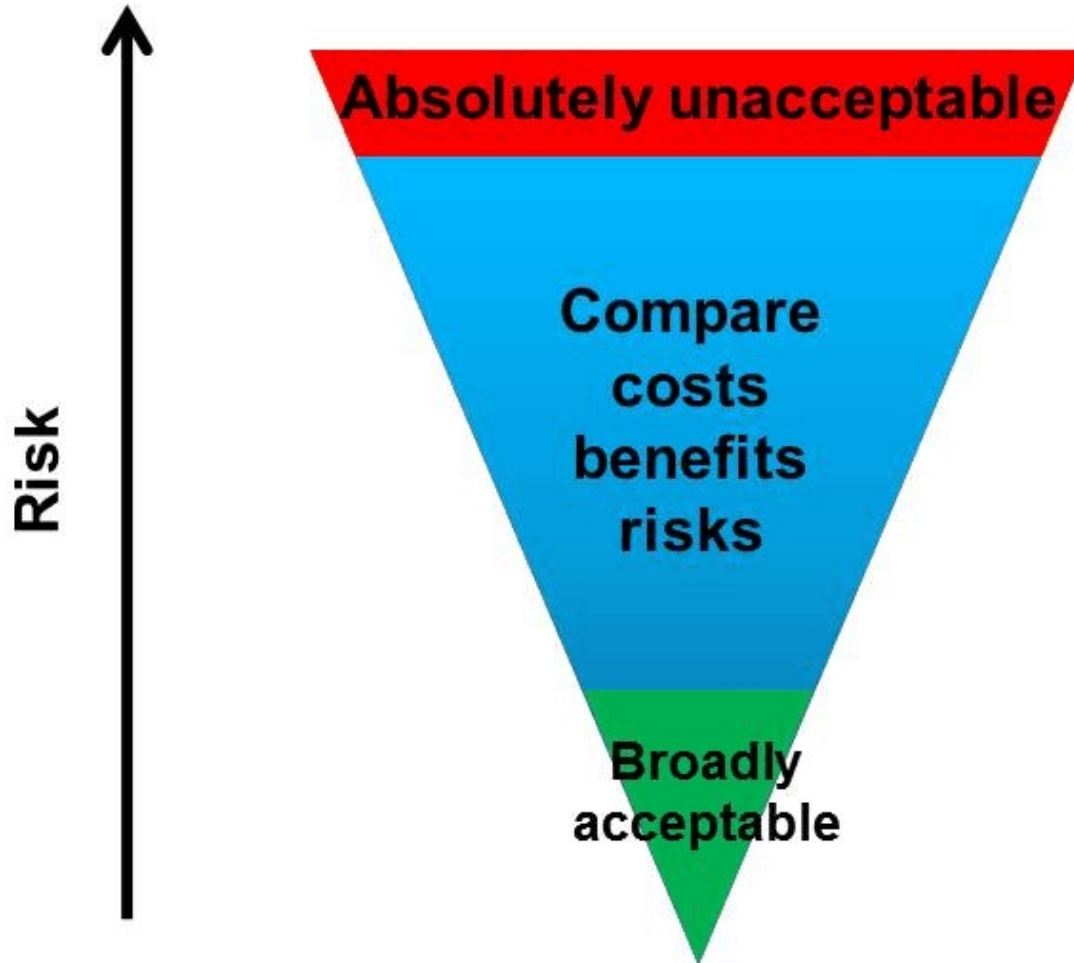
Your process and product should protect:

- Safety,
- Health, and
- Environment

Project management role

schedule   task prioritization

budget   resource allocation

Time-tested wisdoms:

While solving a problem,
   avoid creation of other problems
        ("Global solutions invite global problems")

Prevention of unwanted events is
     cheaper and easier
than dealing with the aftermath