SE Risk Management: Part I

CSULA – EE 4130

Prof. Joel K. Harris

March 12, 2018

"Terminal Learning Objectives" For Today...

- Understand the definition of a *risk* vs. an *issue*, & the implications of both

- Know the <u>5 elements</u> of a standard risk management process

- Be able to differentiate between *qualitative* and *quantitative* risk management approaches

- Appreciate the difficulties associated with schedule risks and their mitigation

"Risk Management 101"

- A Few Risk Definitions:

  - ➤ *"Project risk is an uncertain event or condition that, <u>if it occurs</u>, has a positive or negative effect on at least one project objective, such as time, cost, scope or quality."*

    - PMI Book of Knowledge (PMBOK) (2004)

  - ➤ *"Risk: a measure of the uncertainty of attaining a goal, objective, or requirement pertaining to technical performance, cost and schedule."*

    - INCOSE SE Handbook, Version 3

  - ➤ *"Risk is a measure of the potential inability to achieve overall program objectives within defined <u>cost, schedule, and technical constraints</u>, and has two components: (1) the probability/likelihood of failing to achieve a particular outcome, and (2) the consequences/impacts of failing to achieve that outcome"*

    - DoD Risk Management Guide, Version 3

Primary Risk Management Processes

- Risk Management as a process consists of 5 main elements:
  - ▲ Risk *Identification*
  - ▲ Risk *Assessment/Analysis*
  - ▲ Risk *Planning/Handling* (acceptance, transfer, mitigation or avoidance)
  - ▲ Risk *Control* (tracking)
  - ▲ *Communication*

- 2 fundamental methods of risk assessment are:
  - ▲ Qualitative
  - ▲ Quantitative
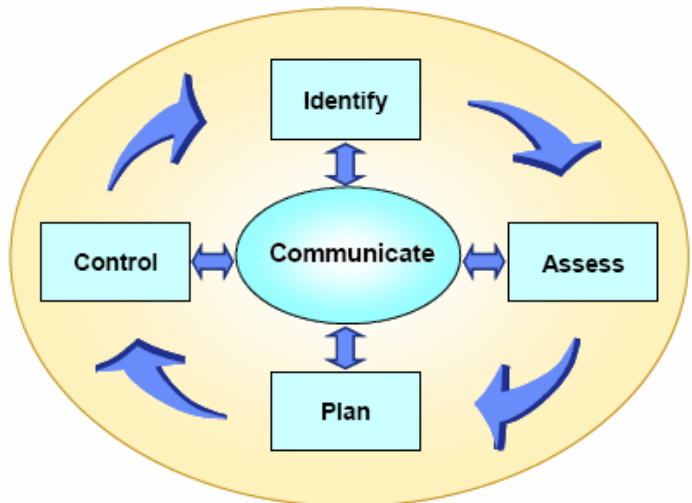
Qualitative Risk Management

- The most prevalent form of risk management in use within most industries
  - Why: it's simple, intuitive and easy to learn
  - Also, it leverages SME knowledge from experienced IPT members

- Uses two parameters to determine a risk threat: 1) risk consequence and 2) likelihood of occurrence
- Risk severity is determined by the formula:

  Risk Exposure = Consequence X L_o [Likelihood of Occurrence]

| Risk Likelihood	Risk Consequence				
	1 Insignificant ≤ $1 M ≤ 2 week slip	2 Modest $1.5 M 6 week slip	3 Moderate $3 M 2 month slip	4 Significant $5 M 4 month slip	5 Unacceptable ≥ $10 M ≥ 6 month slip
E High (Almost Certain)					
D Medium High (Somewhat Likely)		2	3 7	17	
C Medium (Even Chance)	4	11 13 1	12 10	8 9 5	
B Medium Low (Unlikely)	15 16 14	6			
A Low (Highly Unlikely)					

Low   Medium   High

Quantitative (PRA*) Risk Management

- Not used as extensively as qualitative risk management
  - ➤ Why: PRA is not meant to *manage* or *determine the status* of program risks
  - ➤ Instead, it is a tool of *system safety and reliability engineering* disciplines (a *predictive* tool vs. a *descriptive* tool)
  - ➤ Quantitative RM addresses randomness/probability, but not vagueness/impreciseness
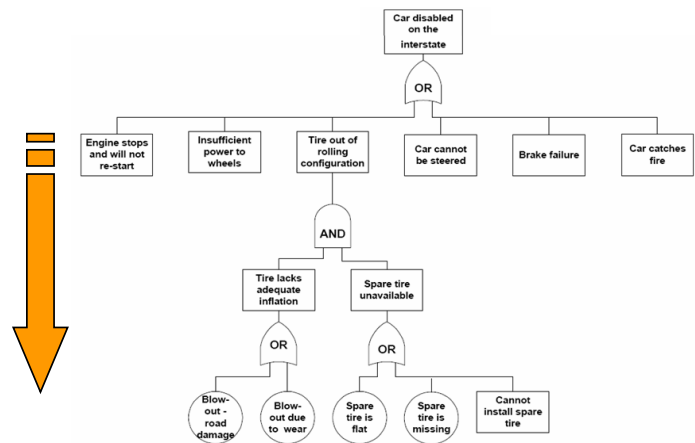 - ➤ It requires significant knowledge in statistics and/or probability theory

  *** Probabilistic Risk Assessment**

Quantitative/PRA Risk Management Tools (1 of 2)

- **Decision Tree Analysis**
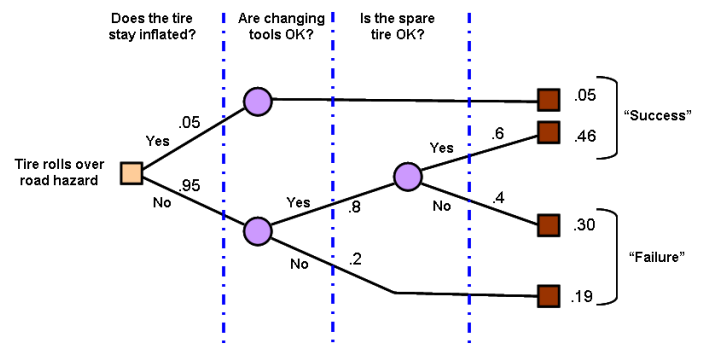
- **Fault Tree Analysis**

Quantitative/PRA Risk Management Tools (2 of 2)

- The primarily quantitative method used in program risk management is the Monte Carlo method (MCM) - developed during the Manhattan Project by John von Neumann

- MCM predicts a range of outcomes/scenarios using a random number algorithm to produce a Gaussian/normal distribution/cumulative distribution function, indicating the probability of event outcomes

Forecast: Nozzle Material Cost Distribution

Forecast: Nozzle Mat'l Risk Cost

8
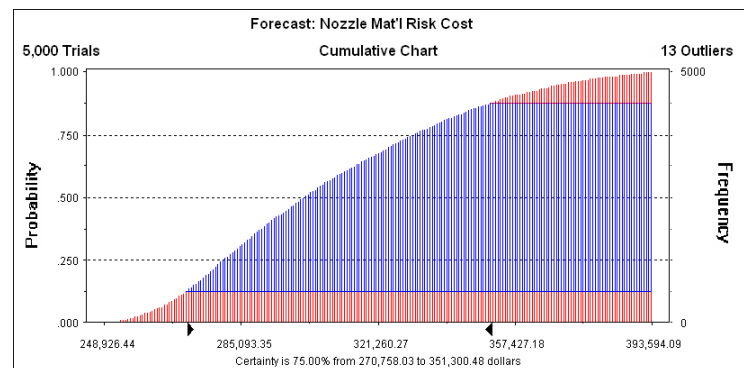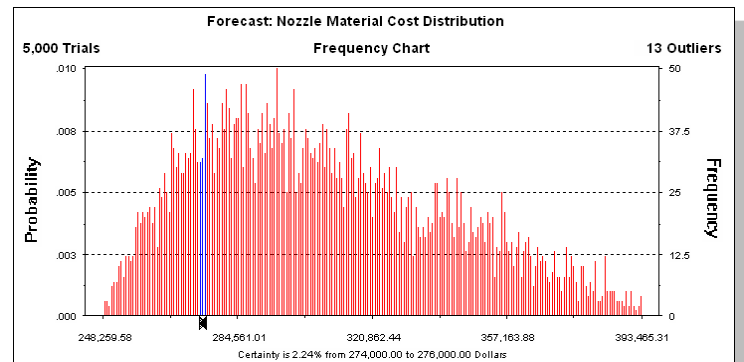
How *Risks* and *Issues* Differ
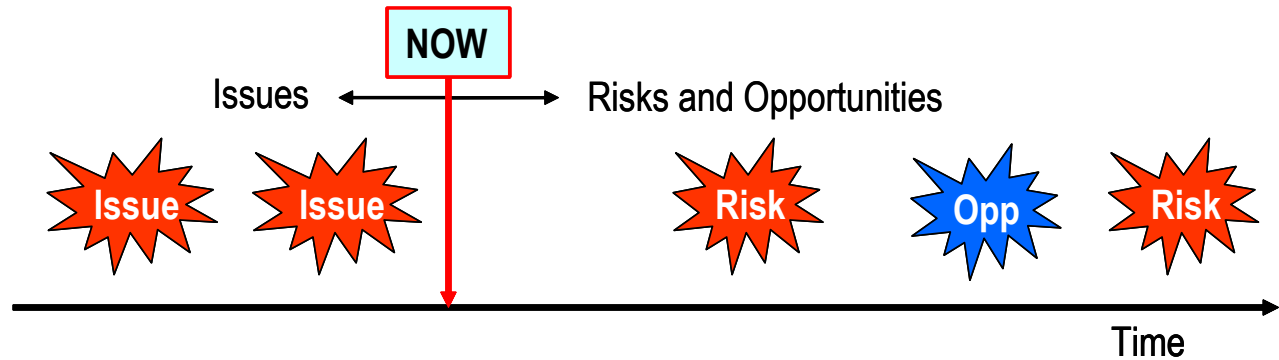
Risks have NOT occurred yet (they are in the *future*)

Issues have already taken place (they are in the *past*)

Source: S. Carman - NGST

Risk Management Steps - $\varnothing$ One: Risk Identification

- Important points to keep in mind:
  - ➢ <u>Anyone</u> can identify, propose and contribute a new risk candidate within the risk process
  - ➢ Risks are not solely <u>technical</u> in character (process, schedule, resource, and capability are valid risk sources)
  - ➢ All risks progress through discrete stages within the risk process:
    - ▲ Candidate risk
    - ▲ "In Process" risk
    - ▲ Baselined/Active risk (also inactive/watch list risk)
    - ▲ Closed/mitigated risk

Risk Management Steps - ∅ Two: Risk Assessment (1 of 2)

- The intent of risk assessment is to answer the question: "How <u>significant</u> is this risk?"
- There are two parameters we assess each risk item upon:
  - ➢ *Likelihood* or *probability* of the risk occurring
  - ➢ *Impact* or *consequence(s)* suffered, if the risk should be realized
- Examples of risk likelihood and impact criteria:
  - ➢ A typical risk Likelihood scale:

    - ▲ **Frequent - > 1 in 10; Continuously experienced**

    - ▲ **Probable - 1 in 10 to 1 in 100; Occurs frequently**

    - ▲ **Occasional - 1 in 100 to 1 in 1000; Occurs several times**

    - ▲ **Remote - 1 in 1000 to 1 in 1000000; Unlikely, but could reasonably be expected to occur**

   - ▲ **Improbable - < 1 in 1000000; Unlikely to occur, but possible**

Source: Mil-Std-882

11

Risk Management Steps - $\varnothing$ Two: Risk Assessment (2 of 2)

- Sample risk consequence scale:

Factor	Description
1	Minimal or no impact
2	Team budget increases or unit cost increase <5%
3	Team budget increases or unit cost increase 5-7%
4	Team budget increases or unit cost increase >7-10%
5	Team budget increase or unit cost increase >10%

Risk Threat Levels
- **Red** – **High Risk (capable of major project disruption)**
- **Yellow** – **Moderate Risk (some disruption possible)**
- **Green** – **Low Risk (minimum disruption)**
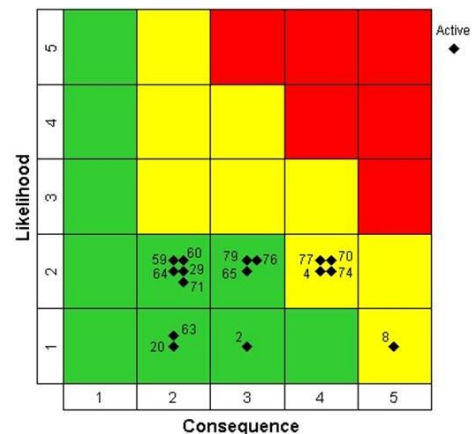
Risk Probability Impact Diagram (PID)

Risk Management Steps - ∅ Three: Risk Handling/Planning (1 of 2)

- There are four (4) fundamental risk handling approaches:
  - ➤ <u>Acceptance</u> – accept the risk and its attendant consequences as part of "doing business"/the project
  - ➤ <u>Avoidance</u> – change the requirement, alter the design, do something to cause the risk to essentially "go away"
  - ➤ <u>Transfer</u> – move the risk item to either another discipline area, or another owner/team (**note**: this does NOT mean simply <u>refusing to accept the risk</u> or "throwing it over the fence")
  - ➤ <u>Mitigation</u> – applying program resources (time, $$$, heads) to lessen either/both the potential risk likelihood or impact