

***Advanced Concepts for
Practicing Risk Management***
A Tutorial on How to Avoid the Perils and Pitfalls

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Topics

- **An Interactive Discussion to Set the Context for the Tutorial**
- **Pitfalls in Practicing Risk Management**

And How to Avoid Them!

What is a Risk?

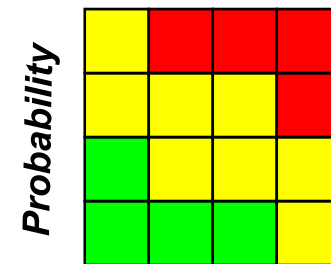
- **Simply An Uncertain Future Consequence**
 - The Level of the Consequence that might be Realized is Uncertain
 - The *Measure* of Risk is the *Probability* that a Consequence *at or Above a Specified Level* will be Realized

What is An Opportunity?

- **Simply An Uncertain Future Consequence**
 - **Most if Not All Consequences can Range from Very Bad to Very Good**
 - ***PMI* and Decision Theory Texts Do not Distinguish between Risks and Opportunities**
 - **The *Math* is the Same**
 - **Managing Disadvantageous Risks and Advantageous Risks (Opportunities) Separately Leads to Poor RM Performance (a pitfall to avoid)**

What is the Risk Matrix?

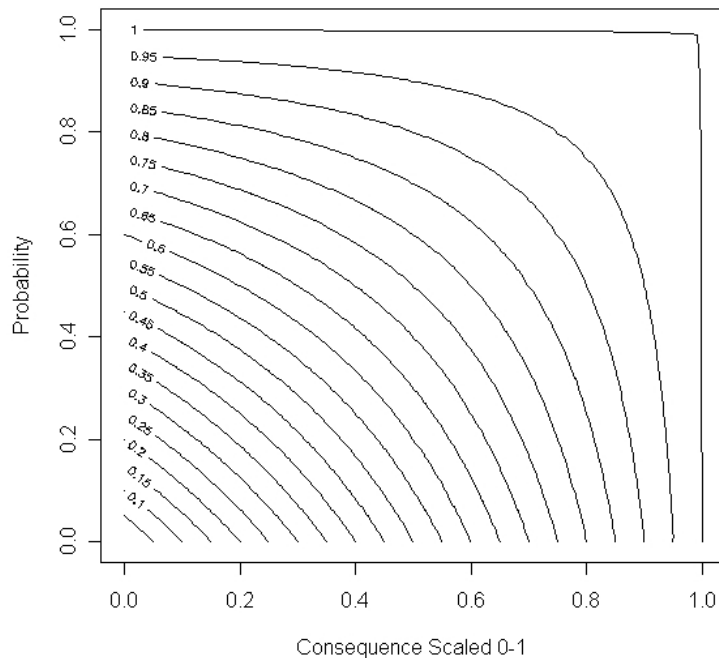
- A Means to Illustrate *Equivalent* Risks
 - A High Probability, Low Consequence Risk may be *Valued* the Same as a Low Probability, High Consequence Risk
 - Shows the *Risk Tolerance* of the *Decision Maker*
- 5 x 5 is Common, but not Always Suitable
 - Generally, an n x m
 - *The Familiar n X m Risk Matrix*
 - **Green** are Low or Acceptable Risks
 - **Yellow** are Moderate Risks
 - **Red** are High or Unacceptable Risks



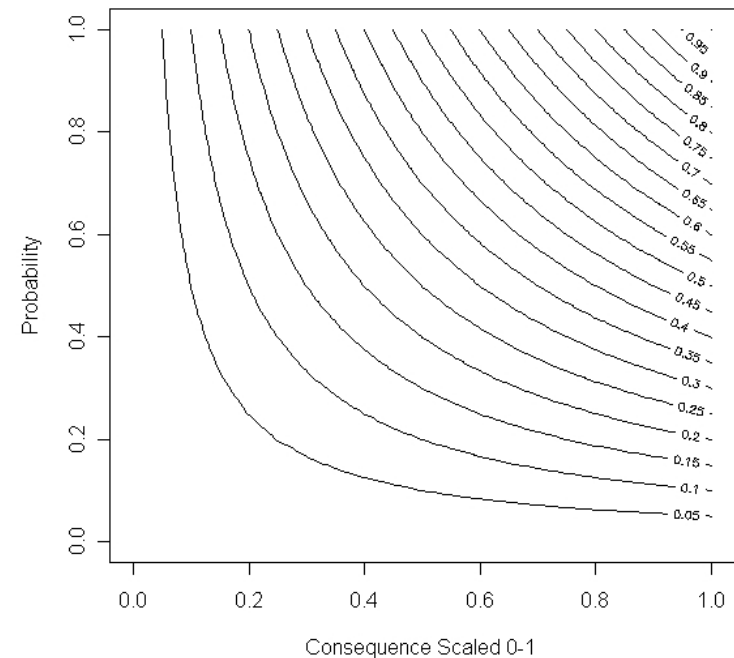
Consequence

Risk Level Contours

Risk Factor - Risk Averse



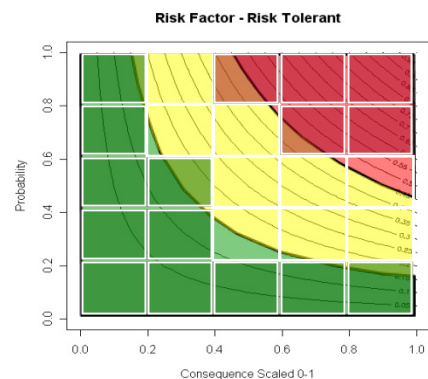
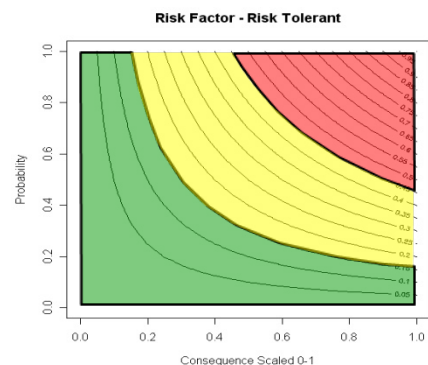
Risk Factor - Risk Tolerant



Isocontours are Equivalent Risk Levels – Lines of Constant Values for Combinations of Probabilities with Consequence Levels

How to Create a Risk Matrix

- Develop Risk Level Contours based on Decision Maker *Values* on the Consequence (Decide)
- Have the Decision Maker Decide on **Acceptable** and **Unacceptable** Risk Levels
- *Quantize* Consequence and Probability Scales Appropriately
- Fill in the Colors (**G**, **Y**, **R**) Appropriately



What is Risk Management?

- **A Decision Process**
 - For What to Do About Future Consequences *Unanticipated* in the Project Plans
 - *Expend Resources* to **Change** the Uncertainty
 - *Expend Resources* to **Plan** What to Do if the Uncertainty Changes in an Undesirable Way
 - **Commit** the Resources as if the Consequences have been Realized
- **All Decisions on a Project (including RM Decisions) are Based on a *Risk Assessment***

What is a Risk Assessment?

- Risk Assessment *Always* Answer a Simple Question:

*Based on the Available Data, How Sure can we be that the Risk Level is **Unacceptable**?*

- Risk Assessment Can be Purely *Qualitative* - Seat of the Pants, Shoot from the Hip, Best Engineering Judgment (SWAG), or just a Guess (WAG)
- *Quantitative* Risk Assessments Statistically Process the Available Data producing a Numerical Answer (probability)
 - Unfortunately, Available Statistical Packages Do Not Calculate Assurance Levels for Risks, Definitely *not without a Lot of Assumptions*
 - Up until about 1995, *Impossible* to do Quantitative Risk Assessments for Real World Problems, *especially without a lot of Assumptions*

Qualitative or Quantitative Risk Management?

- **Unless Quantitative Risk Assessments are Used, it *is* Qualitative Risk Management**
- **Qualitative RM May be Good Enough!**
- **However –**
 - **If there exists a *lot* of Data, or**
 - **If the Consequences can be *Severe***

Quantitative Risk Management may be Worth the Investment!

Qualitative vs. Quantitative

- Quantitative Risk Management *Always* uses Quantitative Risk Assessments
 - Usually *thought* to be Expensive, But Rarely is
 - Always Produces More Comforting and Less Controversial Risk Management
 - Very Difficult to Find Skills to Perform
- Qualitative Risk Management – *Anything Else*
 - Numerical Schemes for Risk Matrices *don't* Make it Quantitative
 - Use of Probability Numbers in the Risk Matrix *don't* Make it Quantitative
 - Guesses or Best Professional Estimates on Probability and Consequence Numbers *don't* Make it Quantitative
 - But, May be Good Enough for a Lot of Risks
- Calling Risk Management Quantitative when really Qualitative can Lead to Bad Decisions (a pitfall)

More on the Risk Management Concept

- **The Risk Matrix Illustrates the *Decision Structure***
- **Risk Assessment Provides the *Decision Discriminator***
 - **Statistically Processes (either mentally or mathematically) Data to Produce an *Assurance* for the Level of Risk**
 - **The Level of Assurance Required for Action is Determined by the *Project Risk Strategy***

Common Risk Pitfalls

Those We have Already Hit

- **Pitfall:** Managing Disadvantageous (Risks) and Advantageous (Opportunities) Separately
- **Solution:** Manage Both *Together*; If Some Manager wants it Separate, Report Separately, but Manage Together
- **Pitfall:** Forcing a 5 x 5 Risk Matrix when Not Appropriate
- **Solution:** Use Some *Common Sense* based on the Risk Consequences and Probabilities
- **Pitfall:** Not Using Decision Maker Values to Form the Risk Matrix
- **Solution:** Use them if you can, If not, *Parameterize*

More We have Already Hit

- ***Pitfall:*** Calling Risk Management *Quantitative* when Really *Qualitative*
- ***Solution:*** Be *Honest* – Managers will Lose Faith Otherwise; Don't Use Misleading Terms like Semi-Quantitative
- ***Pitfall:*** Ignoring the Advantageous Side of a Risk Consequence
- ***Solution:*** Include the Potential Advantageous Consequences

Programmatic Risk Pitfalls

- **All Risks are Truly Technical**
- ***Pitfall:*** Managing “Programmatic” Risks Separately
- ***Solution:*** Manage All Risks with the Same System; Have Systems Engineering Perform all Risk Management

Management Pitfalls

- ***Pitfall:*** Failing to Establish Risk Margins for Schedule and Budget
- ***Solution:*** Re-schedule and Re-budget to Establish Risk Margins
- ***Pitfall:*** Using Risk Margins for Something besides Risk Analysis, Risk Assessment, and Risk Mitigation
- ***Solution:*** Manage with Some Discipline; Never Use or Release Margin unless the Risks become OBE

Risk Matrix Pitfalls

- **Pitfall:** Improper Scaling and Binning of Consequences and Probabilities Axes
- **Solution:** Scaling and Binning requires and should reflect *Decision Maker Values*
 - Not Some Arbitrary Formula
 - Try Utility Approaches
- **Pitfall:** Always Using a 5 x 5 Matrix
- **Solution:** Bin Appropriately based on a Proper Scaling, and How Binning Fits with Unacceptable and Acceptable Risks
- **Pitfall:** Using the Same Risk Matrix for All Risks
- **Solution:** Create a Risk Matrix for Each Risk (Each Risk will be Different)

General Risk Pitfalls

- **Pitfall:** Probability Value Numerical Distortions
 - Relative vs. Absolute
 - $1.3e-5$ is 30% More than $1e-5$
 - $1e-6$ is 1,000 times More than $1e-9$
- **Solution:** Be very Careful with Probability (or Risk) Comparisons
 - Most of us Only Handle Probabilities in the Deciles Well
 - Most of Our Project Risks should have Low Probabilities
- **Pitfall:** Using Point Estimates of Risk
- **Solution:** Plot Risk Distributions, not Means or Variances
 - All Risk Assessments, even Qualitative, Produce a Risk Distribution
 - Quantiles Work Well

Risk Comparison Pitfalls

- ***Pitfall:*** Treating Consequences with Different Units the Same
- ***Solution:*** Attempt Multi-Attribute Utility Approaches
 - Multi-Attribute Utility Theory is Very Difficult to Apply
 - Decision Maker Values are Never Stationary

Qualitative Risk Assessment Pitfalls

- **Pitfall:** Forgetting or Ignoring or Not Revealing Assumptions
- **Solution:** Be Forthright about All Assumptions
 - Managers always Question Assumptions
 - Parameterize Risk Assessment based on Distributions of Assumptions
 - The Independence Assumption Always Adds Conservatism
- **Pitfall:** Forgetting that Engineers are Notoriously Conservative when Providing Assessments
- **Solution:** Don't Take the First Assessment
 - Drill Down to Understand the Why
 - Parameterize The Engineer's Qualitative Assessment
 - Or, Use Quantitative Risk Assessment

Risk Roll-up Pitfalls

- **Pitfall:** Using Risk Assessment Point Estimates in Roll-ups
- **Solution:** Roll-up Risk Distributions
 - $\mu_A \neq (\mu_B^2 + \mu_C^2)^{1/2}$
 - Monte Carlo Techniques Have to Be Used
 - Be Careful with Assumed (Qualitative) Risk Distributions
- **Pitfall:** Forgetting Multi-Attribute Utilities in Roll-ups
- **Solution:** Scale Differing Unit Consequences According to Decision Maker Values using Multi-Attribute Utilities

Decision Maker Pitfalls

- The Entire Point of Risk Management is to ***Enable Good Decisions***
- Risk Management Can be Performed to Minimize Decision Maker Pitfalls
- The List of these Pitfalls for Risk Management
 - *Focusing on Extreme Consequences*
 - *Excessive Optimism*
 - Use of *Fudge Factors* to Account for *Risk*
 - *Decision Paralysis* from too few Data
 - Reliance on *First Impressions*
 - Fear of Change

More Decision Maker Pitfalls

- **Letting *Sunk Costs* Influence your Decision**
- **Seeing only *Confirming Evidence***
- ***Framing* the Problem for the Answer wanted**
- ***Overvaluing* Prediction Capabilities**
- ***Neglecting* Relevant Information**
- **Seeing *Patterns* in *Randomness***
- **Assigning *Reasons* for *Coincidences* or *Observing Rare Events***

Summary and Conclusions

- **Risk Management is Surprisingly neither Practiced nor Understood Well in General**
 - **There are some Very Useless Texts on Risk Management Out There**
 - **Most Recommend Practices Enabling these Pitfalls**
- **Recognizing *when* these Pitfalls are Possible is a Huge First Step to Avoid Them**
- **Presented a Sampling of Pitfalls, There are Many More You Probably Already Know**
- **Welcome Contact about Your Risk Management Problems**

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