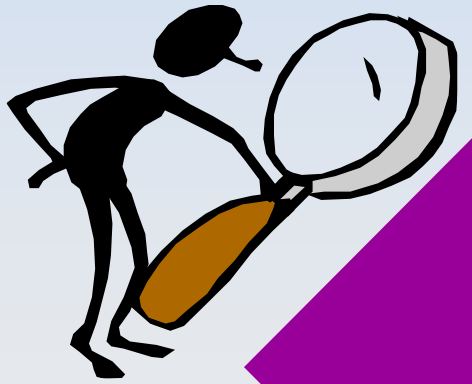
MANAGING RISK

A One-Day Tutorial

Dr. Elaine Christine



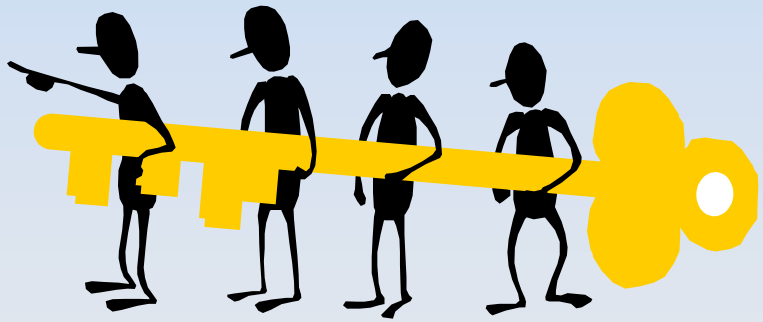
Risk

Risk

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Agenda

8:00	Introduction
9:45	Break
10:00	Assess Risk
12:00	Lunch
1:00	Control Risk
2:45	Break
4:30	Conclusion
5:00	Adjourn



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"Managing risk is a lot like playing golf."



Elaine

Christine

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Risk Definition

- Risk is …



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Top-3 Risk List

1.

2.

3.



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Risk

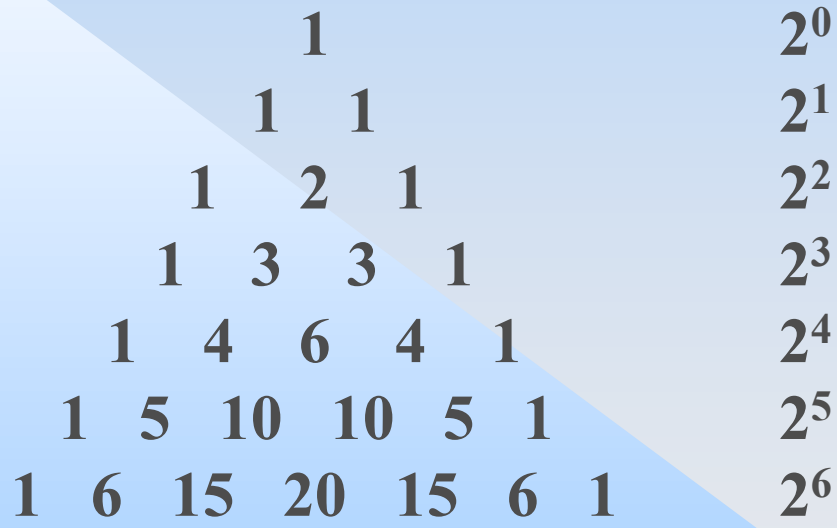
L^2 = Likelihood x Loss



Risk is a Potential LOSS

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Probability



1	2^0
1 1	2^1
1 2 1	2^2
1 3 3 1	2^3
1 4 6 4 1	2^4
1 5 10 10 5 1	2^5
1 6 15 20 15 6 1	2^6

- Pascal's Triangle
- Probability begins with uncertainty
- Analysis begins by counting possibilities
- Example: A coin toss has two possibilities. The probability of the outcome is 50 percent.

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Consequence



- Bernoulli measures utility to value risk
- Utility depends on the decision maker
- Measure consequences of an outcome
- Subjective considerations

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Method to Manage Risk

$$P(B|A) = \frac{P(A|B)\,P(B)}{P(A)}$$

- Risk is *dynamic!*
- Under uncertainty, there is no static answer
- Need to alter judgment as events unfold
- Bayes Theorem is a method to account for new information



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Risk Management

- Risk management resolves a risk if the possible consequences are all acceptable.
- Acceptable risk means that we can live with the worst-case outcome.
- Based on theories that provide different strategies for decision making under probabilistic conditions.



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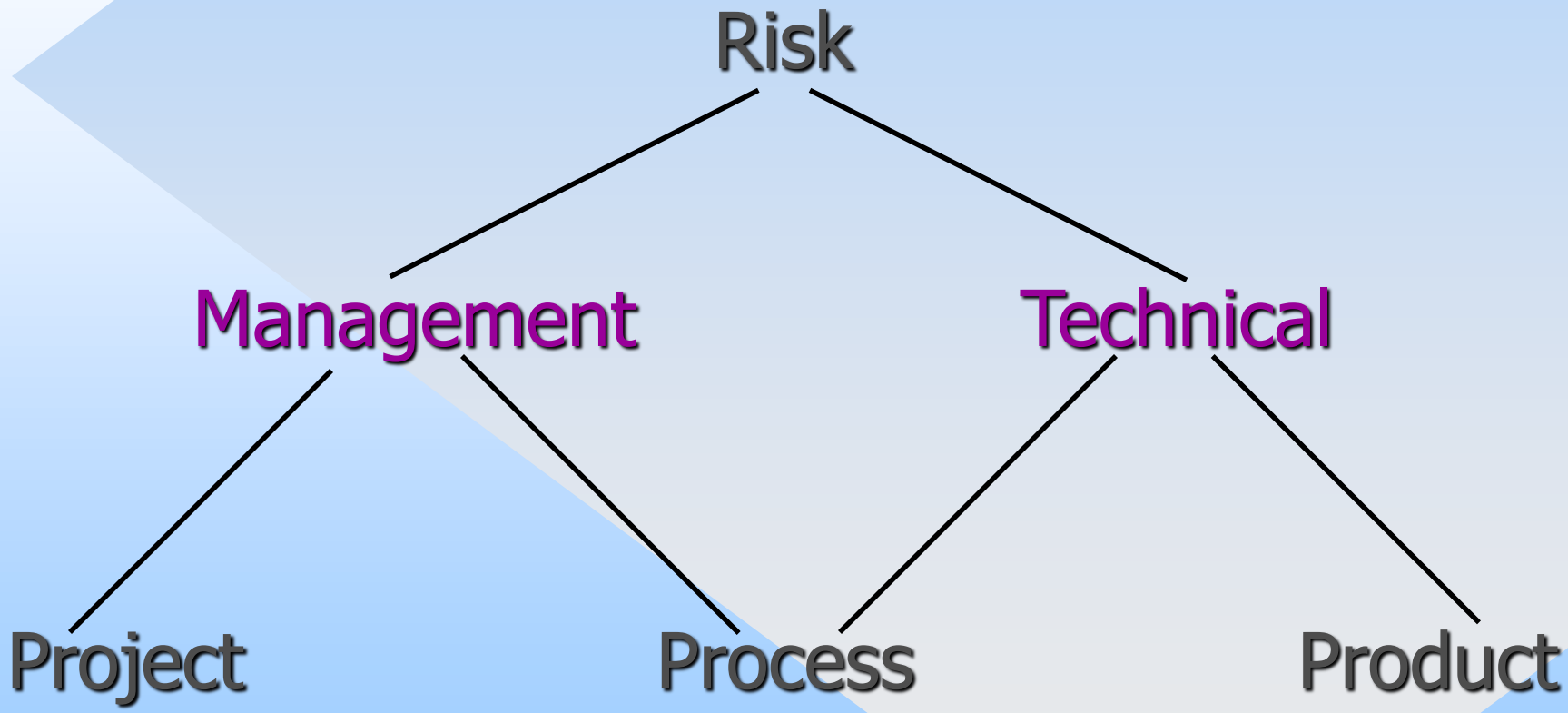
Theories for Decision Making

- Bayes -- blend new information into old
- Chaos -- uncertainty is an opportunity
- Creativity -- individual motivations
- Decision -- structures difficult problems
- Game -- consider psychological factors
- Portfolio -- diversify to reduce risk
- Probability -- forecast an outcome
- Uncertainty -- model uncertain events
- Utility -- model people's risk preference



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Top-Level Risk Categories



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Risk is Dynamic



- Growth in staffing
  - Risk.Management.Project
- Increased awareness of project issues
  - Risk.Management.Process
- Different lifecycle focus
  - Risk.Technical.Process
- Developing product
  - Risk.Technical.Product

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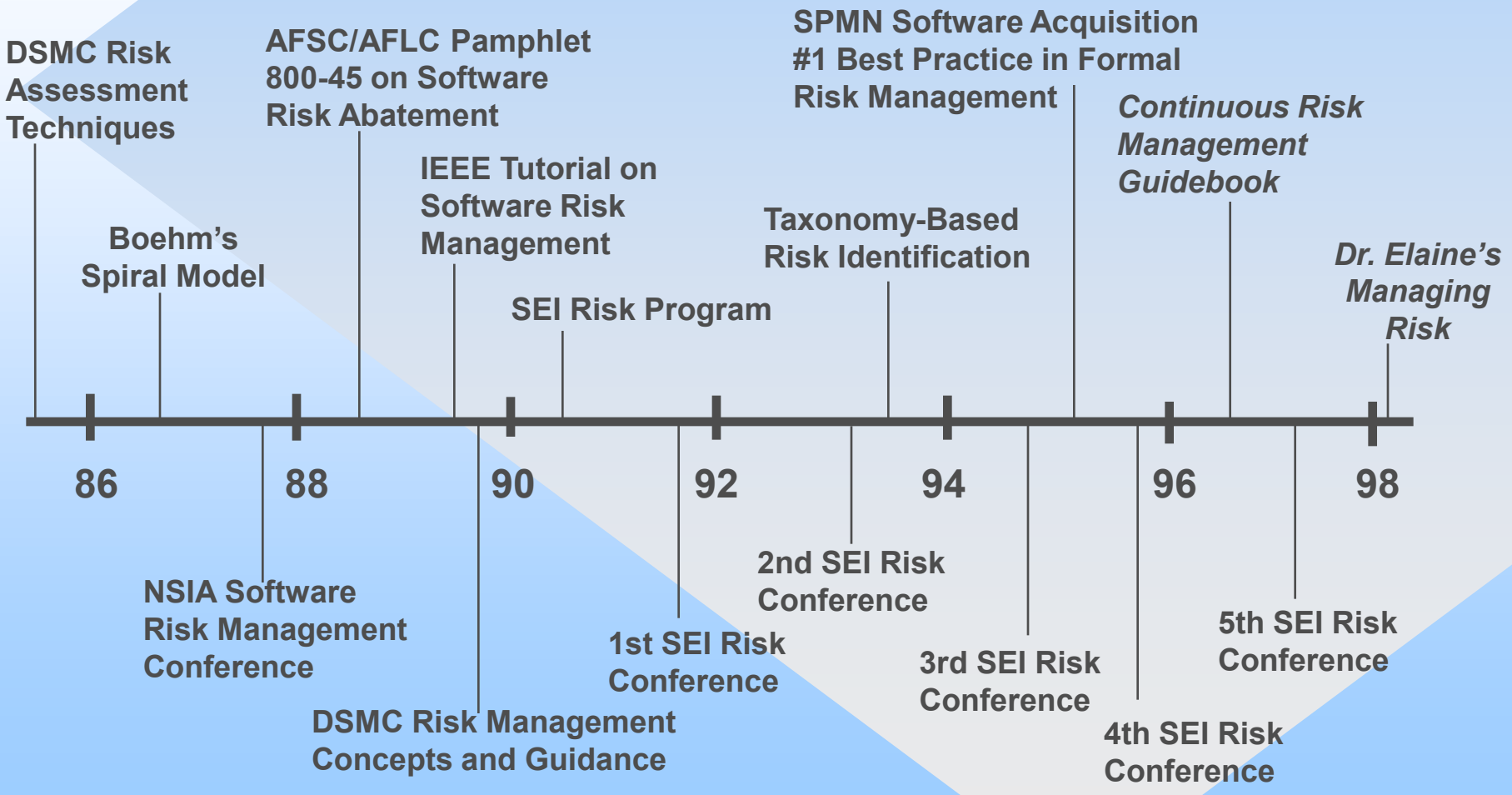
Risk Management

- Goal
- Uncertainty
- Loss
- Time
- Choice



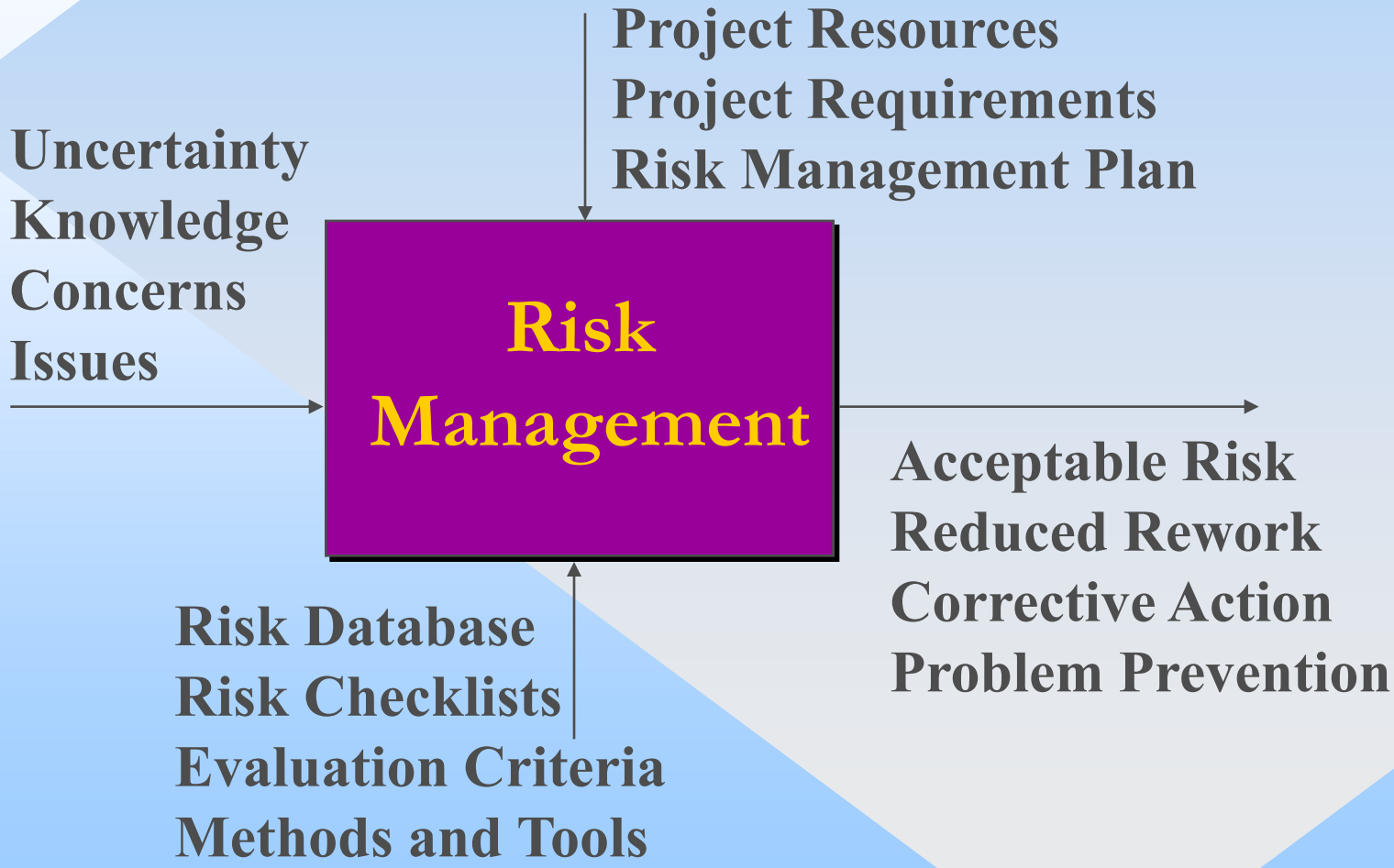
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Managing Risk Timeline



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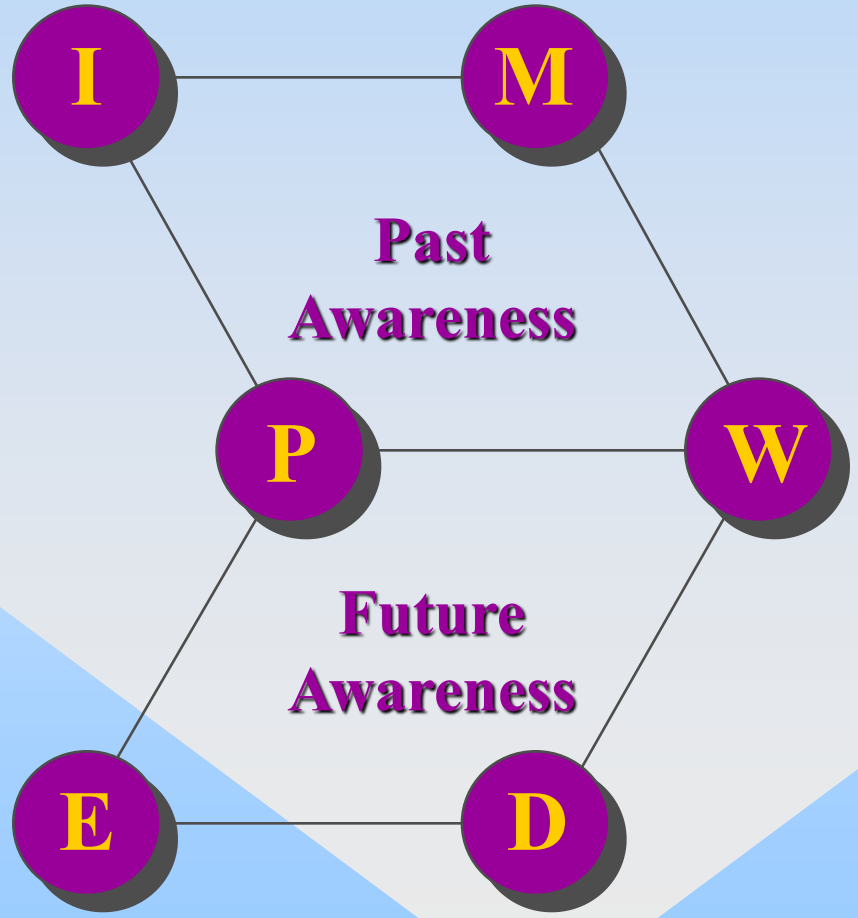
Risk Management in a Box



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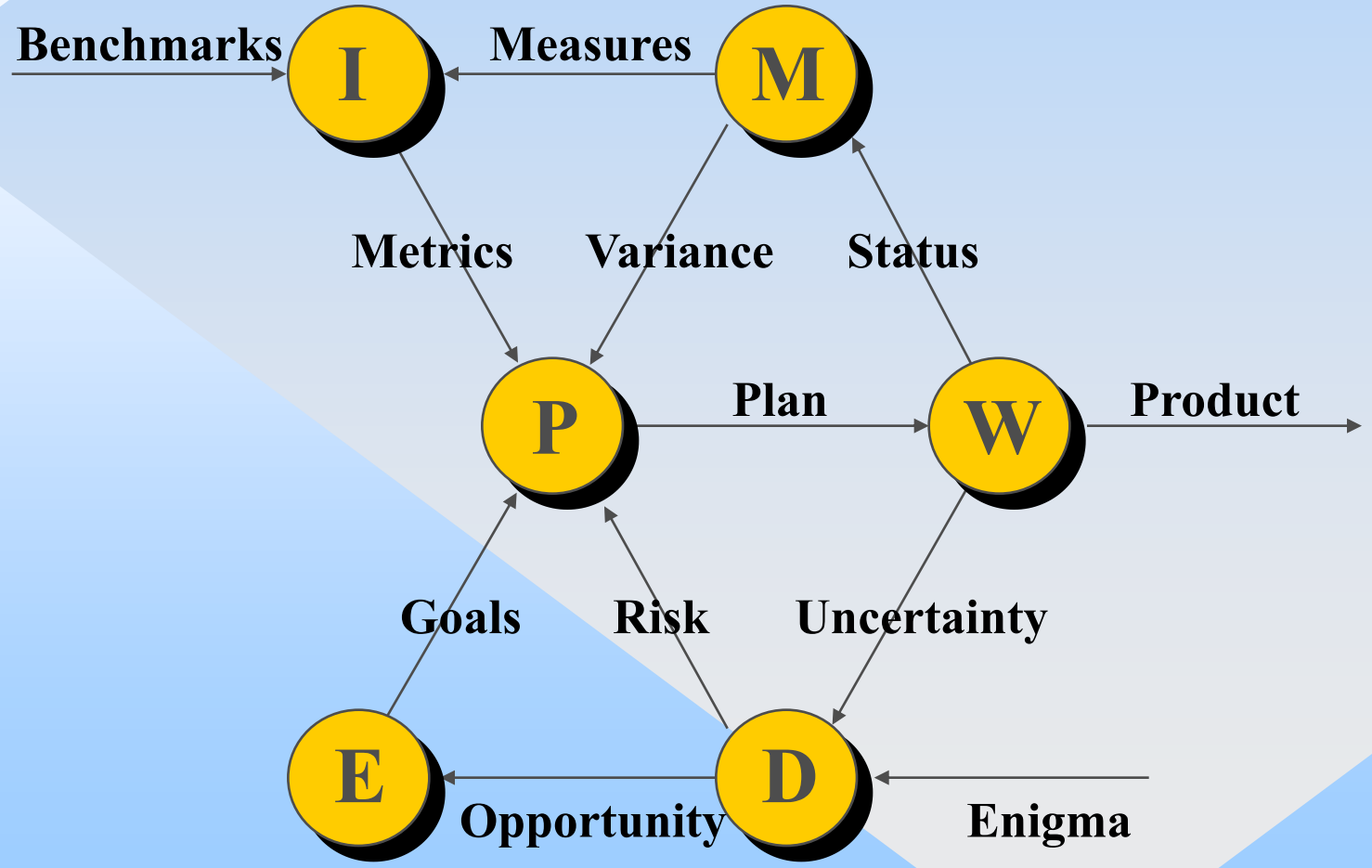
Disciplines for Awareness

1. Discover (D)
2. Envision (E)
3. Plan (P)
4. Work (W)
5. Measure (M)
6. Improve (I)



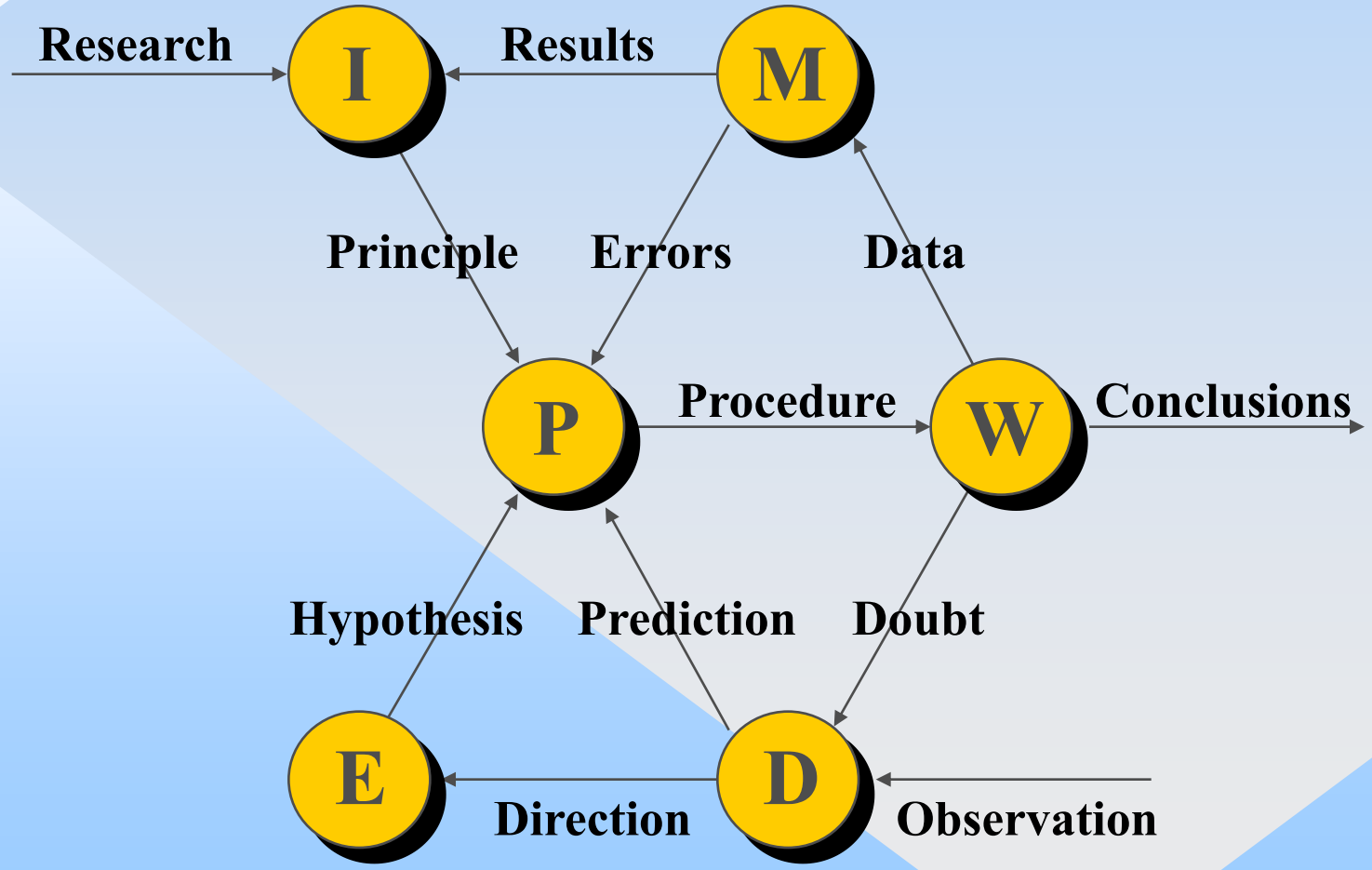
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Six-Discipline Model



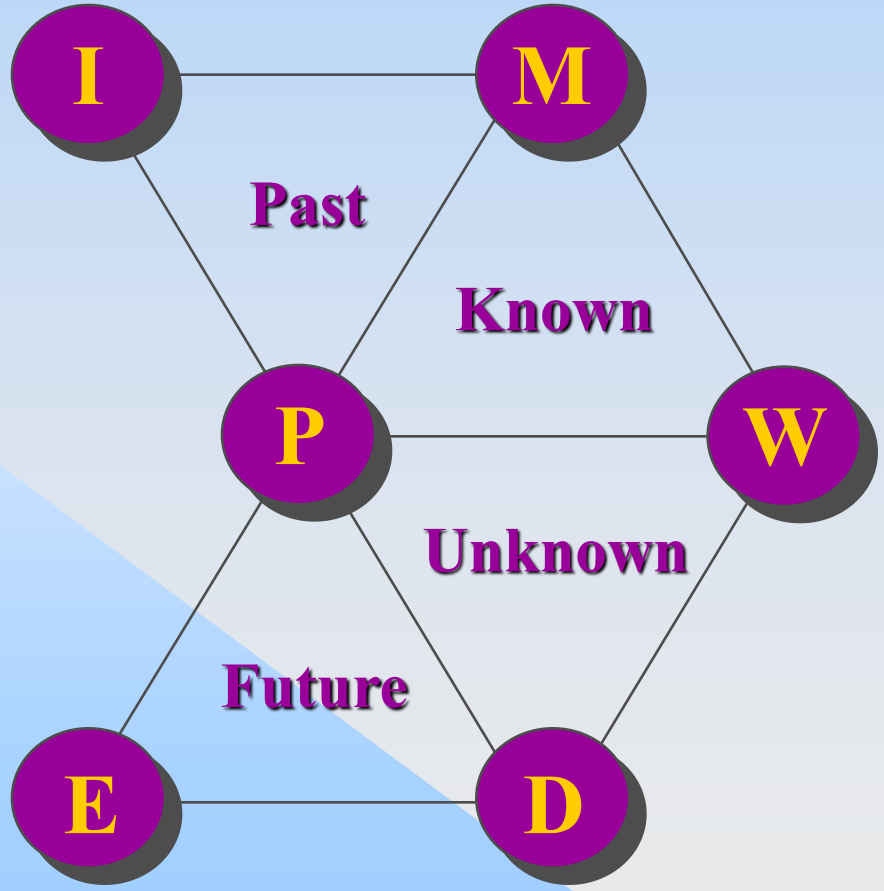
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6D Scientific Method



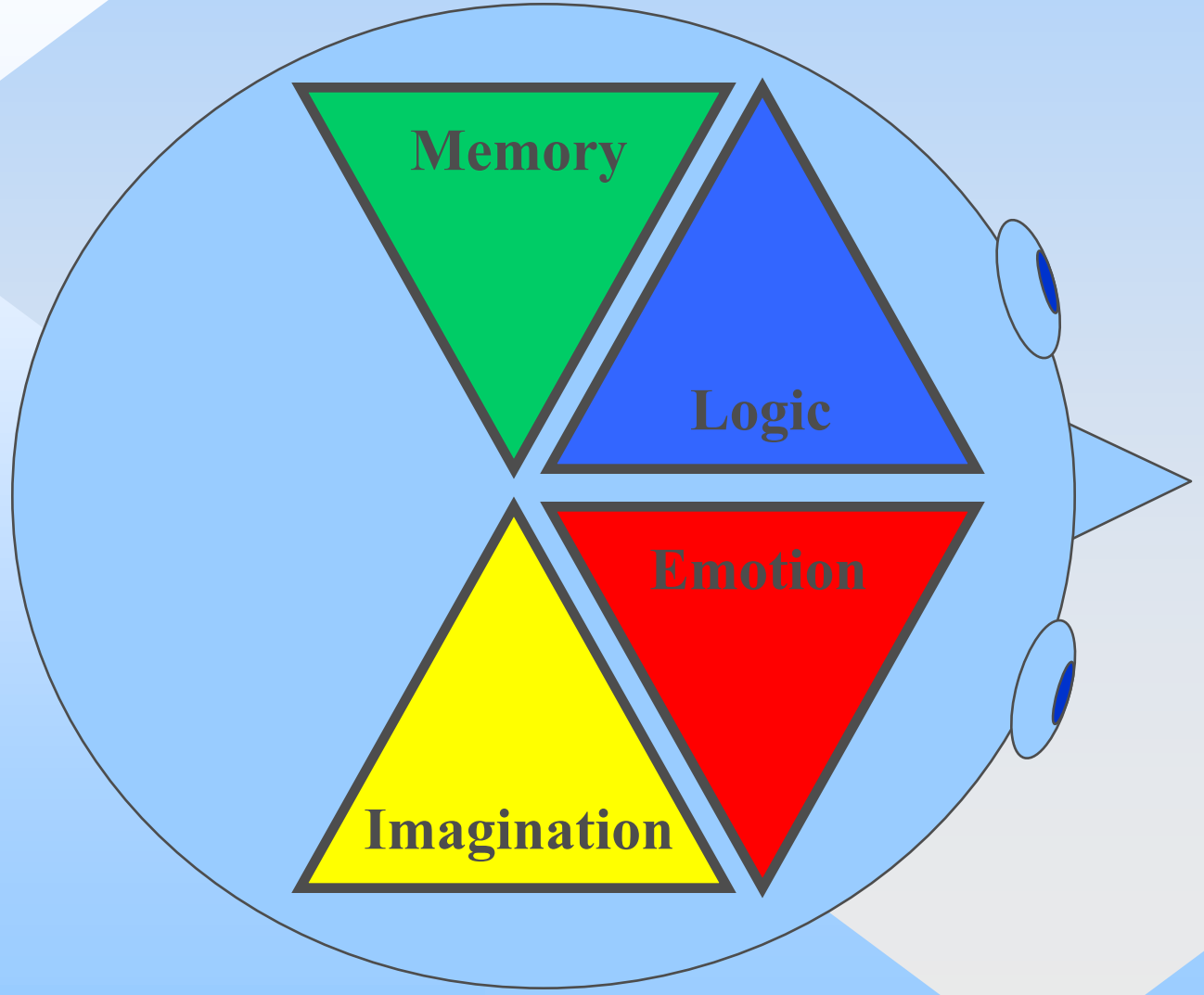
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Quadrants of Awareness



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Human Awareness



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Discussion Questions

1. What is the power of the 6D Model at the personal level?

2. Who should use risk management?

3. What is the difference between risk and opportunity?

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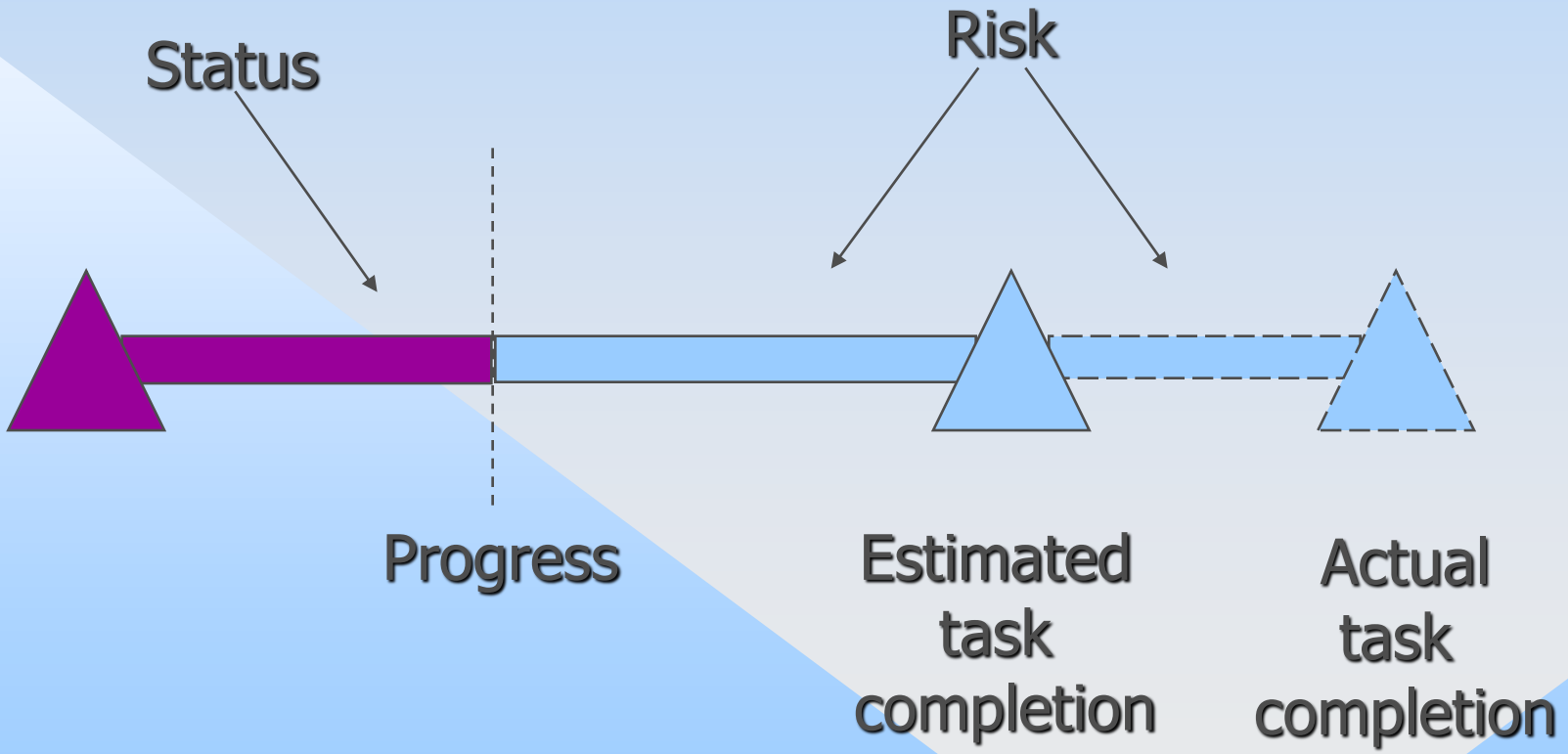
"The world would be a better place if we could insure against every future possibility. Then people would be more willing to engage in risk taking, without which economic progress is impossible."

Kenneth Arrow



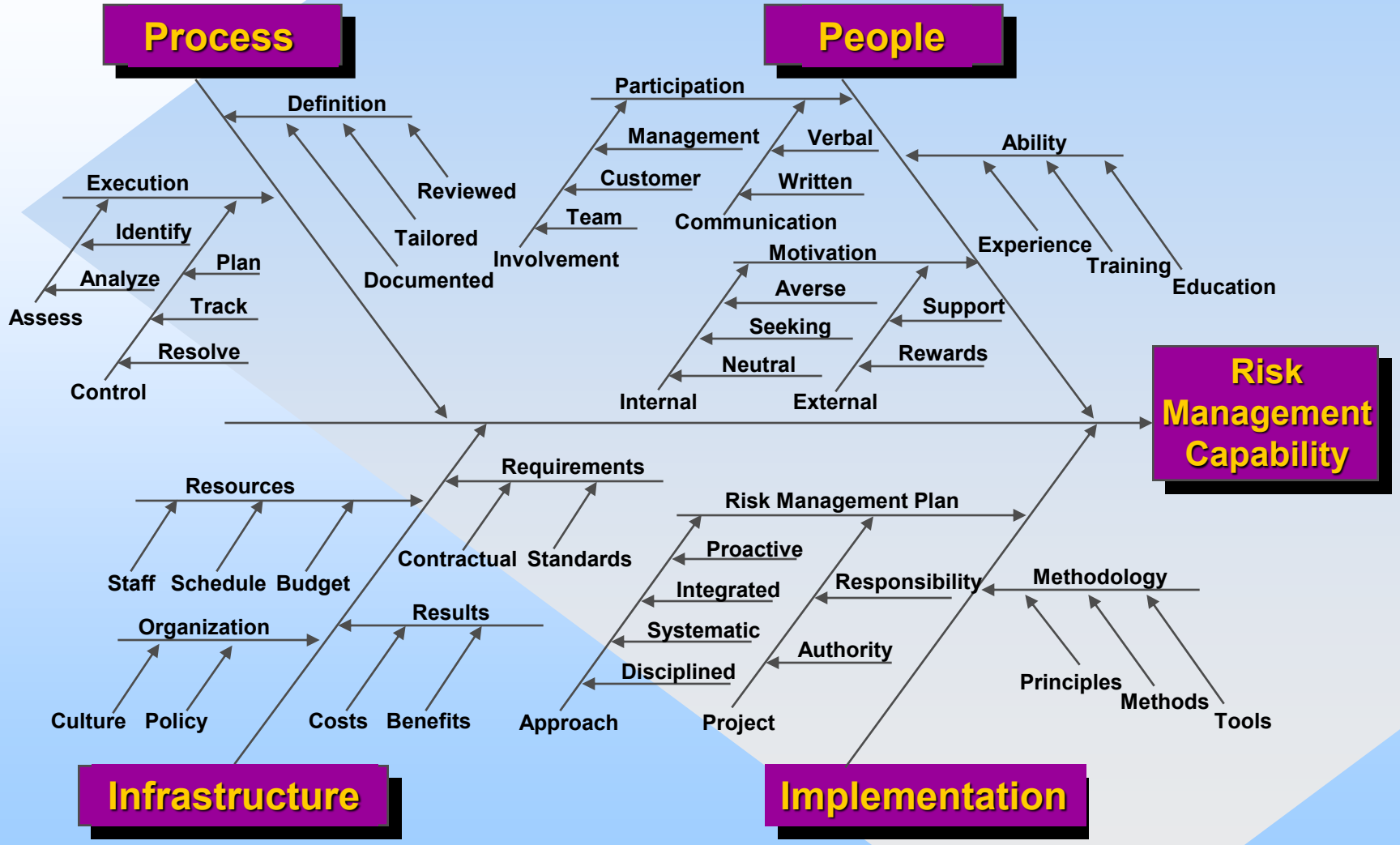
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Schedule Risk



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P^2I^2 Success Formula



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Four Major Factors

- People: The Human Element
  - Barriers to adoption
  - Risk preference
- Process: The Steps to Manage Risk
  - Five process elements
- Infrastructure: The Foundation
  - How to develop a risk-aware culture
- Implementation: The Project Execution
  - Success begins with a quality plan



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Barriers to Managing Risk

-
-
-

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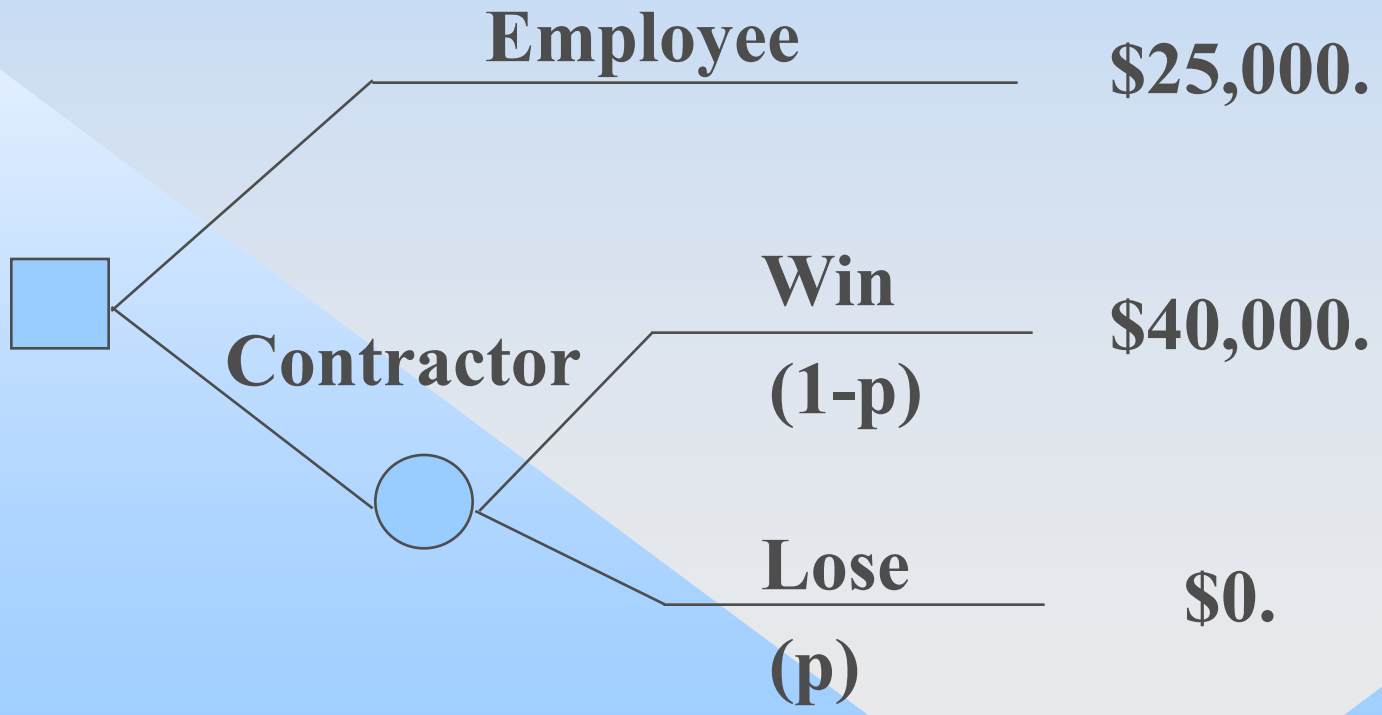
Reasons for Managing Risk

-
-
-



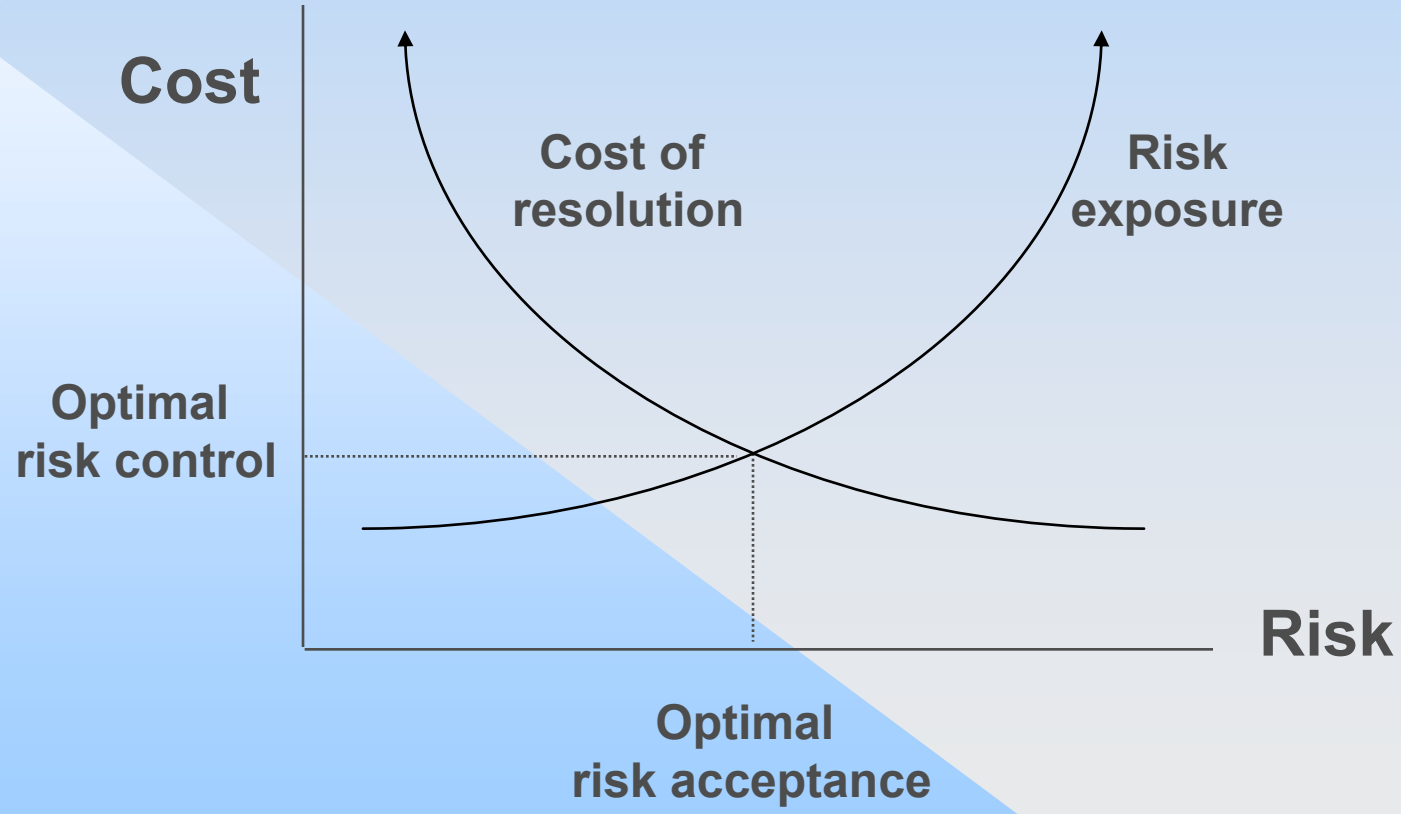
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Decision Tree Model



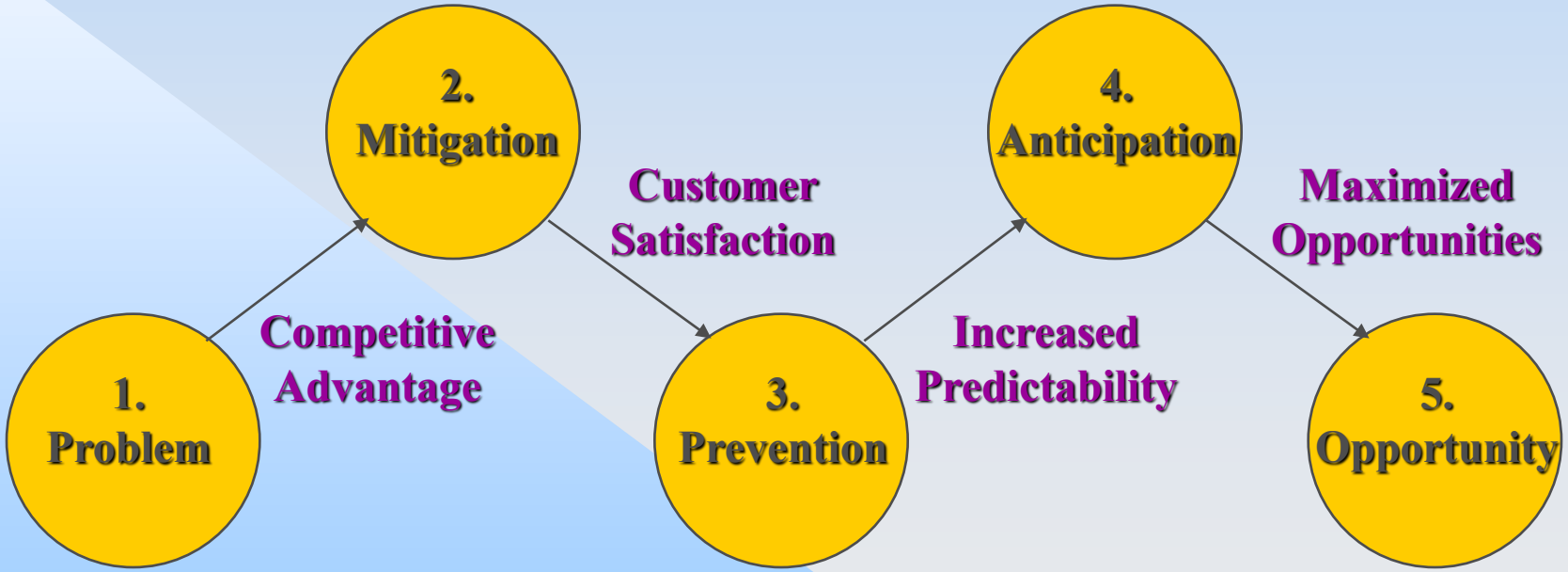
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Cost-Effective Process



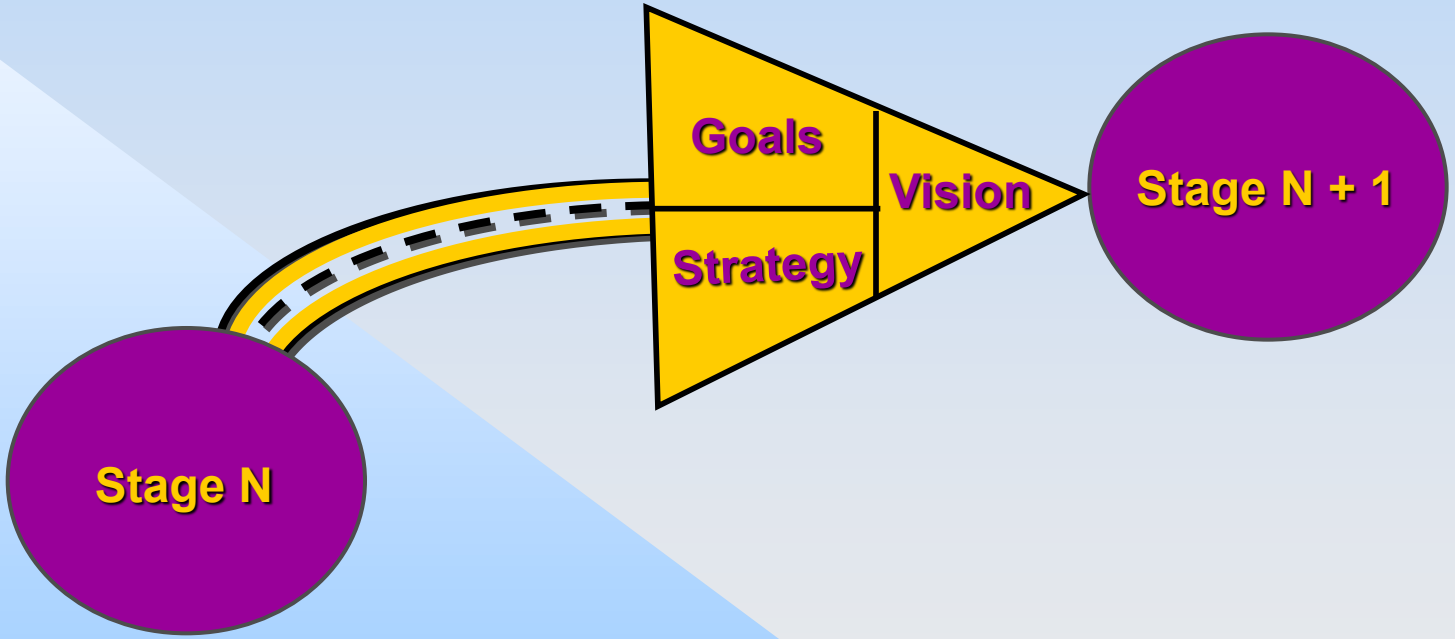
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Risk Management Map



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Map Architecture



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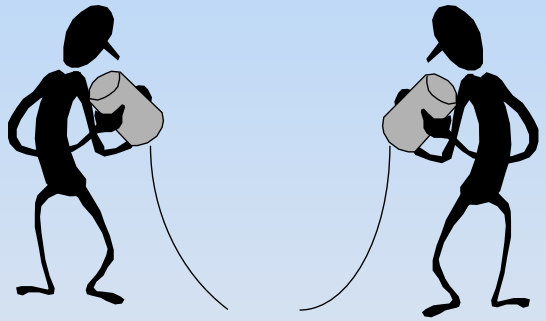
The Road to Capability

- Problem to Mitigation
  - Crisis management to risk management
- Mitigation to Prevention
  - Management activity to team activity
- Prevention to Anticipation
  - Assess risk subjectively to quantitatively
- Anticipation to Opportunity
  - Negative risk to chances with opportunity cost



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Stage 1: Problem



- Lack of communication
- Risks are not addressed
- What you don't know won't hurt you
  - Too busy solving today's problems
  - No training for risk management concepts
  - Problems appear as significant cost overruns and schedule slips

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Stage 2: Mitigation



- Introduction to risk concepts
- People are aware of risks
- What you don't know may hurt you
  - Risk assessment is performed at the beginning of a project only
  - Training provides knowledge of risk concepts
  - Risks are gathered but not passed up

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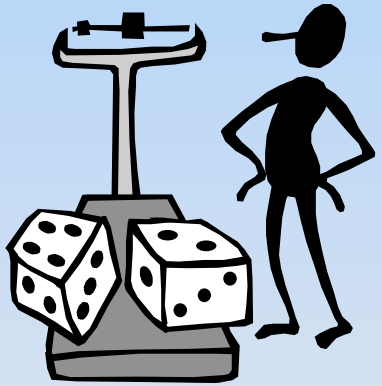
Stage 3: Prevention



- Project team involvement
- A focus on technical risks
- What you don't know <u>will</u> hurt you
- Process
  - Identify sources of risk throughout program
  - Training provides understanding of process
  - Risks are gathered and passed up the chain

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Stage 4: Anticipation



- Metrics anticipate failures
- Quantify risks to provide focus
- Can't manage what you can't measure
  - Risks assessed according to quantitative evaluation criteria
  - Training provides understanding of metrics
  - Risk prioritization occurs by ordering results

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Stage 5: Opportunity



- Innovation and chances
- Risk is everyone's responsibility
- You don't know what you don't know
  - Action plans are revised to take advantage of current information
  - Training provides the knowledge of using metrics to improve
  - Knowledge base of identified risks and resolution strategies exists

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Map Goals

- Process
  - Identify Risk
  - Analyze Risk
  - Plan Risk
  - Track Risk
  - Resolve Risk
- Infrastructure
  - Develop the Policy
  - Define Standard Process
  - Train Risk Technology
  - Verify Compliance
  - Improve Practice
- People
  - Stage 1: Problem
  - Stage 2: Mitigation
  - Stage 3: Prevention
  - Stage 4: Anticipation
  - Stage 5: Opportunity
- Implementation
  - Establish the Initiative
  - Develop the Plan
  - Tailor the Standard Process
  - Assess Risk
  - Control Risk



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Discussion Questions

1. Are you a risk management novice, beginner, intermediate, advanced, expert?

2. What skills will you need to advance?

3. Why is it important to increase your ability to manage risk?

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6D Risk Management



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Discovery Process

cog•ni•tion (kog-nish´en)

1. The mental process or faculty by which knowledge is acquired.

2. Something that comes to be known, as through perception, reasoning, or intuition.

—American Heritage Dictionary



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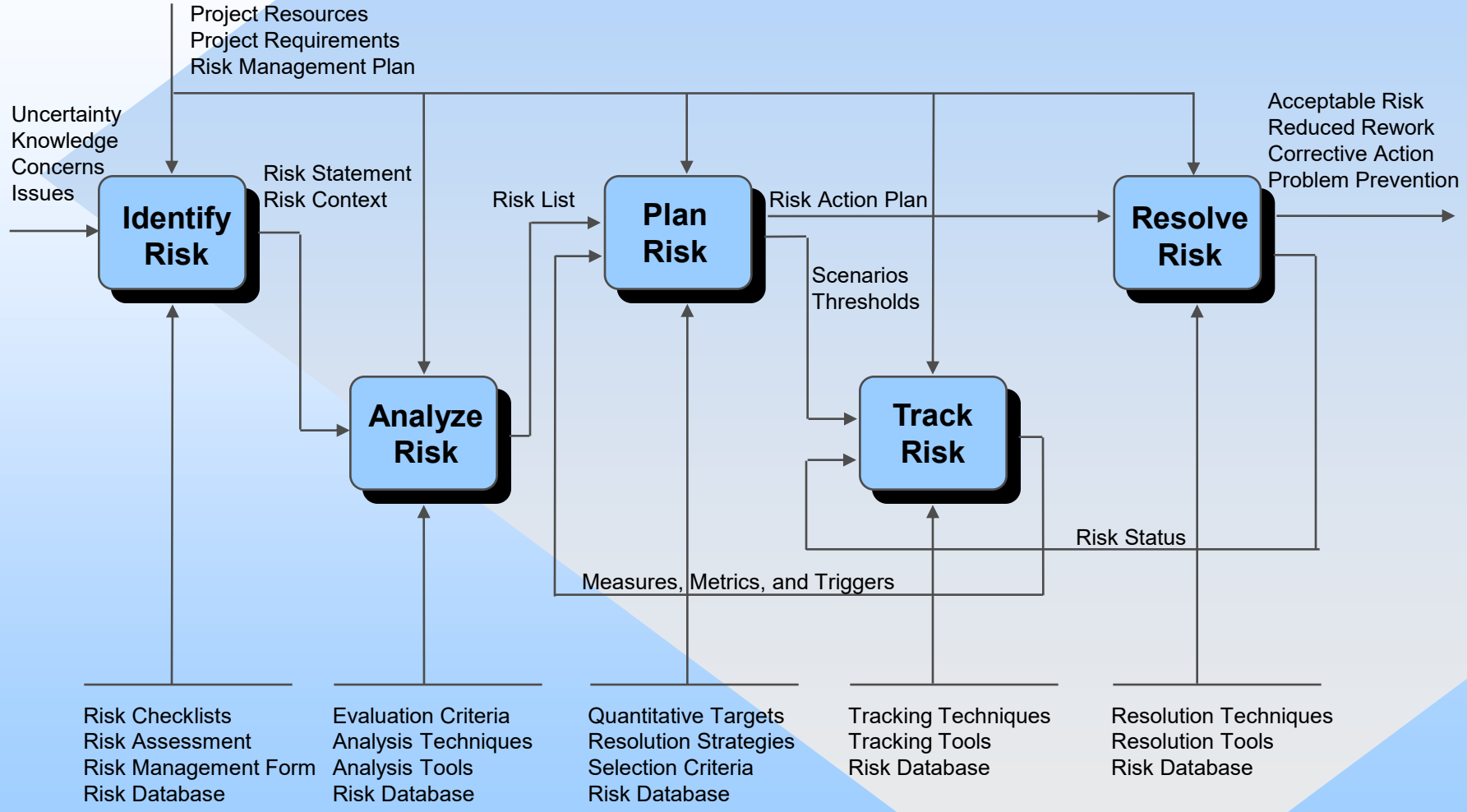
Assess Risk

1. Conduct a risk assessment.
2. Develop a candidate risk list.
3. Define risk attributes.
4. Document identified risk.
5. Communicate identified risk.
6. Estimate and evaluate risk.
7. Prioritize risk.



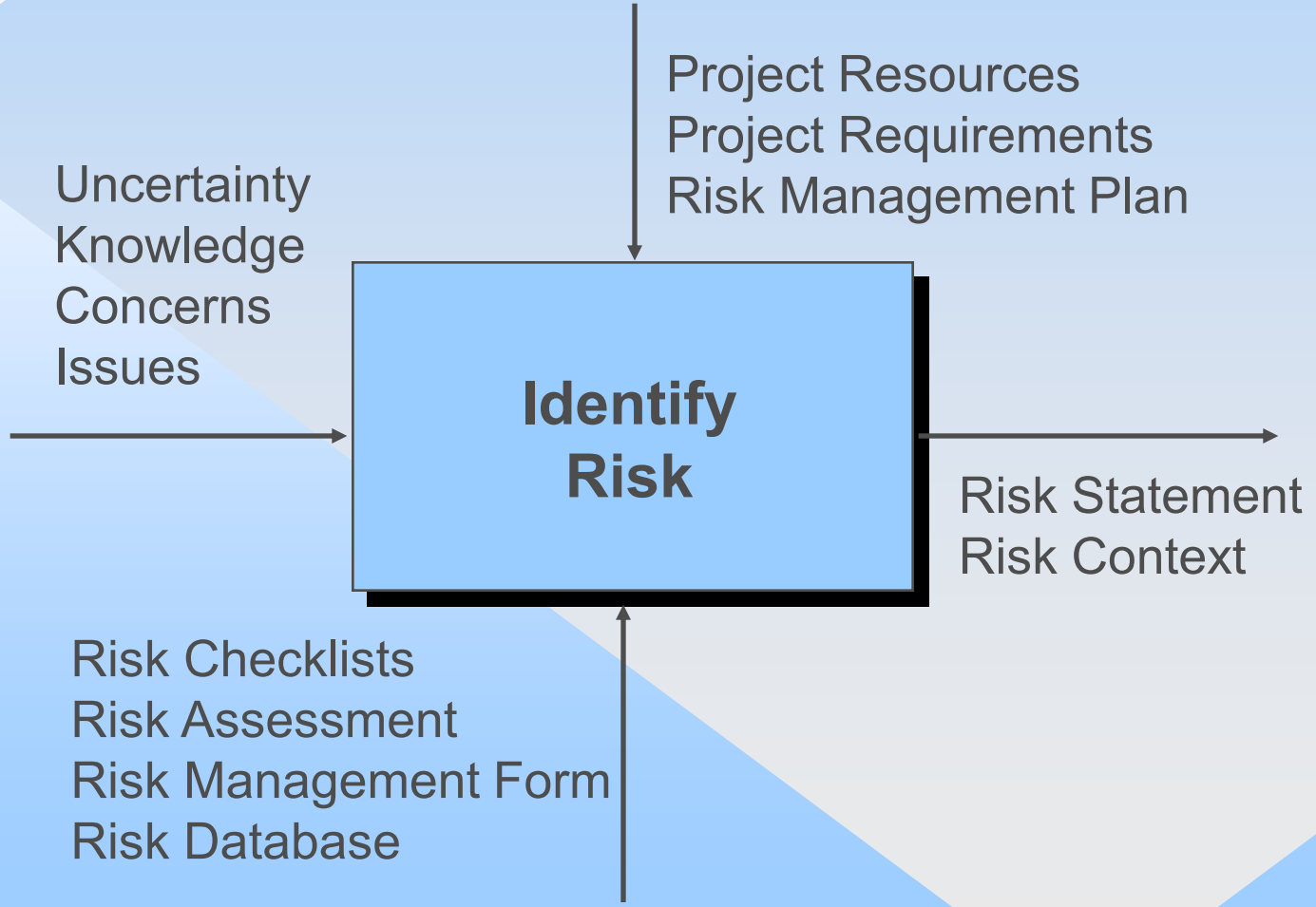
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Risk Management Process



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Risk Identification Process



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Identify Risk Goals

- Encourage risk input from the team.
- Identify risk while there is time for action.
- Uncover risk and sources of risk.
- Capture risk in a readable format.
- Communicate risk to those who can resolve it.
- Prevent project surprises.



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Identify Process Activities

1. Conduct a Risk Assessment.
2. Identify Risk Systematically.
3. Define the Risk Attributes.
4. Document Identified Risk.
5. Communicate Identified Risk.



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Risk Identification Methods

- Checklist
- Interview
- Meeting
- Review
- Routine Input
- Survey
- Working Group



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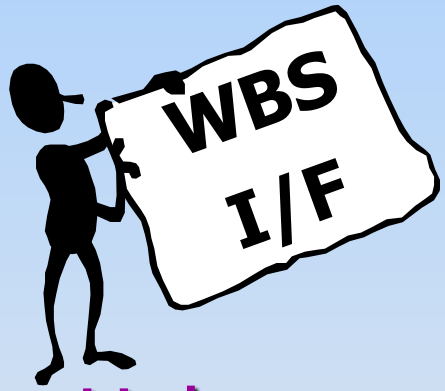
When a Formal Assessment?

- Concept of operations
- Request for proposal
- Proposal evaluation
- Source selection
- Early in system development
- At major milestones
- Phase transitions (e.g., Operations)
- Changing of the Guard (e.g., Sponsor)



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Develop a Risk List



List Known

- Separate individuals from issues
- Report risks
- Report problems

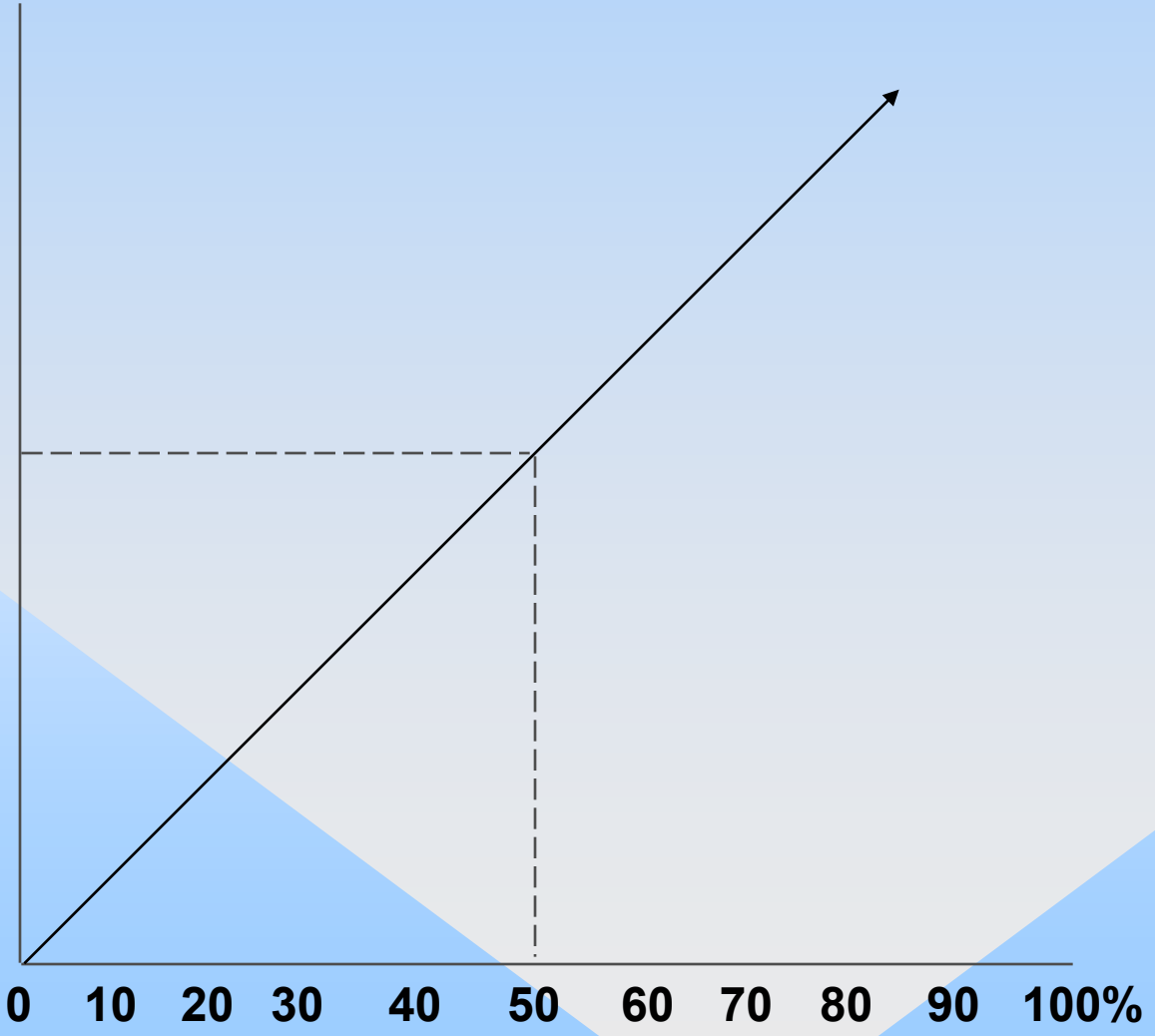
Discover Unknown

- Share knowledge
- Recognize risk importance
- Cumulate indicators

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Probability

ALMOST CERTAINLY
HIGHLY LIKELY
VERY GOOD CHANCE
PROBABLE
LIKELY
PROBABLY
WE BELIEVE
BETTER THAN EVEN
WE DOUBT
IMPROBABLE
UNLIKELY
PROBABLY NOT
LITTLE CHANCE
ALMOST NO CHANCE
HIGHLY UNLIKELY
CHANCES ARE SLIGHT



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Consequence

Criteria	Cost	Schedule	Technical
Low	Less than 1%	Slip 1 week	Slight affect on performance
Moderate	Less than 5%	Slip 2 weeks	Moderate affect on performance
High	Less than 10%	Slip 1 month	Severe affect on performance
Critical	10% or more	Slip >1 month	Mission may be compromised



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Categorize the Risk

1. Clarify
2. Consense
3. Classify
4. Combine
5. Condense



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Risk Statement

Format Issue.Probability.Consequence

Issue "External data format is changing;

Probability it is highly likely that this will

Consequence slip the development schedule."



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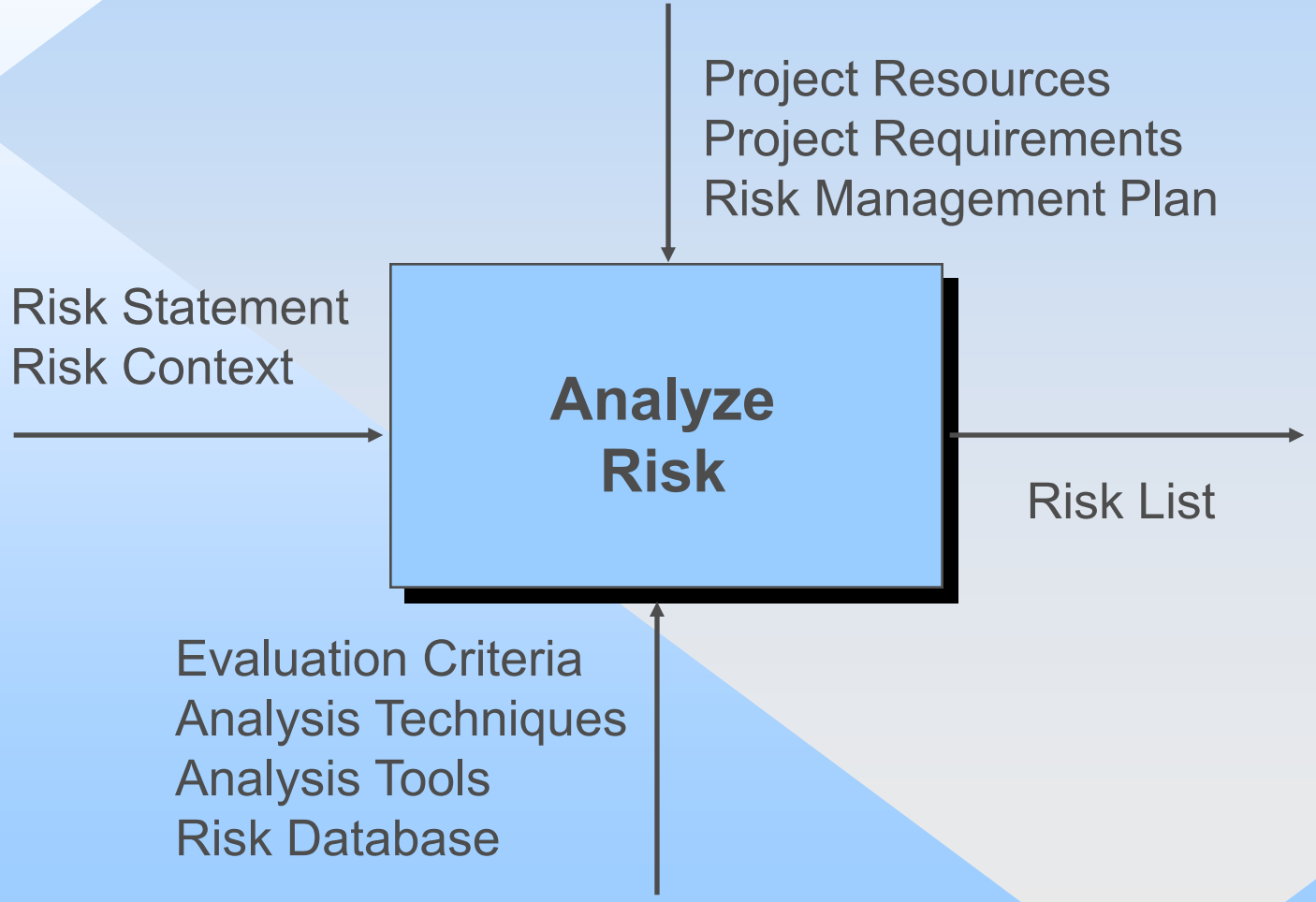
Identify Risk Questions

1. What are the objectives and critical success factors?
2. What may prevent us from meeting the objectives?
3. What are the issues, concerns, potential problems?
4. What is the probability that the risk will occur?
5. What are the consequences if the risk does occur?
6. Who has control over this issue?
7. Who should be informed of this issue?



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Risk Analysis Process



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Analyze Risk Goals

- Analyze risk in a cost-efficient manner.
- Refine the risk context.
- Determine the source of risk.
- Determine the risk exposure.
- Determine the time frame for action.
- Determine the highest-severity risks.



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Analyze Process Activities

1. Group Similar and Related Risks.
2. Determine Risk Drivers.
3. Determine Source of Risk.
4. Use Risk Analysis Techniques and Tools.
5. Estimate the Risk Exposure.
6. Evaluate Risk Against Criteria.
7. Rank Risks Relative to Other Risks.



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Source of Risk

1. Why: Vendor cannot ensure delivery of the ABC subsystem to meet our integration schedule.
2. Why: Subsystem is a development item for vendor.
3. Why: Subsystem design requires component XYZ.
4. Why: Component XYZ requires the application of advanced technology.
5. Why: Vendor does not have engineers experienced in this technology.



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Risk Analysis Tools

- Tools range in price and complexity (p.105).
- Tools use different decision algorithms.
- Tools may be grouped into categories:
  - Multiattribute utility
  - Multicriteria optimization
  - Multicriteria partial ordering
  - Inference packages
  - Group process
  - Decision trees/Influence diagrams



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Risk Analysis Techniques

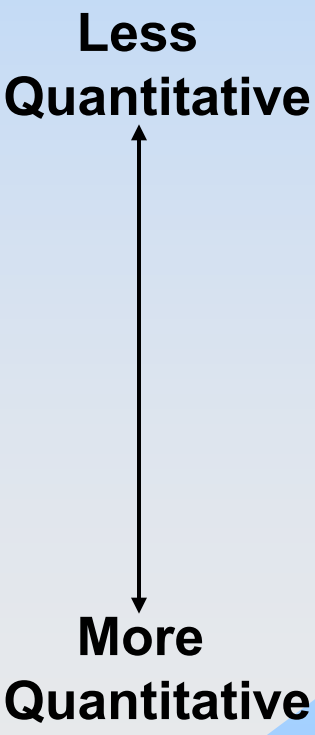
Method	When to Use Each
Influence Diagram	Understand decisions and hide details
Decision Tree	Structure decisions and see details
Tornado Diagram	See the most sensitive variables first
Sensitivity Analysis	Determine what does and doesn't matter
Gap Analysis	Show differences between variables
Fishbone Diagram	Relation between an effect and its causes
Pareto Chart	Determine the order to address issues



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Quantitative Risk Exposure

Method	Risk Exposure
Product	Functionality for subsystem XYZ will not likely be ready for release.
Time	Very likely that testing will continue for three more months.
Ballpark	IV&V will likely cost about $50K.
Range	Adding that feature could cost between $10 - 20K.
Cost	The regression test will take three Senior Engineers for one month.



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Risk Severity

Risk Exposure

Time Frame	Low	Moderate	High
Short	5	2	1
Medium	7	4	3
Long	9	8	6

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Rolling Up the Risk

Risk severity is easily converted to a color for identifying the hot issues:

- Red (severity 1 - 3)
- Yellow (severity 4 - 6)
- Green (severity 7 - 9)



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Analyze Risk Questions

1. What is the risk category?
2. What are the variables that cause risk to increase?
3. What is the source of risk?
4. What is the risk exposure?
5. What is the time frame for action?
6. What is the risk severity category?
7. What is the relationship to other identified risks?
8. What is the risk ranking relative to other risks?



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Discussion Questions

1. Do you think it is important to communicate risk in a standard format?

2. Discuss how a standard format might make people more receptive to uncertainty.

3. Explain how you could measure risk exposure over time to predict risk occurrence.

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Control Risk

1. Develop risk resolution alternatives.
2. Select the risk resolution strategy.
3. Develop the risk action plan.
4. Monitor risk status.
5. Execute the risk action plan.
6. Take corrective action as required.



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Risk Planning Process



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Plan Risk Goals

- Provide visibility for key events and conditions.
- Reuse successful risk resolution strategies.
- Optimize the selection criteria.
- Understand the next action for each critical risk.
- Establish automatic triggering mechanisms.



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Plan Process Activities

1. Develop Risk Scenarios for High Risks.
2. Develop Risk Resolution Alternatives.
3. Select the Risk Resolution Approach.
4. Develop a Risk Action Plan.
5. Establish Thresholds for Early Warning.



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Risk Scenario

"Product is produced without traceability to requirements."

Events:

- Design reviews focus on data flow diagrams.
- Product features not backed up by requirements.
- Tests cannot be traced to design specifications.

Conditions:

- Process is not documented.
- No automated tool for requirements analysis.
- Design reviews are informal and ad hoc.



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Develop a Risk Scenario

- Exercise: Describe the events and conditions of a risk scenario.
- Activity:
  - 1. Think about the risk as if it had occurred.
  - 2. State the risk scenario as if the risk already happened.
  - 3. List the events and conditions that would precede the risk occurrence.



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Quantitative Targets

Measurement	Target	Threshold
Defect removal efficiency	>95%	<85%
Schedule slip or cost in excess of risk reserve	0%	≥10%
Total requirements growth	≤1% Per month	≥50% Per year
Total program documentation	<1000 Words per function point	<2000 Words per function point
Voluntary staff turnover per year	1–3%	≥10%



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Resolution Strategies

1. Acceptance ...*you can live with the loss*
2. Avoidance ...*a lose-lose situation is likely*
3. Protection ...*redundancy will mitigate risk*
4. Reduction ...*risk reduction leverage exists*
5. Research ...*more information is needed*
6. Reserves ...*uncertainty exists in cost or time*
7. Transfer ...*another group has control*



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Risk Resolution Alternatives

Low effort

High effort

- Do nothing
- Set trigger mechanism
- Obtain information
- Obtain resources
- Coordinate resources
- Create contingency
- Divide and conquer

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Risk Resolution Strategy

- Goals and Objectives
  - Quantitative Target
- Alternatives
  - Acceptance, Avoidance, Protection, Reduction, Research, Reserves, Transfer
- Approach
  - Selection Criteria (e.g., Risk Leverage)
  - Threshold Value
  - Trigger Device



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Develop a Risk Strategy

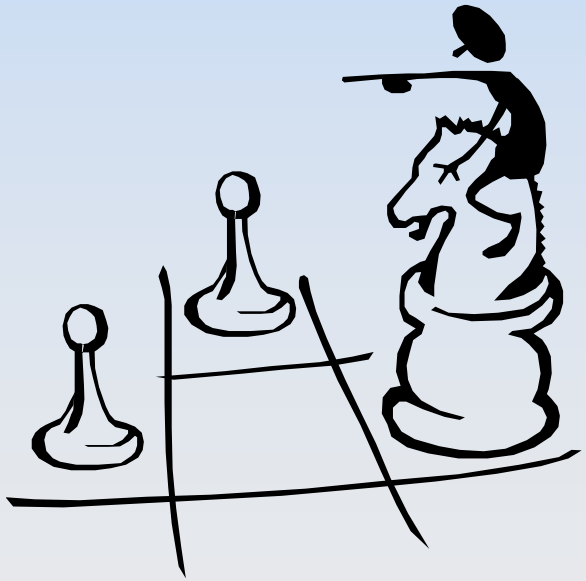
- Exercise: Describe risk resolution approach.
- Activity:
  - 1. Define goals as targets and threshold values.
  - 2. List all possible alternatives.
  - 3. Describe the selected approach and the criteria for selection.
  - 4. Define a trigger device for the threshold.



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Risk Action Plan

- Responsible person
- Resources required
- Activities
- Start date
- Due date
- Actions taken
- Results achieved
- Lessons learned



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Develop a Risk Action Plan

- Exercise: Describe what is needed to resolve risk.
- Activity:
  - 1. Assign the plan to a responsible person.
  - 2. List all resources required.
  - 3. Describe the activities to resolve risk.



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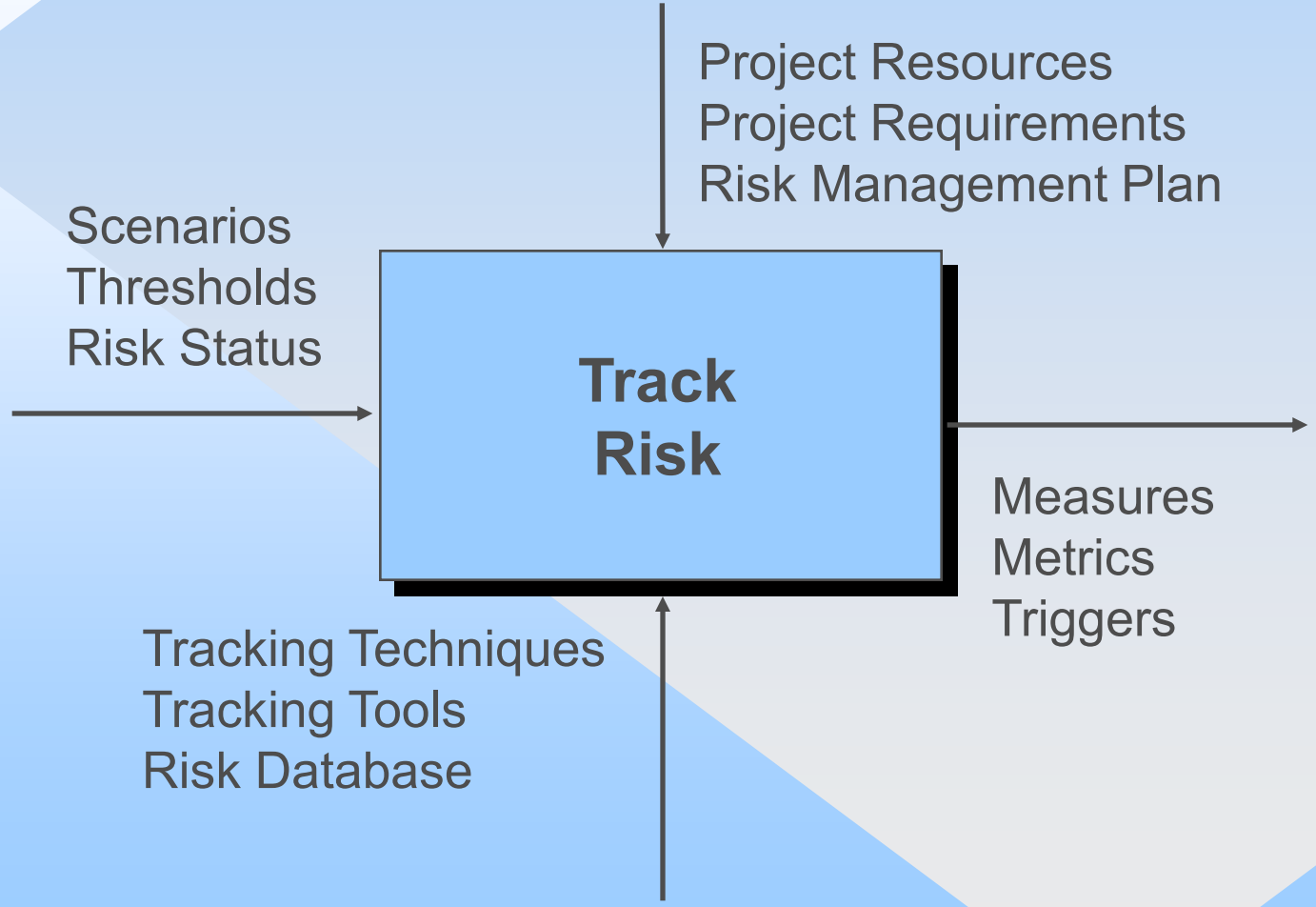
Plan Risk Questions

1. What could cause the risk to occur?
2. What are the alternative strategies?
3. How can the risk probability be reduced?
4. How can the risk consequence be reduced?
5. What is the risk reduction leverage?
6. When should action be taken?
7. What triggers could be used for early warning?



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Risk Tracking Process



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Track Risk Goals

- Monitor events and conditions of risk scenarios.
- Track risk indicators for early warning.
- Provide notification for triggering mechanisms.
- Capture results of risk resolution efforts.
- Report risk measures and metrics regularly.
- Provide visibility into risk status.



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Track Process Activities

1. Monitor Risk Scenarios.
2. Compare Thresholds to Status.
3. Provide Notification for Triggers.
4. Report Risk Measures and Metrics.



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Triggers for Early Warning

- **Periodic event**
  - notification for activities on the schedule
- **Elapsed time**
  - notification for dates based on a calendar
- **Relative variance**
  - notification for values outside an acceptable range
- **Threshold value**
  - notification for values that cross a threshold



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Risk Measures and Metrics

- Number of risks
- Number logged risks
- Risk category
- Risk exposure
- Risk severity
- Risk leverage
- Risk threshold
- Risk indicator
- Risk management index
- ROI $_{(RM)}$



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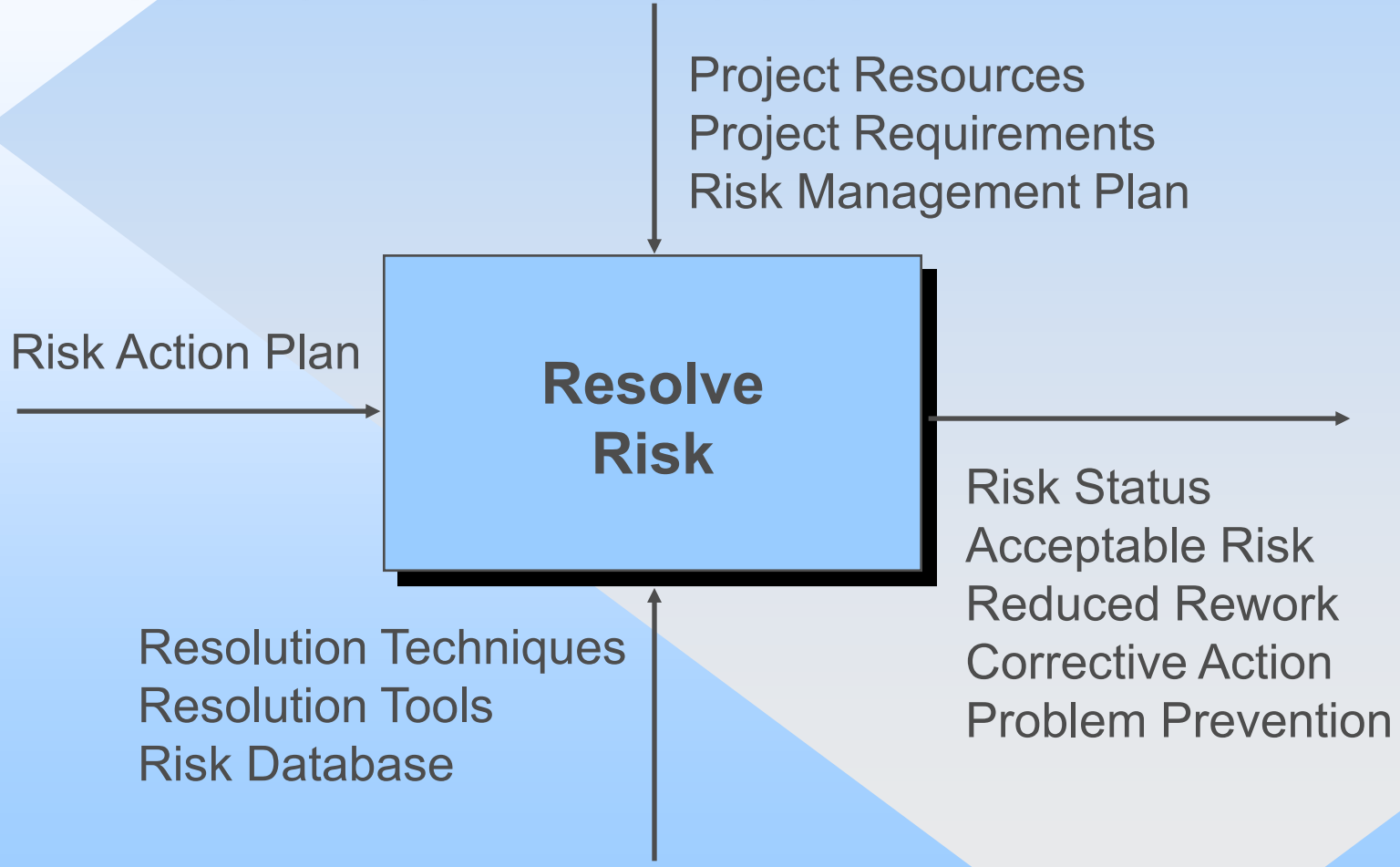
Track Risk Questions

1. What is the current risk status?
2. Have events or conditions changed?
3. Will triggers provide early warning?
4. What is the rate of change of the risk indicators?
5. Is the trend data format easy to understand?
6. Is the risk report provided in a timely manner?



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Risk Resolution Process



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Resolve Risk Goals

- Assign to the lowest possible level.
- Follow a documented risk action plan.
- Report results of risk resolution efforts.
- Provide for risk aware decision making.
- Is prepared to adapt to circumstances.
- Systematically control risk.



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Resolve Process Activities

1. Respond to Notification of Trigger Event.
2. Execute the Risk Action Plan.
3. Report Progress Against Plan.
4. Correct for Deviation From Plan.



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Acceptable Risk

- When you make sufficient progress in risk resolution, project status indicators will improve.
- Status indicators within acceptable ranges trigger the deactivation or suspension of risk resolution activity.
- You make a risk aware decision to live with the risk consequence.



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Resolve Risk Questions

1. Have the results of risk resolution been reported?
2. Have circumstances changed?
3. Is the progress sufficient to avoid problems?
4. Does the risk action plan require modification?
5. Is the level of risk acceptable?
6. What decisions could be made at this time?
7. What are the risk management lessons learned?



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Measure of Success



- ROI: ratio of savings to cost
- Without ROI data, testimonials judge perceived benefits
- Reliance on testimonials is built on
  - trust
  - perception
- Trust will erode over time unless perceptions are validated by ROI data

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Business Case



- Cost: number of person-hours to develop risk management process
- Benefit: amount of resources saved those who reuse process
- Example: time, money, and staff not expended on nine of ten programs
  - Cost-benefit analysis: justified at 10 to 1 ROI

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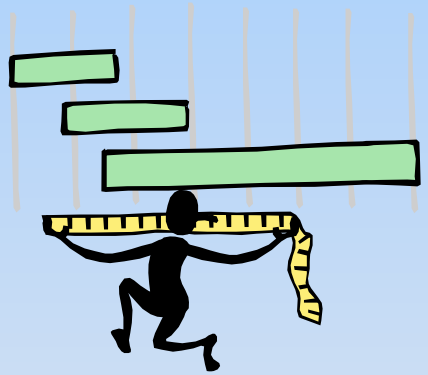
$ROI_{(RM)}$

- $ROI_{(RM)}$ is the ratio of savings to cost that indicates the value of risk management
- Cost of risk management is the investment
  - time spent in risk management meetings
  - cost of reporting risk information
  - staff to develop a risk action plan
- Savings is the return for each managed risk
  - cost avoidance and cost reduction



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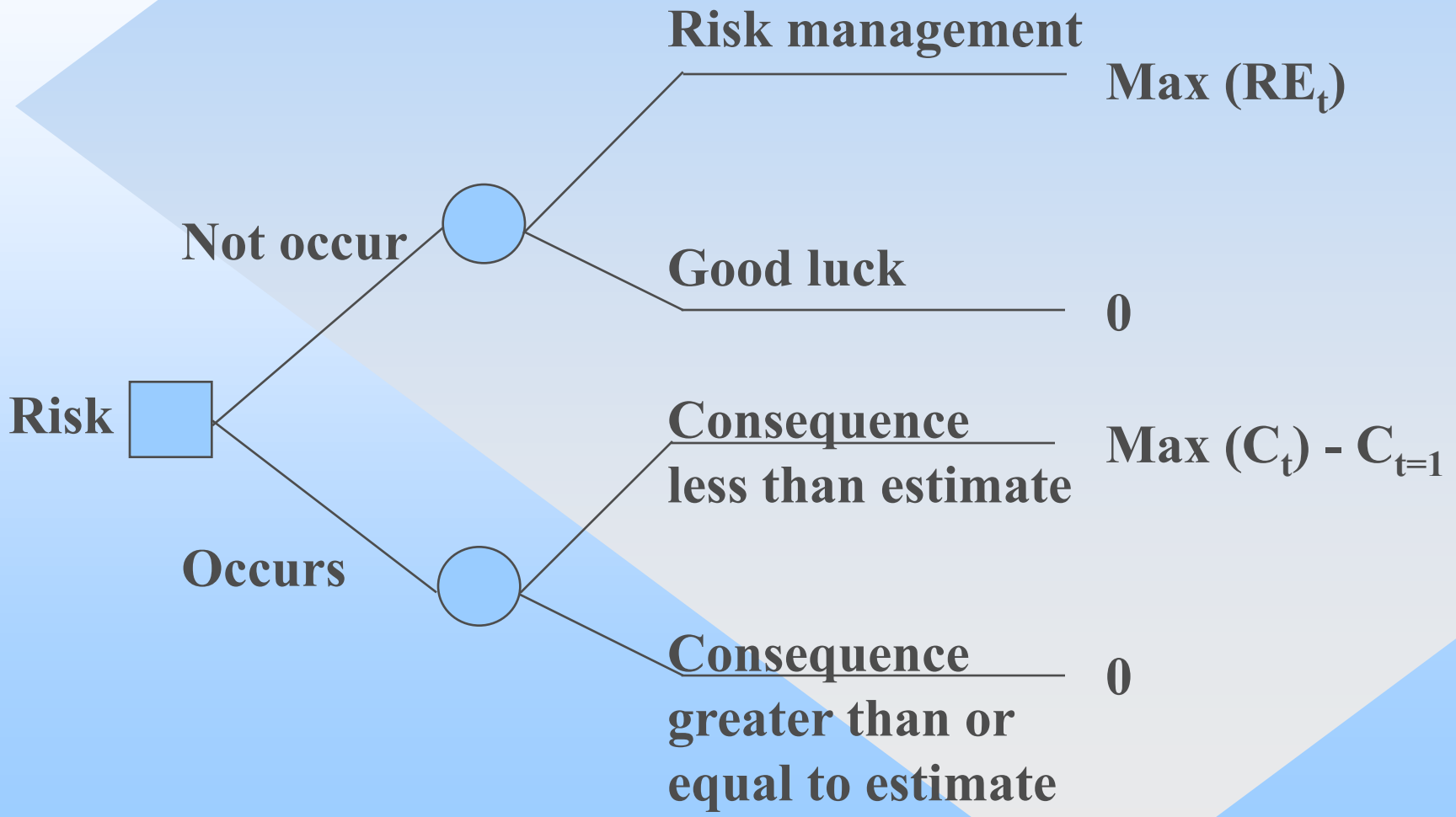
Cost Avoidance



- Decreases the anticipated cost growth
- Difference between possible cost without risk resolution and actual cost with risk resolution
- Any resolution strategy that successfully contains cost growth to maintain the budget
- Depends on four possible risk outcomes

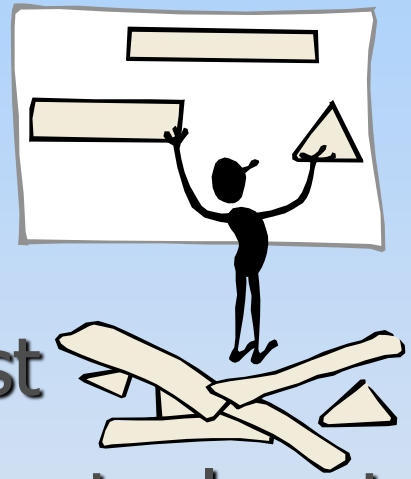
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Cost Avoidance Calculation



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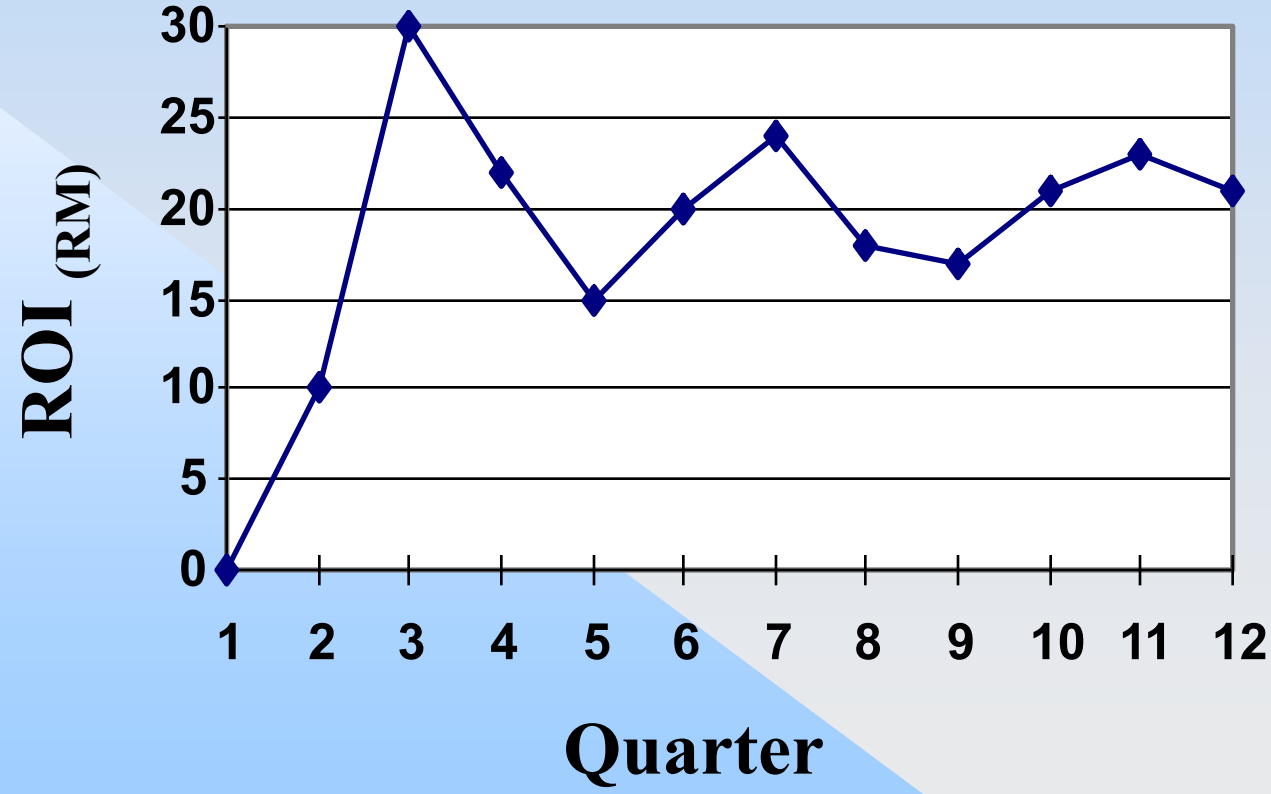
Cost Reduction



- Decreases estimated planned cost
- Difference between planned and actual costs
- It is possible to underrun the budget
- Opportunities for a program to do better than their baseline plan
- An alternate course of action to reduce resources needed

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$ROI_{(RM)}$ Trend Data



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$ROI_{(RM)}$ Metric Utility

- Planning benchmark for risk leverage
- Planning benchmark for management reserve
- Project indicator of risk management effectiveness
- Organizational measure of risk management utility



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$ROI_{(schedule\ risk)}$ 23 to 1

- Savings: 25,600 labor hours cost avoidance (2 mo. x 80 engineers x 160 hrs./mo.)
- Cost: 1,120 labor hours:
  - 480 hours meetings (10 engineers x 1 hour/week x 48 weeks)
  - 320 hours assessment (40 hours x 8 engineers)
  - 320 hours model research (1 engineer x 320 hr)
- $ROI_{(schedule\ risk)}$ = 25,600 hrs/1,120 labor hrs



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$ROI_{(RM)}$ 22 to 1

- Savings: $8M ($6M cost avoidance and $2M cost reduction)
- Cost: $370,000
  - $150,000 programwide risk management
  - $100,000 software risk management
  - $120,000 risk resolution cost
- $ROI_{(RM)}$ = $8 million / $370,000



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Maximizing Opportunities

- Business case based on cost-benefit analysis
- Calculate the benefits of risk management
  - cost avoidance (risk of exceeding plan)
  - cost reduction (opportunity to beat plan)
- Best-in-class standard for $ROI_{(RM)}$ is 20 to 1
- Achieve this benchmark to maximize opportunities within your organization



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Why Are Decisions Difficult?

- Multiple objectives
  - Conflicting goals
  - Different motivations
  - Trade-offs
- Different perspectives
  - Different alternatives
  - Different choices
  - Different conclusions
- Complexity
  - Interrelated issues
  - Multiple alternatives
  - Economic impact
- Uncertainty
  - Risk
  - Assumptions
  - Perceptions



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A Good Decision

- Made after systematic decomposition.
- Based on a thorough understanding.
- Careful thought regarding important issues.
- Discuss goals and possible outcomes.
- Action taken from the essential elements.
- A good decision can have an unlucky outcome.



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Conclusion



- The grail is our brain.
- Risk identification is a right-brain activity.
- Results matter more than process.
- The benchmark for $ROI_{(RM)}$ is 20 to 1.
- Negative thinking is positive.

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New Methods

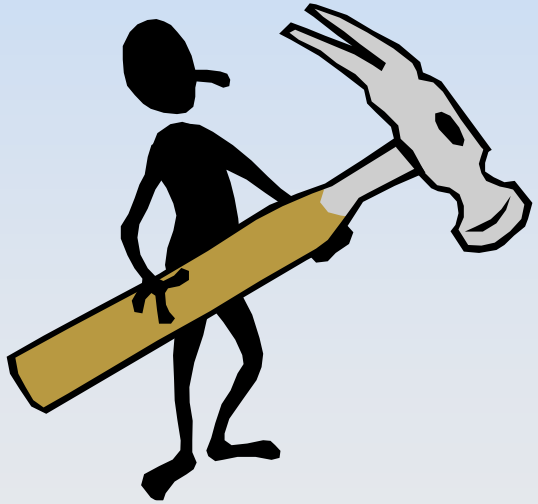
- The 6-D Model
  - Extends the Deming PDCA cycle by adding the ability to reveal risk and opportunity.
  - Describes an effective approach to thinking that scales from individuals to teams, projects, and organizations.
- P^2I^2 Success Formula
  - Distributes the task of managing risk to four major factors: people, process, infrastructure, and implementation.
- Risk Management Map
  - Synchronizes efforts to manage risk by providing direction through five evolutionary stages.



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New Tools

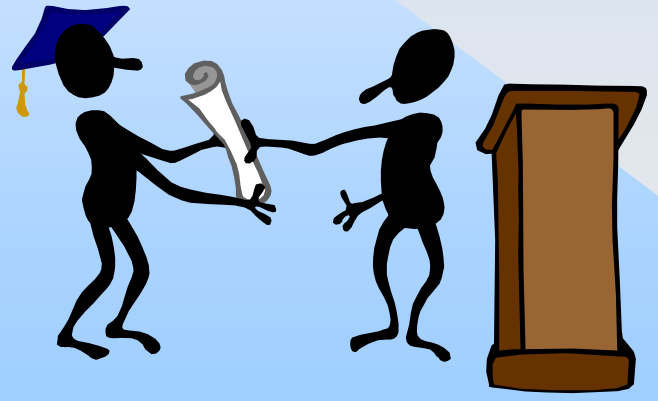
- 6D Risk Management
- Living Lifecycle Model
- Personal Risk Management Matrix
- Risk Management Form
- Risk Practices Survey
- Risk Preference Test
- Risk Statement
- $ROI_{(RM)}$
- Quantitative Process Improvement
- Ten-Point Game Plan



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Graduation

- Use your knowledge wisely.
- Congratulations!



Commencement
is a
beginning.

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