Risk Management

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Risk Management

- “The process involved with identifying, analyzing, and responding to risk. It includes maximizing the results of positive risks and minimizing the consequences of negative events”

Why Do We Manage Risk?

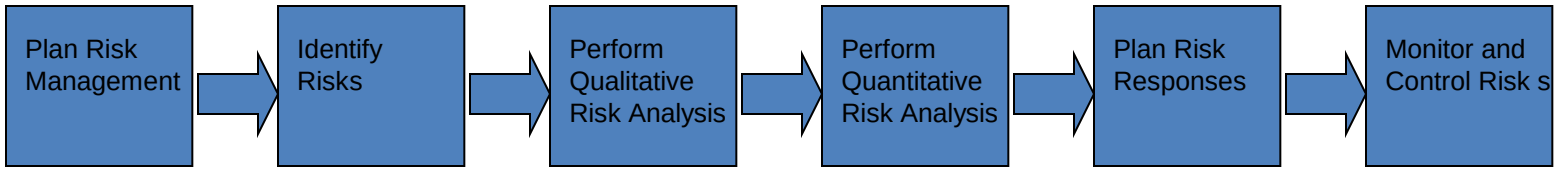
- Project problems can be reduced as much as 90% by using risk analysis
- Positives:
  - More info available during planning
  - Improved probability of success/optimum project
- Negatives:
  - Belief that all risks are accounted for
  - Project cut due to risk level

Key Terms

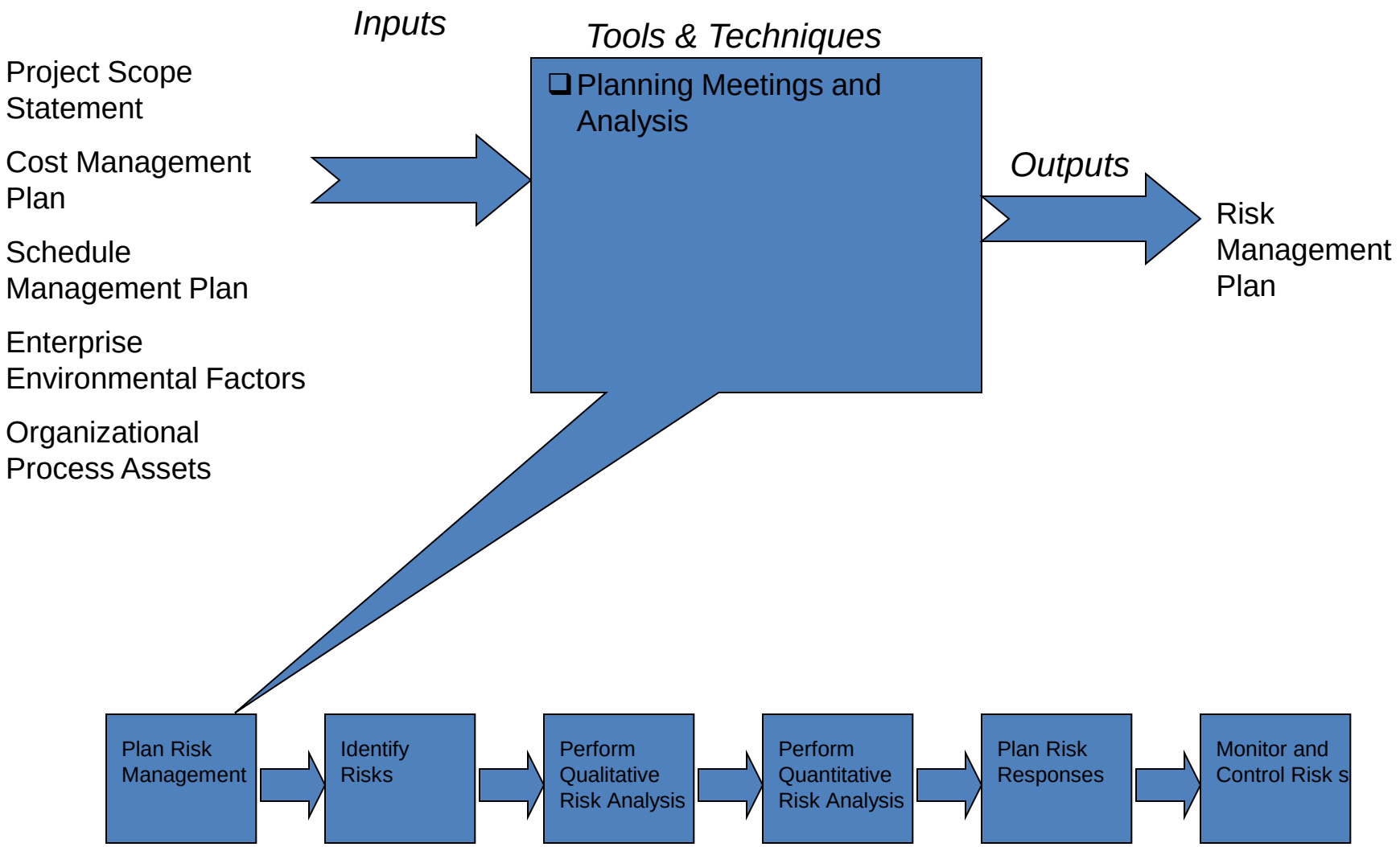
- Risk Tolerance – The amount of acceptable risk
- Risk Adverse – Someone that does not want to take risks
- Risk Factors
  - *Probability* of occurrence
  - *Range* of possible outcomes (impact or amount at stake
  - *Expected Timing* of event
  - Anticipated frequency of risk events from that source

How Do We Manage Risk?

- Use the six risk management processes
  - Plan Risk Management
  - Identify Risks
  - Perform Qualitative Risk Analysis
  - Perform Quantitative Risk Analysis
  - Plan Risk Responses
  - Monitor and Control Risks



Plan Risk Management



What is a Risk Management Plan?

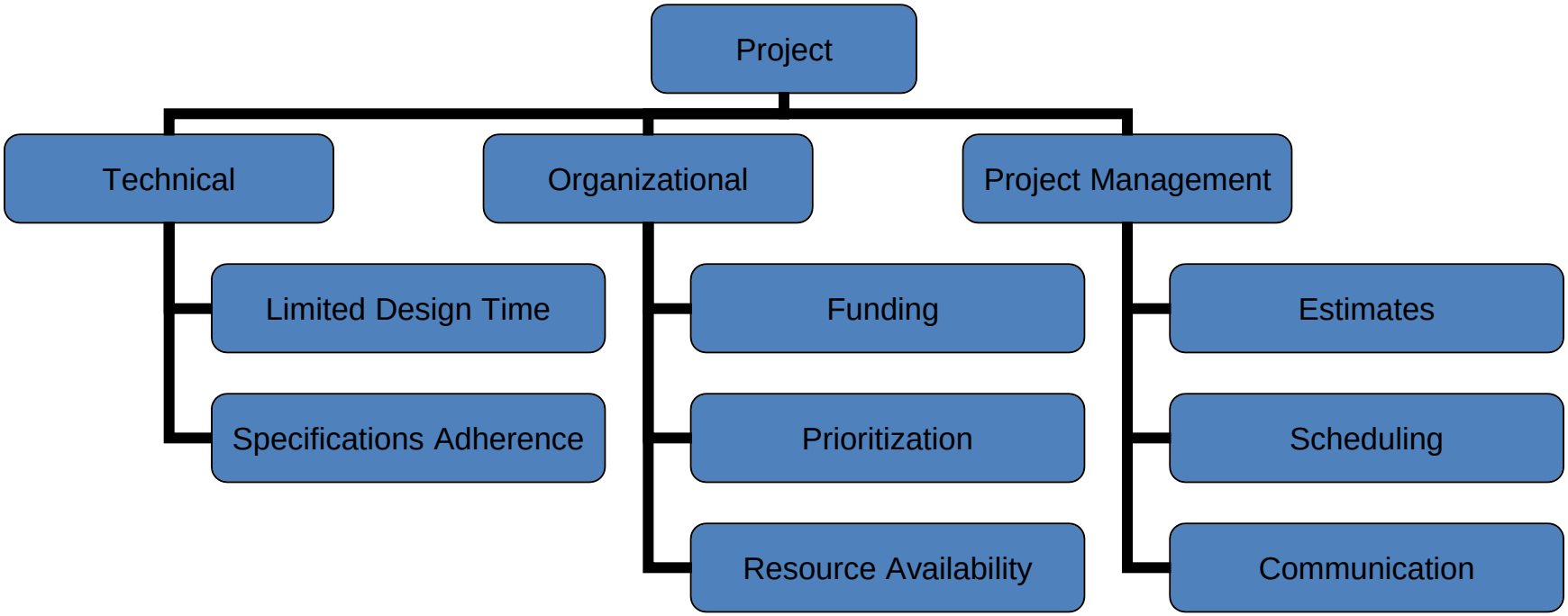
- Methodology – Approach, tools, & data
- Roles & Responsibilities
- Budgeting – Resources to be put into risk management
- Timing – When and how often
- Risk Categories – Risk Breakdown Structure (RBS)
- Definitions – Risk probabilities and impact

What is a Risk Mgmt Plan (Cont'd)?

- Probability and Impact Matrix
- Stakeholder tolerances
- Reporting formats
- Tracking

Risk Breakdown Structure

- Lists categories and subcategories where risks may arise



Identify Risks

Risk Management Plan

Activity Cost Estimates

Activity Duration Estimates

Scope Baseline

Stakeholder Register

Cost Management Plan

Schedule Management Plan

Quality Management Plan

Project Documents

Enterprise Environmental Factors

Organizational Process Assets

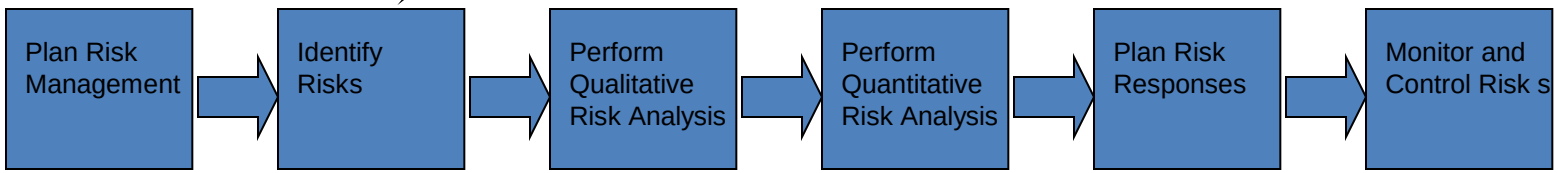
Inputs

Tools & Techniques

- ❑ Documentation Reviews
- ❑ Information Gathering Techniques
- ❑ Checklist Analysis
- ❑ Assumption Analysis
- ❑ Diagramming Techniques
- ❑ SWOT Analysis
- ❑ Expert Judgment

Outputs

Risk Register

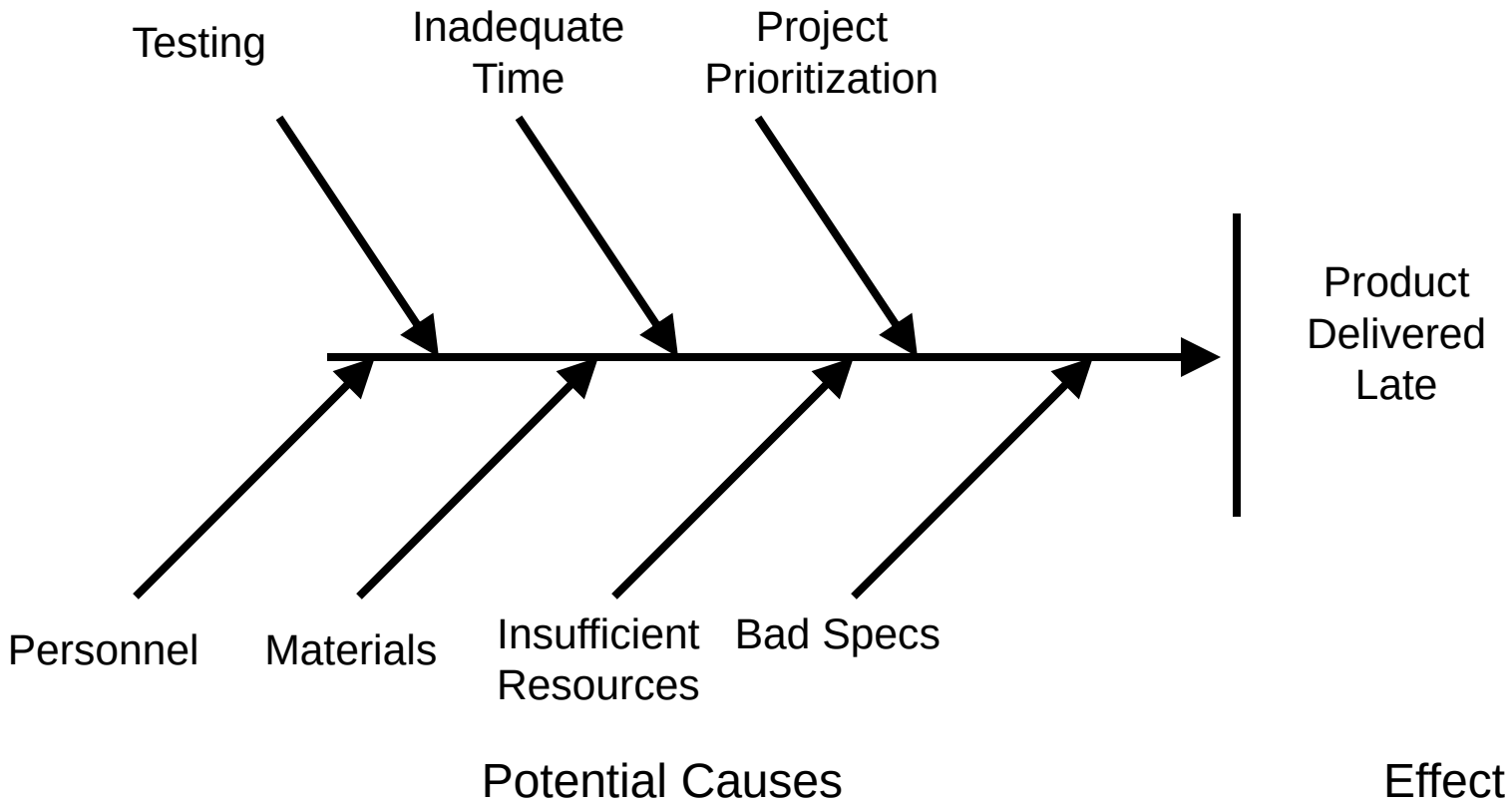


Information Gathering Techniques

- Brainstorming
- Delphi technique
  - Successive anonymous questionnaires on project risks with responses summarized for further analysis
- Interviewing
- Root cause identification
- Strengths, weaknesses, opportunities, and threats (SWOT) analysis

Diagramming Techniques

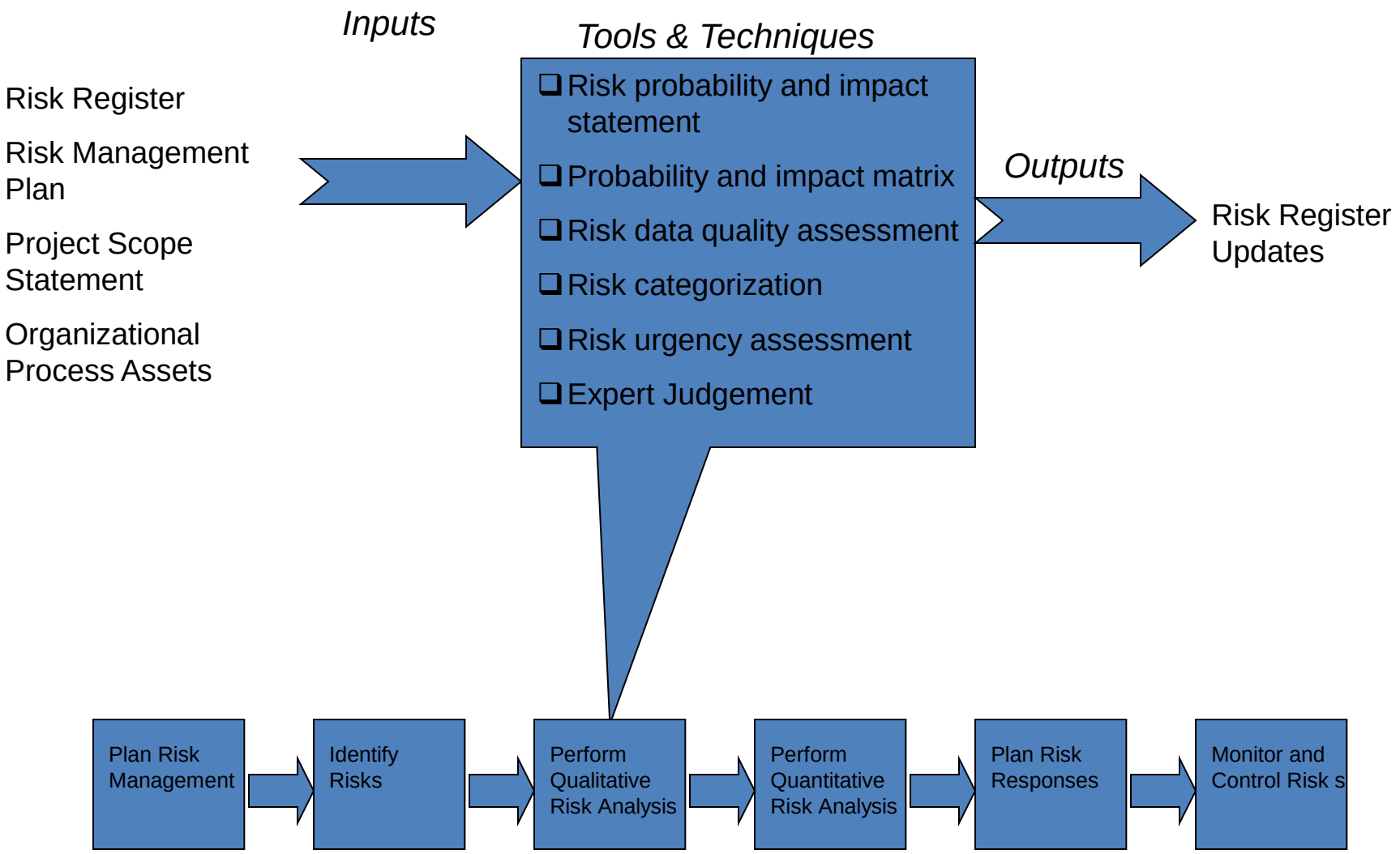
- Cause and Effect Diagrams
  - Also known as Ishikawa or fishbone



Risk Register

- List of
  - Identified risks
  - Potential responses
  - Root causes
- Updated risk categories (if required)

Perform Qualitative Risk Analysis



Methodologies

- Probability and Impact Matrix
  - Based on Failure Modes and Effects Analysis (FMEA)
  - From 1950's analysis of military systems

Probability and Impact Matrix

- Define Probability Scale & Impact Scale

Impact Scale

Consequence	Health and Safety
Extreme	Fatality or multiple fatalities expected
High	Severe injury or disability likely; or some potential for fatality
Moderate	Lost time or injury likely; or some potential for serious injuries; or small risk of fatality
Low	First aid required; or small risk of serious injury
Negligible	No concern

Probability Scale

Likelihood Class	Likelihood of Occurrence (events/year)
Not Likely (NL)	<0.01% chance of occurrence
Low (L)	0.01 - 0.1% chance of occurrence
Moderate (M)	0.1 - 1% chance of occurrence
High (H)	1 - 10% chance of occurrence
Expected (E)	>10% chance of occurrence

Probability and Impact Plots

- Rate each risk on scales then plot on matrix
- Develop mitigation technique for risks above tolerance

CONSEQUENCE	LIKELIHOOD: NOT LIKELY	LOW	MODERATE	HIGH	EXPECTED
EXTREME	B14.1, B15.2, B16.2	A61.1, B14.1, B15.2, B16.2	A12.3, A61.2, A62		
HIGH		A41.7, A42.2, A101.3, B21.1, B31.5, B31.6, B33.6	B11.2, B11.3, B32.2	A55.1, B11.1, B15.1, B16.1	B21.2
MODERATE		A13, A22.2, A61.5, A81.6, B22.1, B23.1, B31.4, B33.4, B92.2	A21.1, A21.2, A22.1, A41.6, A52, A81.2, B12.1, B13.1, B13.2	A53.1, A55.2, A61.4, B12.2, B31.3, B33.3	A14.1, A41.8, A42.1, A92.1, B22.2, B23.2, B32.1
LOW	B17	A41.2, A41.4, A57, A92.2, A92.5, A101.2, A101.6, B14.2, B17, B31.2, B34.1, B37.1	A41.5, A63.3, A101.4, A63.5, B18, B31.1, B33.1, B36.1	A12.2, A41.1, A41.3, A53.2, A56, A61.6, A63.4, A71.1, A71.2, A81.4, A81.5, A92.3, B33.2	A11, A12.1, A14.2, A54, A61.3, A63.1, A63.2, A81.3, A92.4, A92.6, A101.5, A101.7, B34.2, B35.1, B36.2, B37.2, B53.2, B51, B52, B53, B71.1, B71.2, B94.2
NEGLIGIBLE		B41.1, B41.2, B41.3, B41.4, B85, B91.2, B91.3, B92.1, B93.1	A81.1, B92.3, B93.2, B93.3	B91.1	A91, B81.1, B81.2, B81.3, B81.4, B94.1

Risk Register Update

- Add
  - Probability and Impact Matrix results
  - Perform quality check on results
  - Categorize the risks to make them easier to handle
  - Perform urgency assessment to determine which risk need immediate attention

Risk Register

FMEA - Example Worksheet

FAILURE MODES AND EFFECTS ANALYSIS (FMEA) WORKSHEET.

MINE AREA/ COMPONENT	ID	FAILURE MODE	EFFECTS	PROJECT STAGE	LIKELIHOOD	CONSEQUENCES				LEVEL OF CONFIDENCE	MITIGATION/ COMMENTS
						BIOLOGICAL IMPACTS & LAND USE	REGULATORY IMPACTS & CONCERNS	PUBLIC CONCERN & IMAGE	HEALTH & SAFETY		
ARD CONTROL	**A1**										
OPEN PIT	A11	pit walls generate acidity	increased acidity at treatment plant	PC	E	L	N	L	N	H	provide increased treatment
TAILINGS STORAGE FACILITY	A12.1	inadequate blending of non-acid and acid forming tailings	increased acidity at treatment plant	O,PC	E	L	M	M	N	H	provide increased treatment/sludge storage, evaluate potential to improve blending
MINE ROCK PILE	A12.2	inadequate cover material stockpiling	increased infiltration & acidity & delayed infiltration reduction	PC	H	L	M	M	N	H	provide increased treatment/water storage
	A13	inadequate segregation of reactive material	contaminated discharge in unexpected areas	O,PC	L	M	H	H	L	M	provide independent QA/QC, provide additional capture or treatment

NOTES:

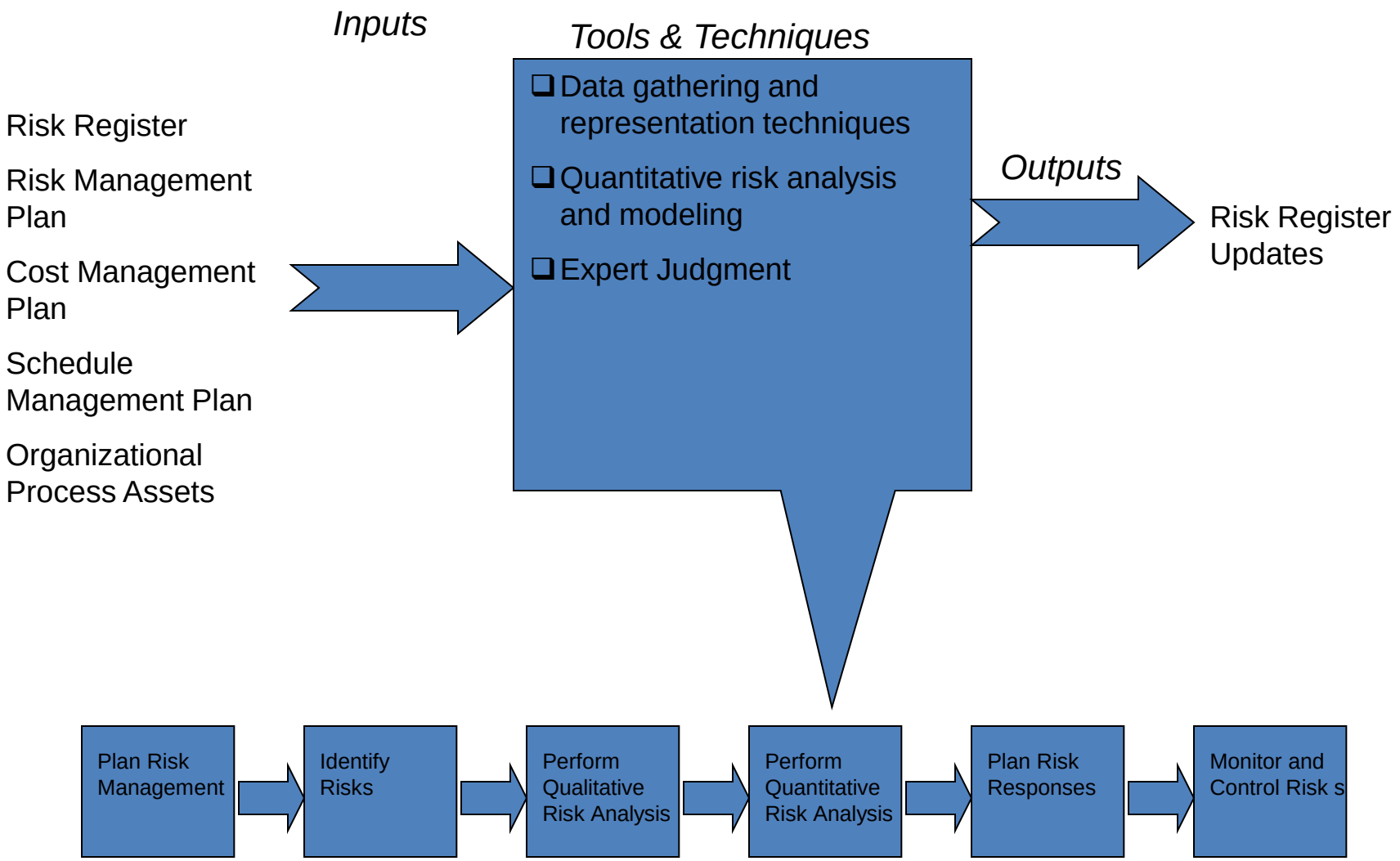
PROJECT STAGE:
- PC = POST CLOSURE
- O = OPERATIONS

LIKELIHOOD
- N = NOT LIKELY
- L = LOW
- M = MODERATE
- H = HIGH
- E = EXPECTED

CONSEQUENCES
- N = NEGLIGIBLE
- L = LOW
- M = MODERATE
- H = HIGH
- E = EXTREME

LEVEL OF CONFIDENCE
- H = HIGH
- M = MODERATE
- L = LOW

Perform Quantitative Risk Analysis



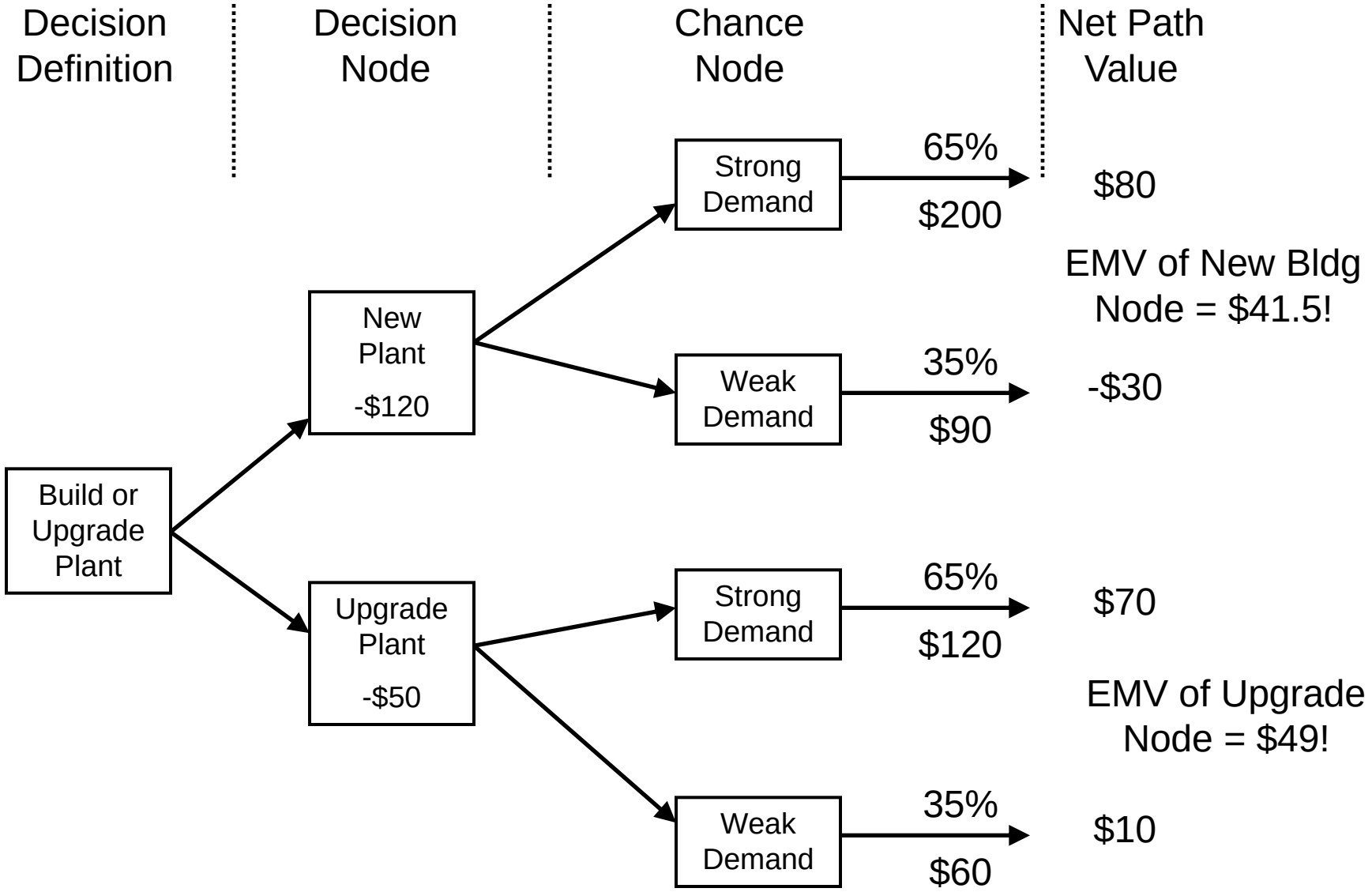
Quantitative Risk Analysis

- Analyze numerically the probability and consequence of each risk
- Monte Carlo analysis popular
- Decision Tree analysis on test
  - Diagram that describes a decision and probabilities associated with the choices
- Expected Monetary Value Analysis (EMV)

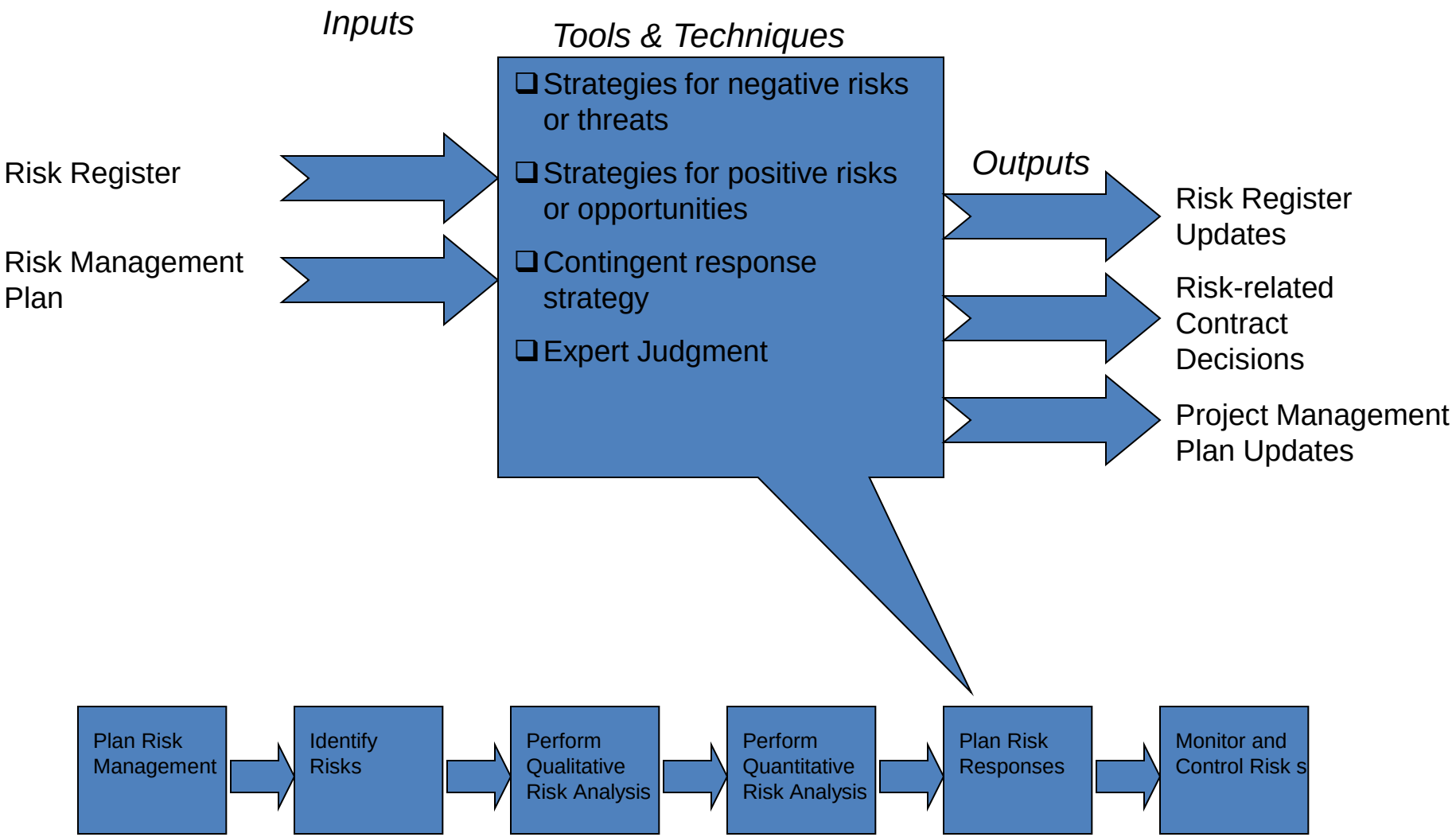
Expected Monetary Value (EMV)

	Building Cost	Probability	
Optimistic Outcome	**$150K**	**0.2**	**$30K**
Likely Outcome	**$225K**	**0.5**	**$113K**
Pessimistic Outcome	**$300K**	**0.3**	**$100K**
		Expected Value	**$243K**

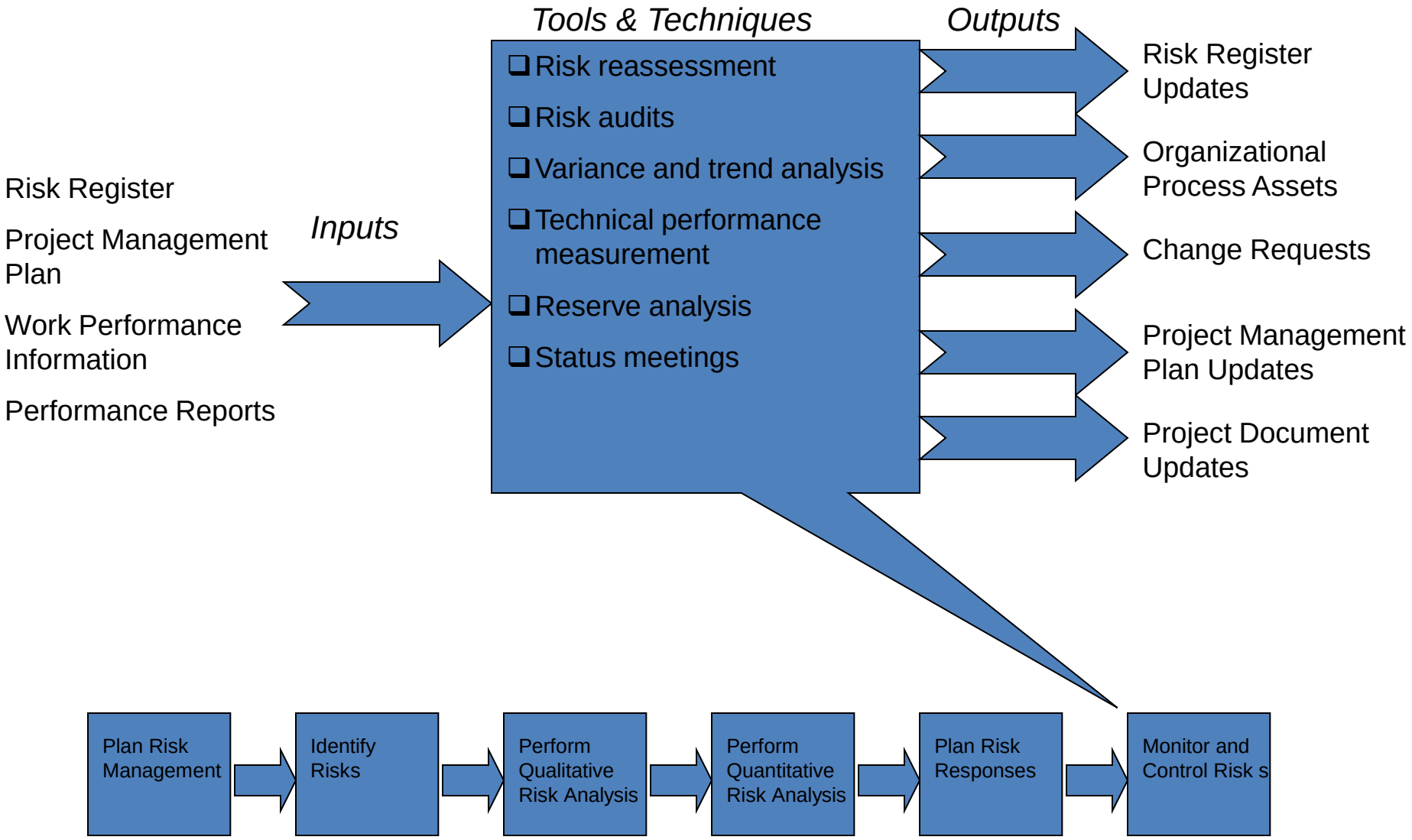
Decision Tree Analysis



Plan Risk Responses



Strategies

- Negative Risks (or Threats)
  - Avoid
  - Transfer
  - Mitigate
  - Acceptance
- Positive Risks (or Opportunities)
  - Exploit
  - Share
  - Enhance
  - Acceptance

Monitor and Control Risks