

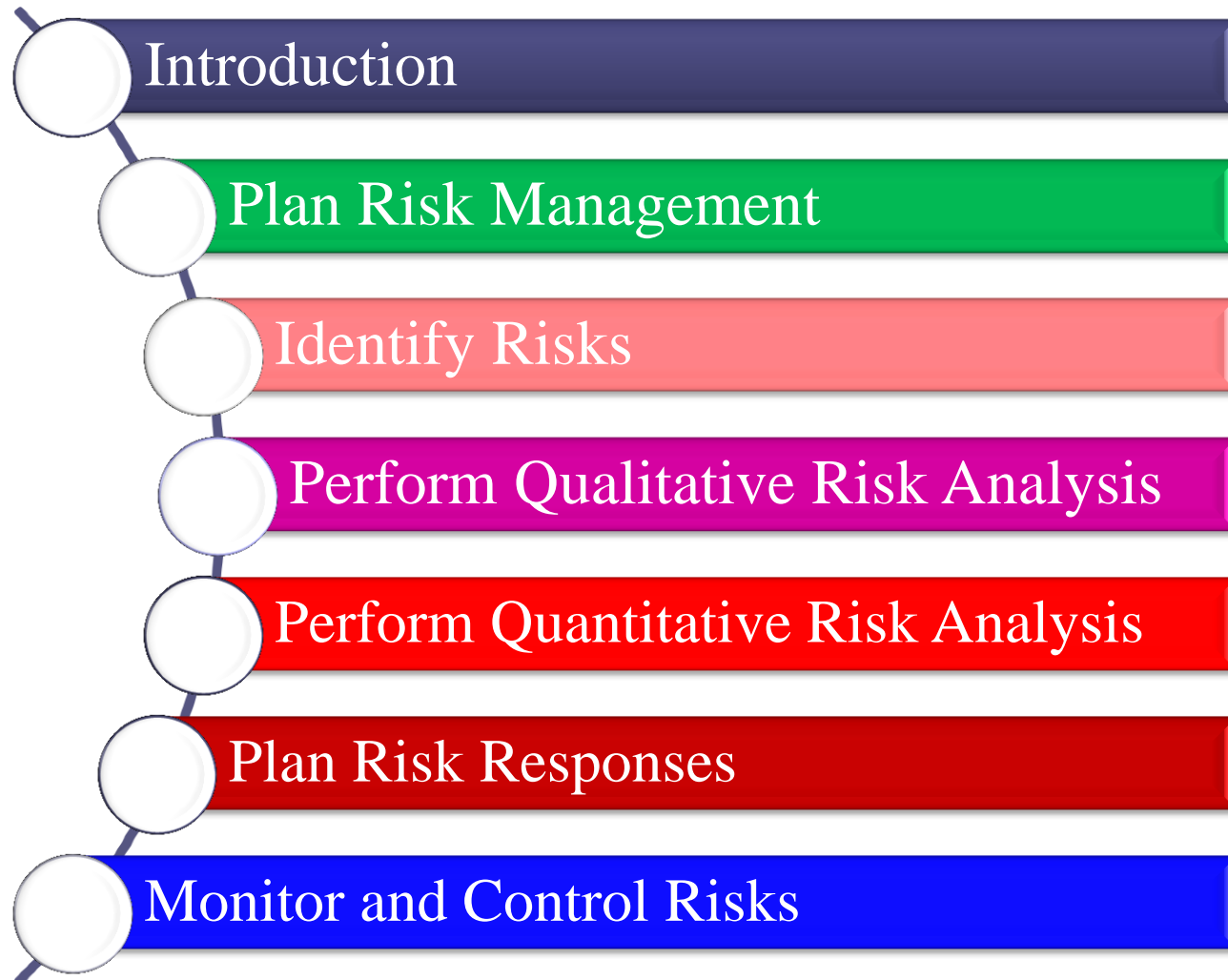
# PROJECT MANAGEMENT

Topic 13

## **Risk Management**

# Contents

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# Introduction

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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”.

# Introduction

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## 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

# Introduction

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## Key Terms

Risk Tolerance – The amount of acceptable risk

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.

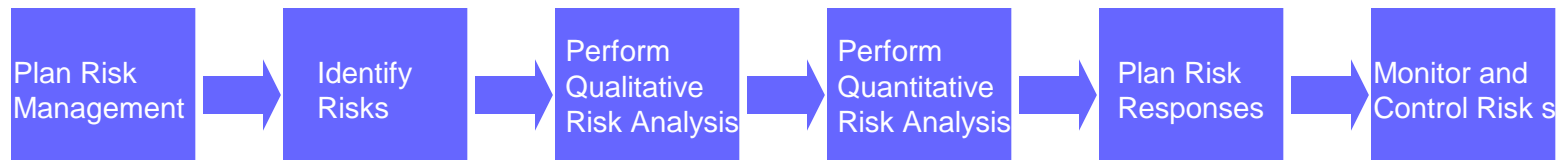
# Introduction

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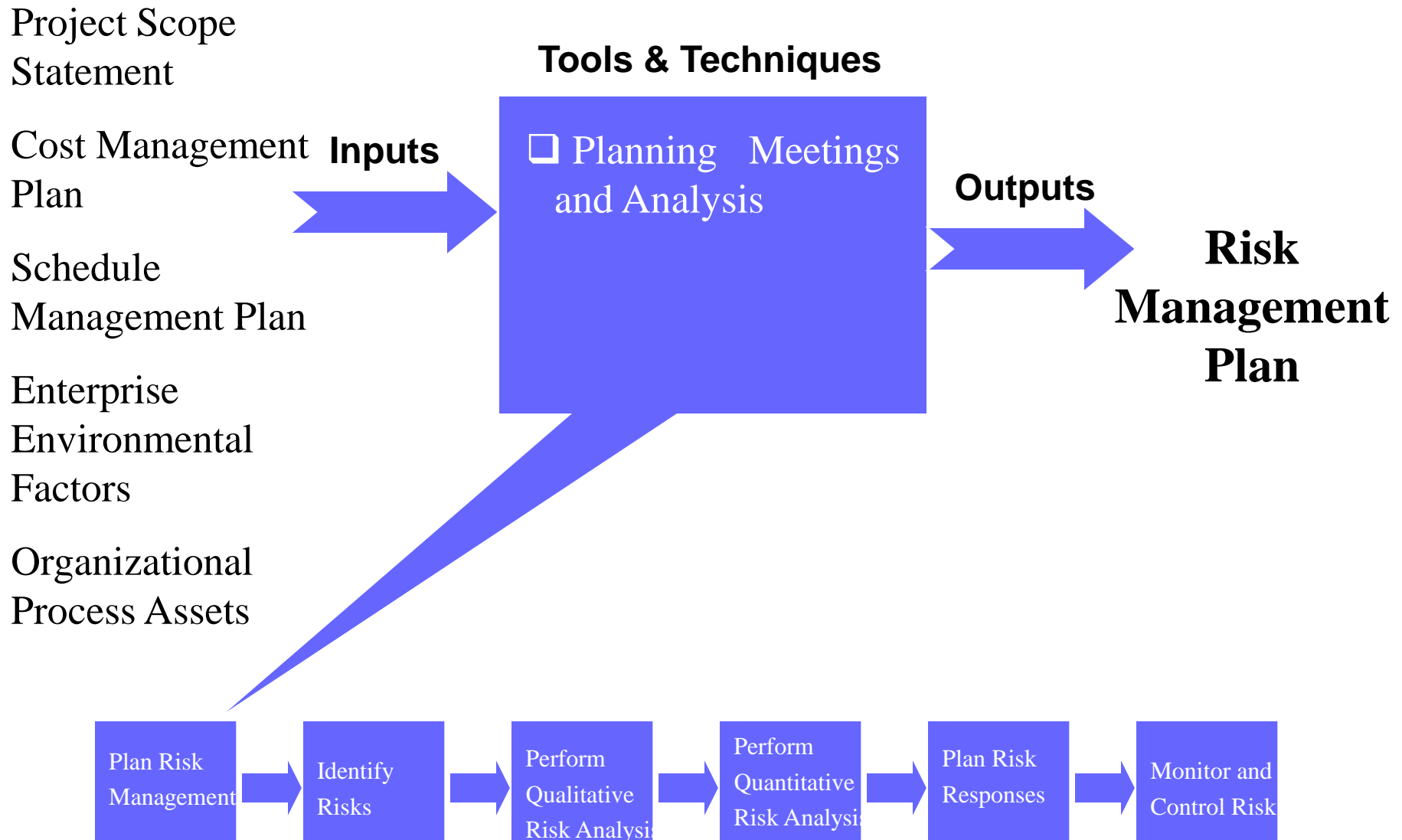
## How Do We Manage Risk?

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



# Plan Risk Management

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



# Plan Risk Management

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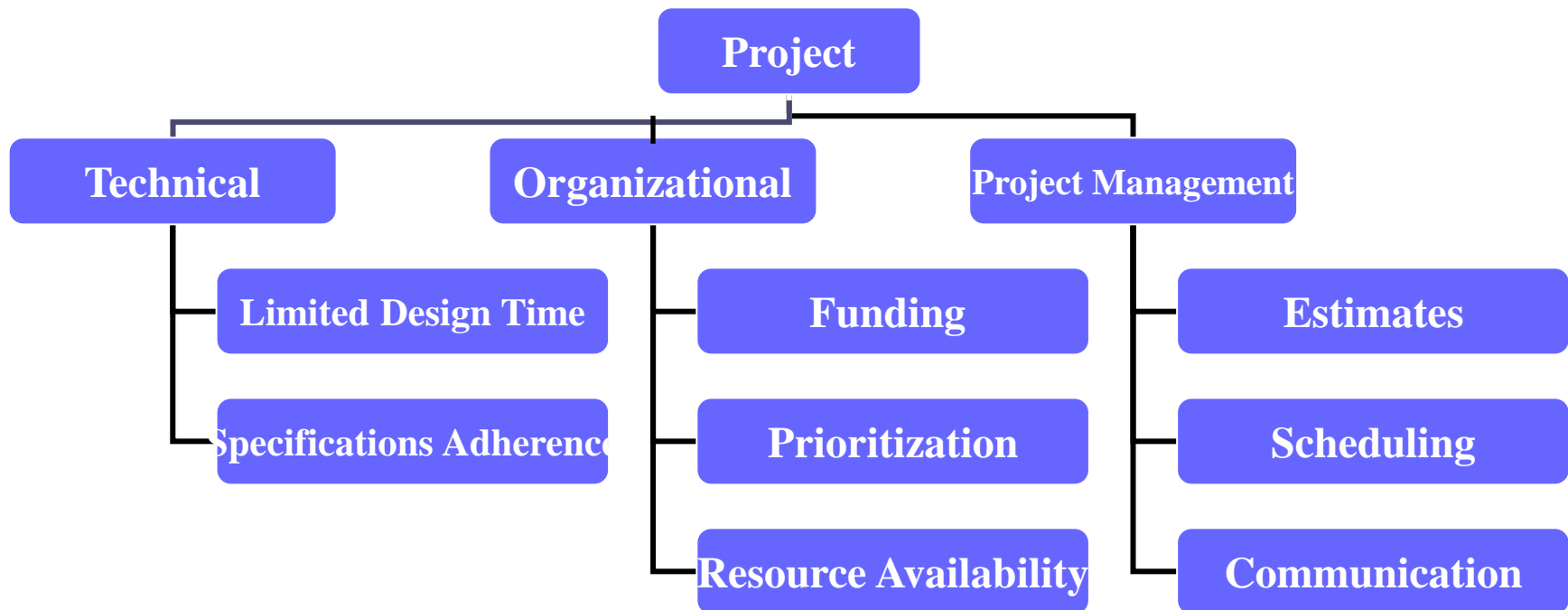
## Categories of risk might include

- **Market risk** – Will the new service or product be useful to the organization or marketable to others? Will the users accept it? Will someone else create a better product?
- **Financial risk** – can the organization afford to undertake the project? Will the project meet NPV, IRR and payback estimates?
- **Technology risk** – is the project technically feasible? Is it leading edge or bleeding edge technology?
- **People risk** – Are people with appropriate skills available to help complete the project? Does senior management support the project?
- **Structure/process risk** – What is the degree of change the new project will introduce into user areas and business procedures? With how many other systems does a new project/system need to interact?

# Plan Risk Management

## Risk Breakdown Structure

- Lists categories and subcategories where risks may arise
- **Similar** to a Work Breakdown Structure but used to identify and categorize risks.



# 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

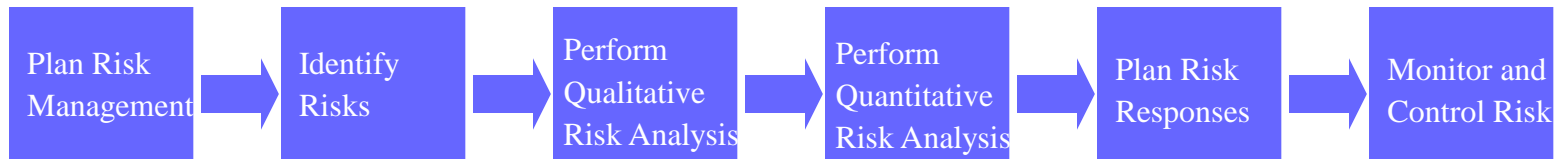
**Inputs**

## Tools & Techniques

- Documentation Reviews
- Information Gathering Techniques
- Checklist Analysis
- Assumption Analysis
- Root cause analysis
- SWOT Analysis
- Expert Judgment

**Outputs**

**Risk Register**



# Identify Risks

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## Information Gathering Techniques

- Brainstorming
- Delphi technique
  - Successive anonymous questionnaires on project risks with responses summarized for further analysis
- Interviewing.

# Identify Risks

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- ❑ **Brainstorming** is a technique by which a group attempts to generate ideas or find a solution for a specific problem by amassing ideas spontaneously and without judgment
- ❑ An experienced facilitator should run the brainstorming session
- ❑ Be careful not to overuse or misuse brainstorming
  - Psychology literature shows that individuals produce a greater number of ideas working alone than they do through brainstorming in small, face-to-face groups
  - Group effects often inhibit idea generation.

# Identify Risks

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- ❑ The **Delphi Technique** is used to derive a consensus among a panel of experts who make predictions about future developments
  - Developed by the RAND Corporation for the US Air Force in the late 1960s
- ❑ Provides independent and anonymous input regarding future events
- ❑ Uses repeated rounds of questioning and written responses and avoids the biasing effects possible in oral methods, such as brainstorming
  - Requires a panel of experts for the particular area in question

# Identify Risks

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- ❑ **Interviewing** is a fact-finding technique for collecting information in face-to-face, phone, e-mail, or instant-messaging discussions
  - Useful to have a prepared set of questions as a guide to the interview
- ❑ Interviewing people with similar project experience is an important tool for identifying potential risks.

# Identify Risks

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**SWOT analysis** (strengths, weaknesses, opportunities, and threats) can also be used during risk identification

Project teams focus on the broad perspectives of potential risks for particular projects

- What are the company's strengths and weaknesses related to this project
- What opportunities and threats exist

Helps identify the broad negative and positive risks that apply to a project



# Identify Risks

## SWOT

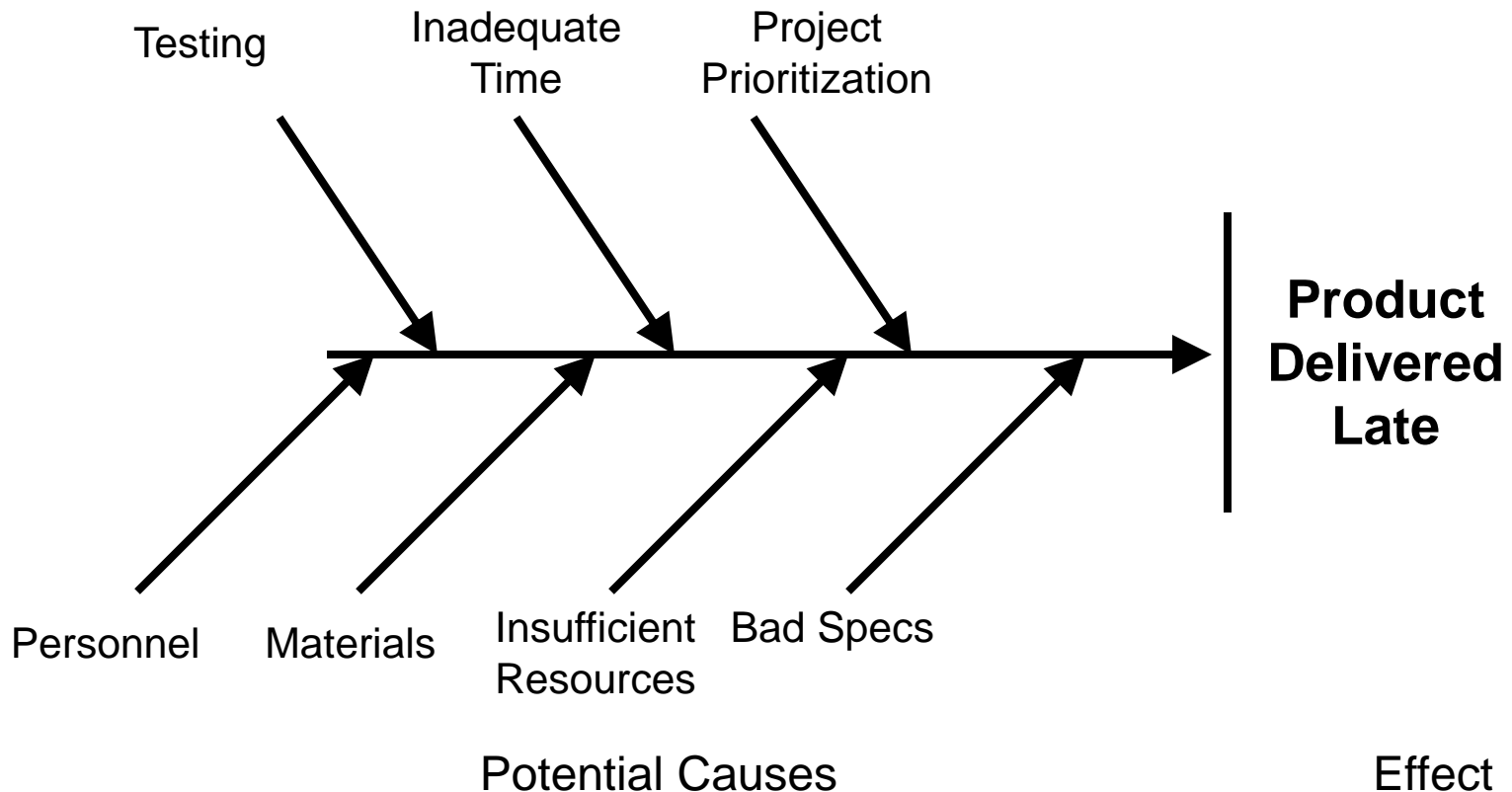
	<b>Cơ hội (O)</b> O1: Giá vật liệu XD O2: Công nghệ XD O3: Thủ tục cấp phép XD	<b>Thách thức (T)</b> T1: Giá đất T2: Giá nhân công T3: Chuyển vận T4: Môi trường
<b>Điểm mạnh (S)</b> S1: Quản lý S2: Chính sách S3: Vốn	<b>S3 + O1 + O3: → Xây nhà</b>	
<b>Điểm yếu (W)</b> W1: Nhân lực W2: Tuân thủ W3: Cạnh tranh		<b>W1 + T2: → Đặt móng</b>

# Identify Risks

## Root cause analysis

### Cause and Effect Diagrams

- Also known as Ishikawa or fishbone



# Identify Risks

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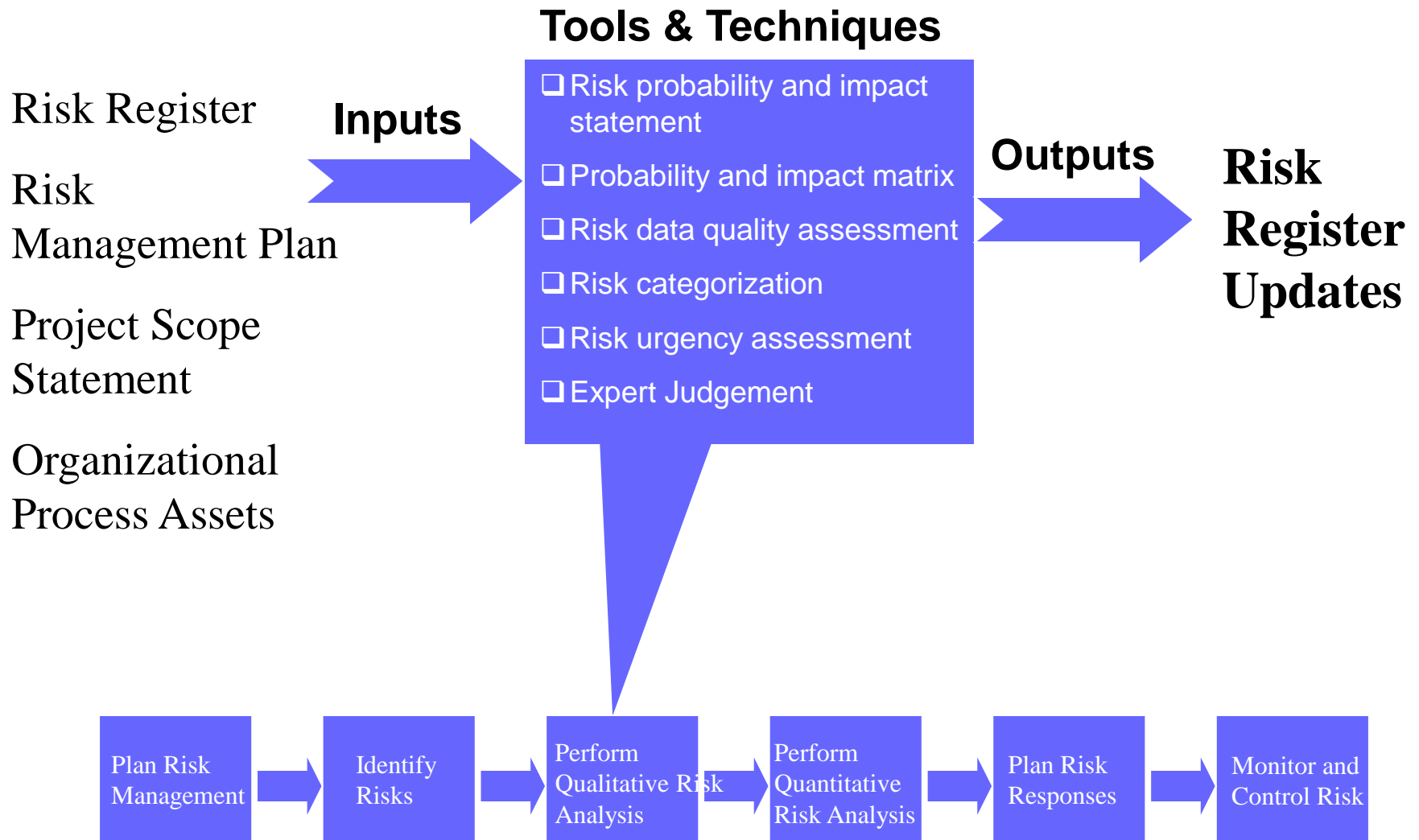
## Risk Register

List of

- Identified risks
- Potential responses
- Root causes

Updated risk categories (if required).

# Perform Qualitative Risk Analysis



# Perform Qualitative Risk Analysis

## Probability and Impact Matrix

- Based on Failure Modes and Effects Analysis (FMEA)
- Lists the relative probability of a risk occurring on one side of a matrix or axis on a chart and the relative impact of the risk occurring on the other.
- Deal first with those risks in the high probability/high impact cell.
- Probabilities of a risk estimated based on several factors based on the unique nature of each project.  
Example: technology not being mature, technology too complex.
- The impact of a risk includes factors such as the availability of fallback solutions.

# Perform Qualitative Risk Analysis

## Probability and Impact Matrix

Define Probability Scale & Impact Scale

### Impact Scale

Consequence	Health & 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

# Perform Qualitative Risk Analysis

## Probability & Impact Plots

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

		LIKELIHOOD				
		NOT LIKELY	LOW	MODERATE	HIGH	EXPECTED
CONSEQUENCE	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
	NEGLECTIBLE		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

# Perform Qualitative Risk Analysis

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## Expert Judgment

- ❑ Many organizations rely on the intuitive feelings and past experience of experts to help identify potential project risks
- ❑ Experts can categorize risks as high, medium, or low with or without more sophisticated techniques.



# Perform Qualitative Risk Analysis

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## 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.

# Perform Qualitative Risk Analysis

## 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:

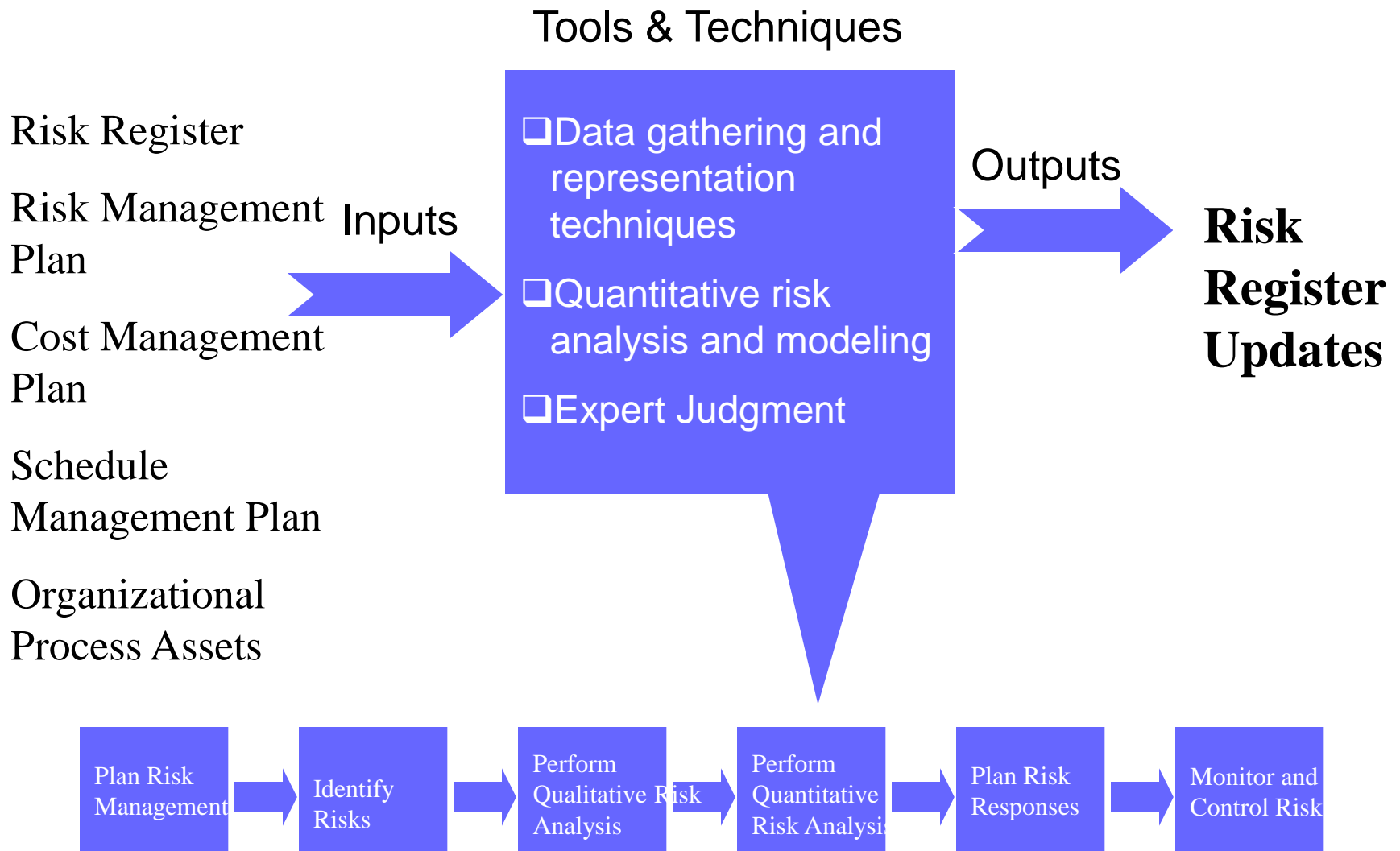
PROJECT STAGE:  
PC = POST CLOSURE  
O = OPERATIONS

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

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

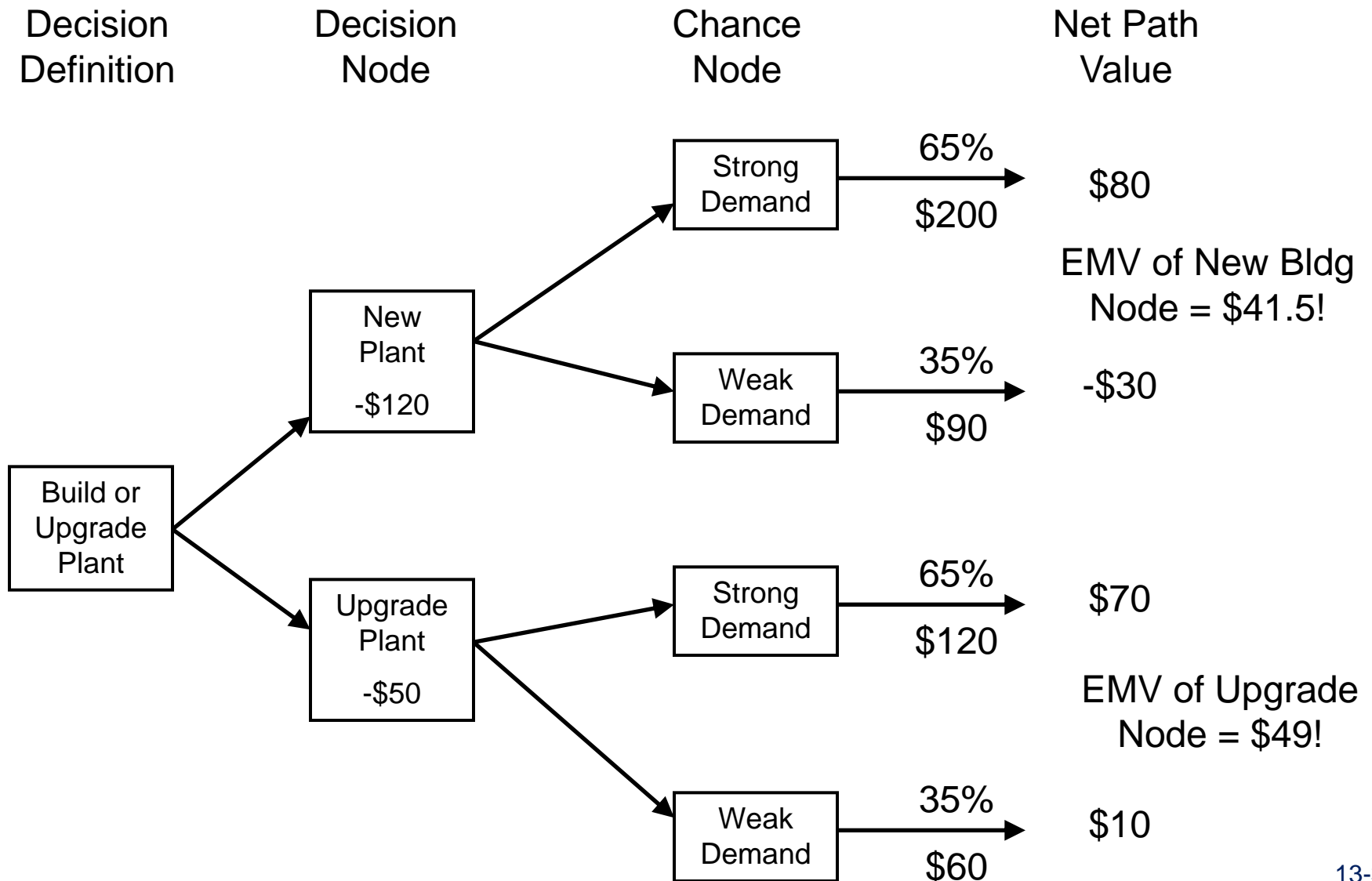
# Quantitative Risk Analysis

**Estimated monetary value (EMV)** is the product of a risk event probability and the risk event's monetary value.

☞ You can draw a decision tree to help find the 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



# Quantitative Risk Analysis

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- ❑ Simulation uses a representation or model of a system to analyze the expected behavior or performance of the system
- ❑ **Monte Carlo analysis** simulates a model's outcome many times to provide a statistical distribution of the calculated results
  - Predicts the probability of finishing by a certain date or that the cost will be equal to or less than a certain value
  - Sensity analysis.

# Quantitative Risk Analysis

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- ❑ **Sensitivity analysis** is a technique used to show the effects of changing one or more variables on an outcome
- ❑ For example, many people use it to determine what the monthly payments for a loan will be given different interest rates or periods of the loan, or for determining break-even points based on different assumptions
- ❑ Spreadsheet software, such as Excel, is a common tool for performing sensitivity analysis.



# Quantitative Risk Analysis






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## Simulation process

1. Identify the critical/most uncertain input variables in a projected model – **risk variables**
2. Substitute single-value assumptions with **probability distributions** which tend to express the possible variability for each of the identified risk variables.
3. Identify the critical calculated results you wish to apply the analysis on – **model results**.
4. **Run simulation** creating a sample of computer scenarios based on inputs from the probability distributions and with respect to any correlation conditions set.
5. **Analyse results**: calculating statistical measures and plotting probability distribution graphs of the results.

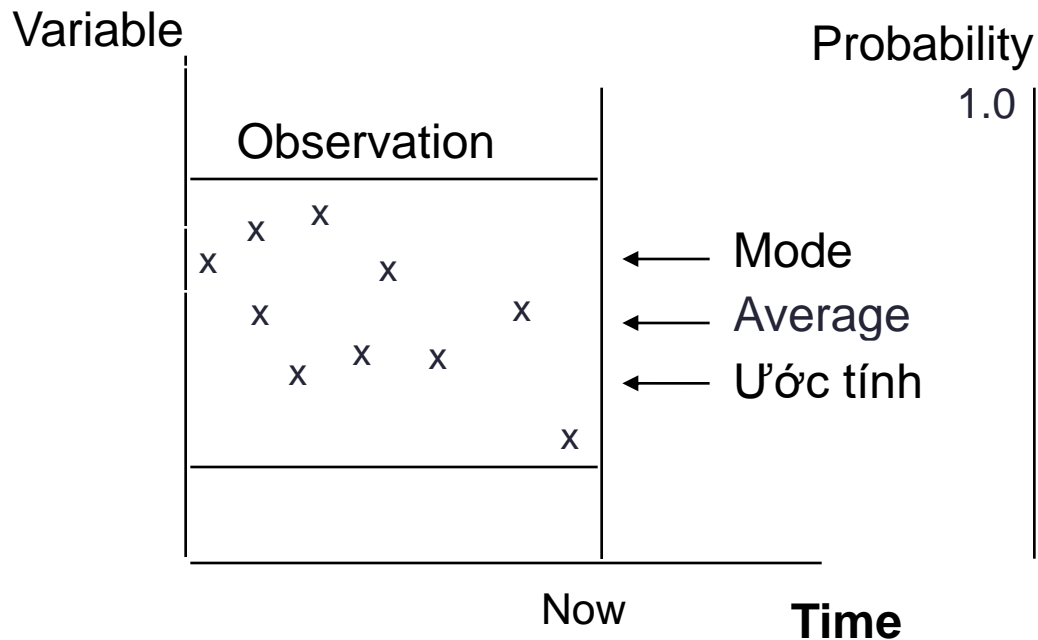
# Quantitative Risk Analysis

## Identify Risk variables

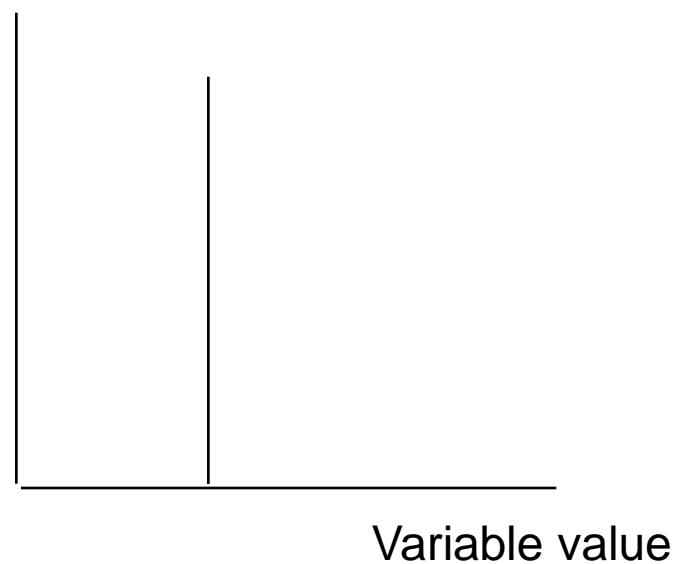
	\$		Rish variable
Sale price	12	<b>V1</b>	 <b>V1</b>
Volume of sales	<u>100</u>	<b>V2</b>	 <b>V2</b>
Cash Inflow ( $V1 \times V2$ )	1200	<b>F1</b>	
Materials	300	<b>V3</b>	 <b>V3</b>
Wages	400	<b>V4</b>	 <b>V4</b>
Expenses	<u>200</u>	<b>V5</b>	 <b>V5</b>
Cash Outflow ( $V3 + V4 + V5$ )	900	<b>F2</b>	
Fixed cost		<b>V6</b>	
Total cost ( $F2 + V6$ )		<b>F3</b>	
Profits ( $F1 - F3$ )		<b>F4</b>	

# Quantitative Risk Analysis

## Single-value estimate

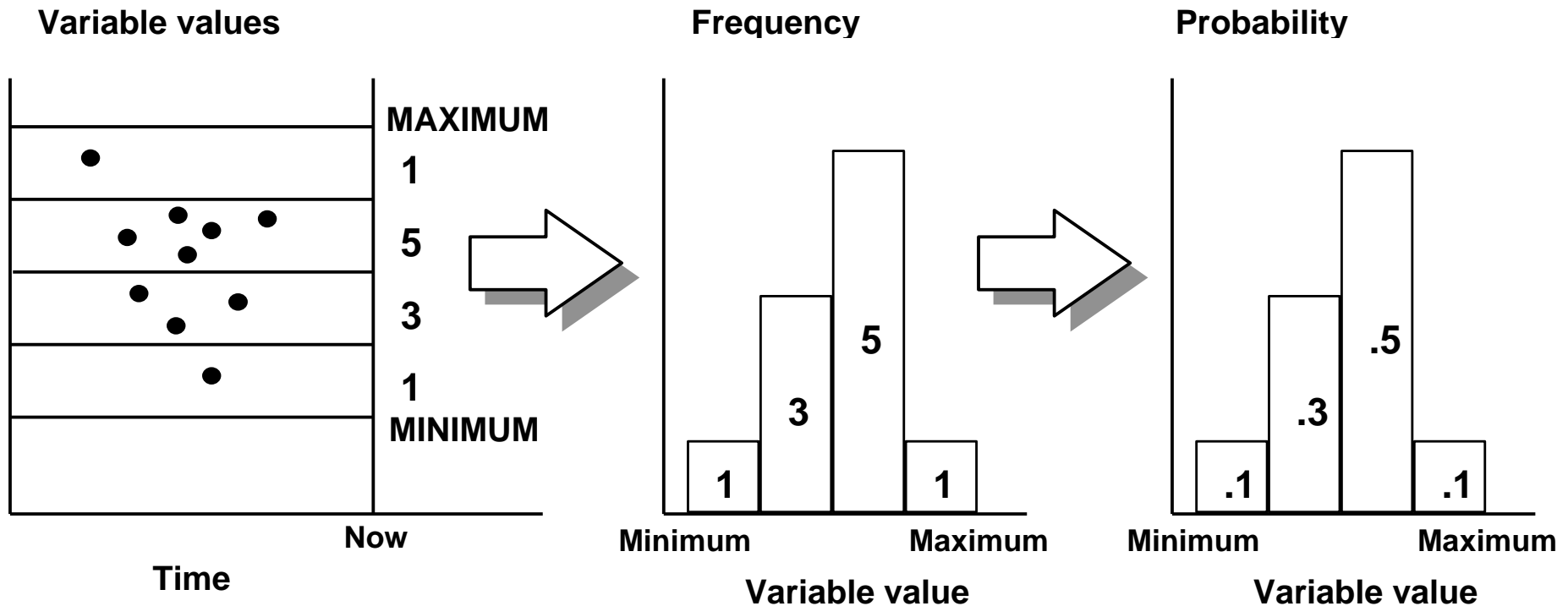


## The deterministes Probability distribution



# Quantitative Risk Analysis

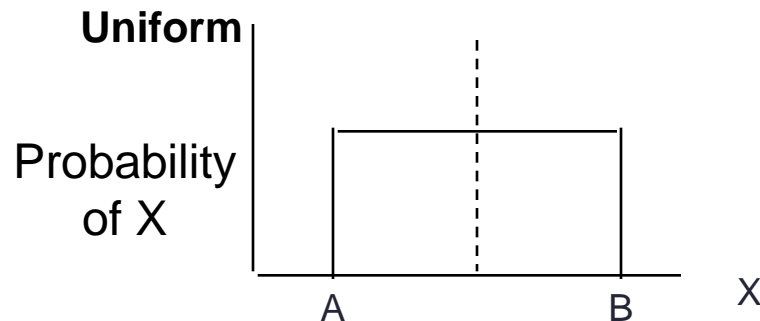
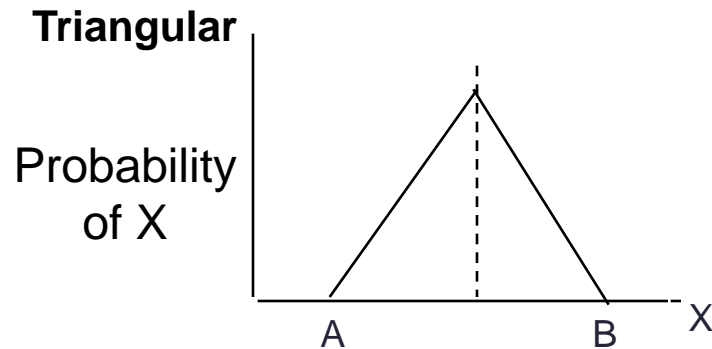
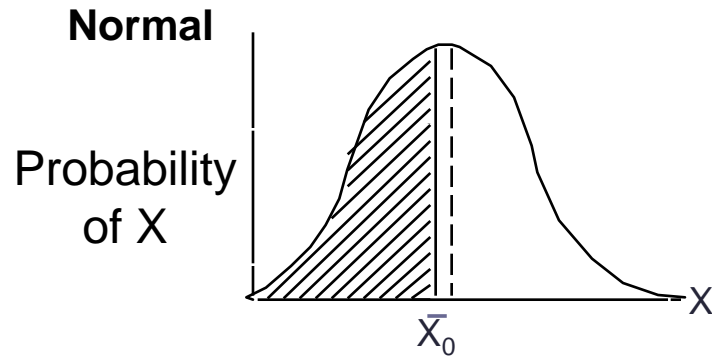
## From frequency to a Probability distribution



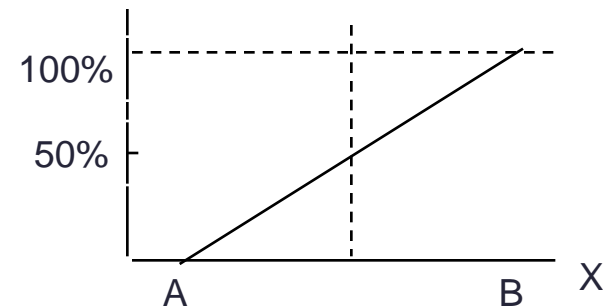
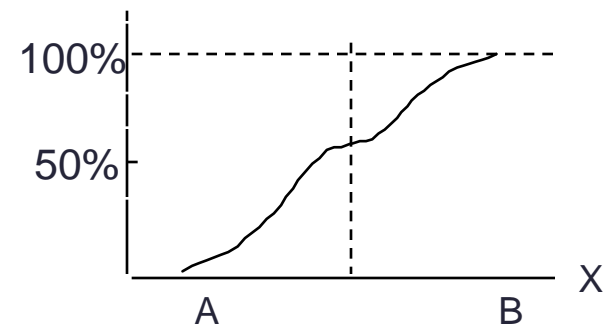
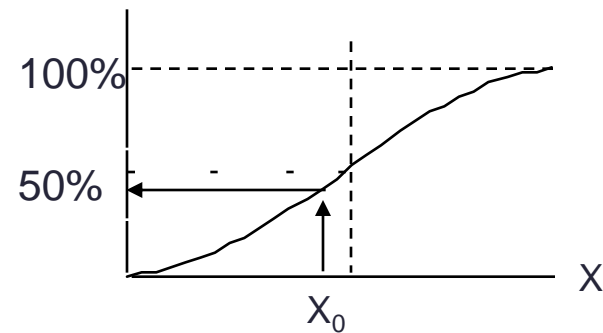
● = Observations

# Quantitative Risk Analysis

## Probability distribution



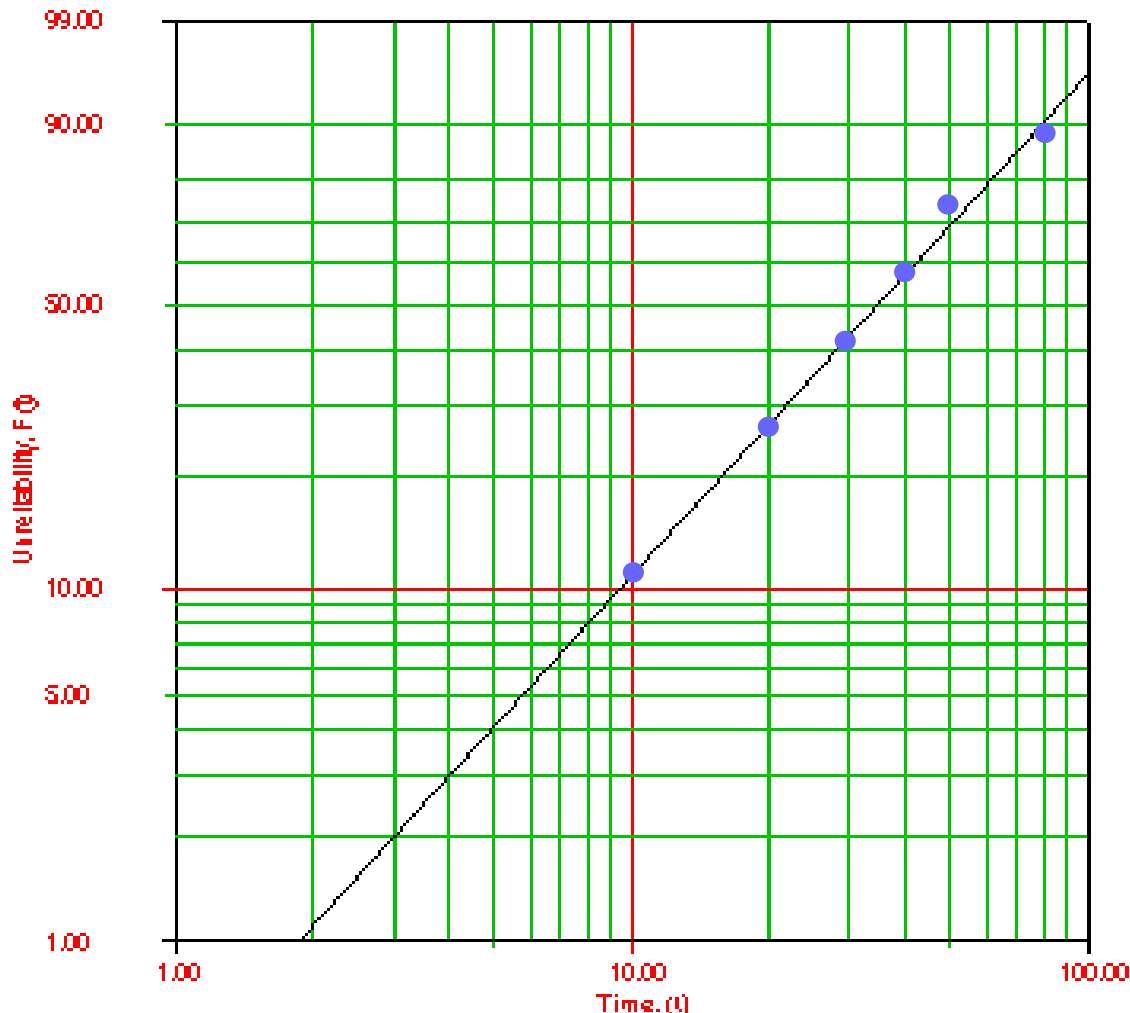
## Cumulative probability



# Quantitative Risk Analysis

## Probability paper

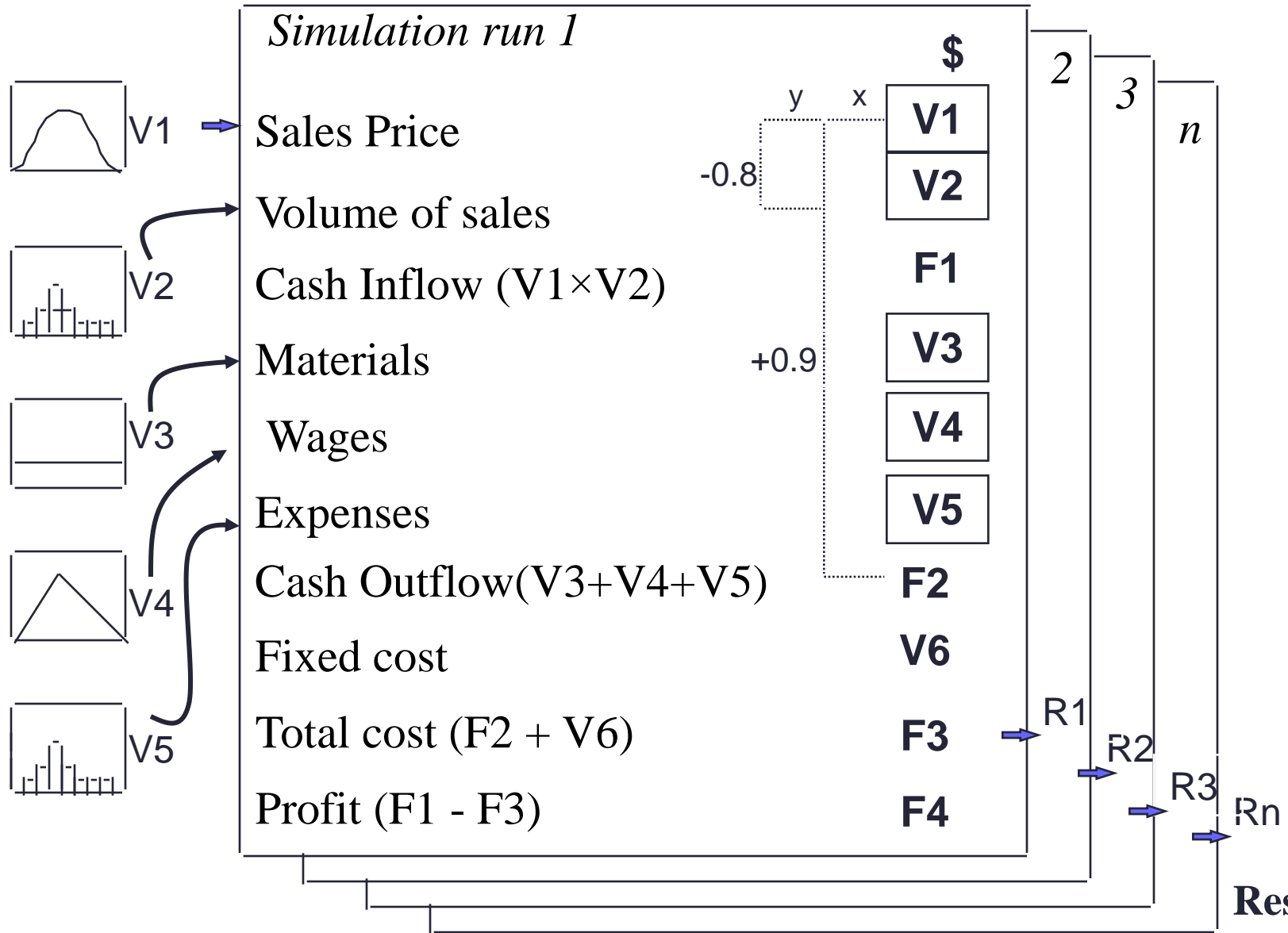
Probability - Weibull



## Fit phân bố

- ❖ Gán  $(x, f(x))$  tương ứng với  $(x, y)$  của giấy Weibull.
- ❖ Nhận thấy các điểm dữ liệu tạo thành đường thẳng.
- ❖ Dựa trên giá trị P-values nếu sử dụng phần mềm.

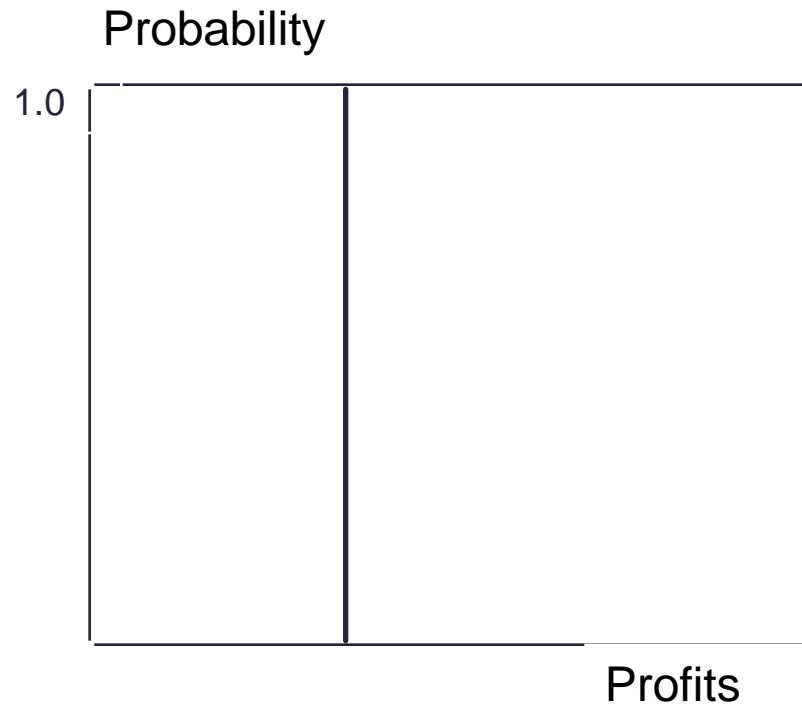
# Quantitative Risk Analysis



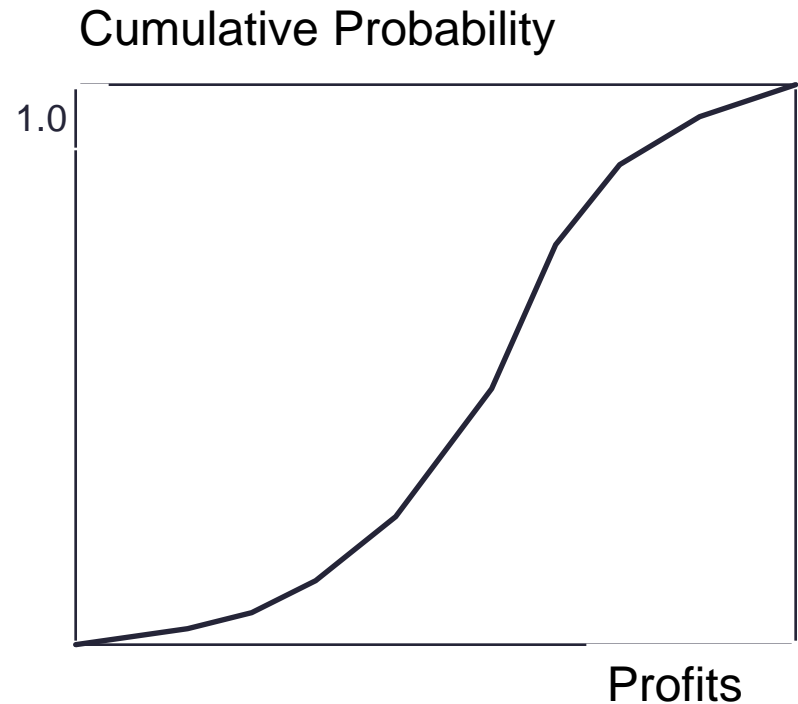
# Quantitative Risk Analysis

## Results

Deterministes



Simulation

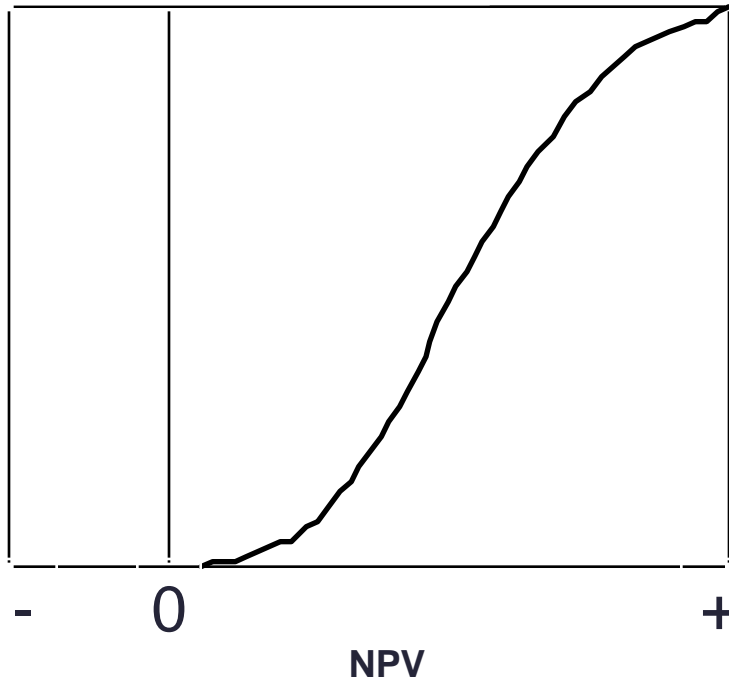




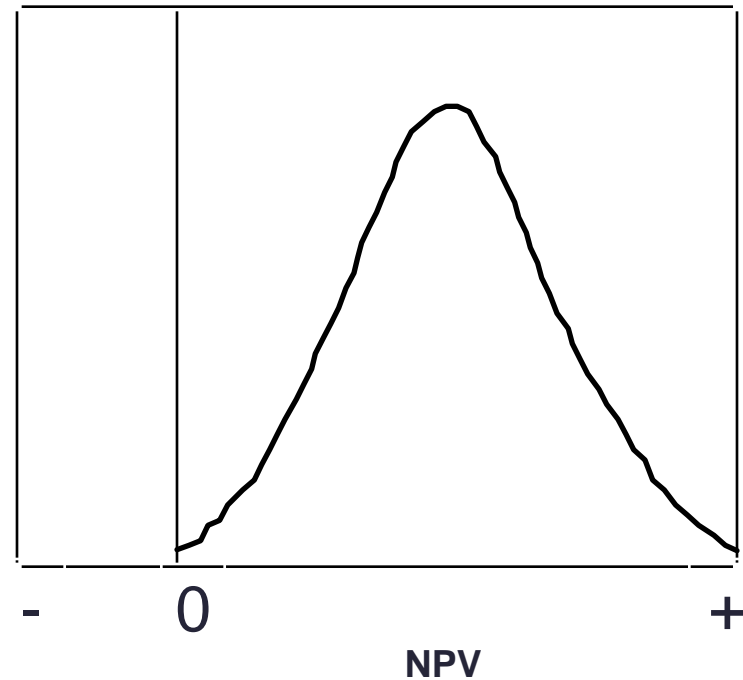
# Quantitative Risk Analysis

## Case 1 - Probability of negative NPV = 0

Cumulative probability



Probability



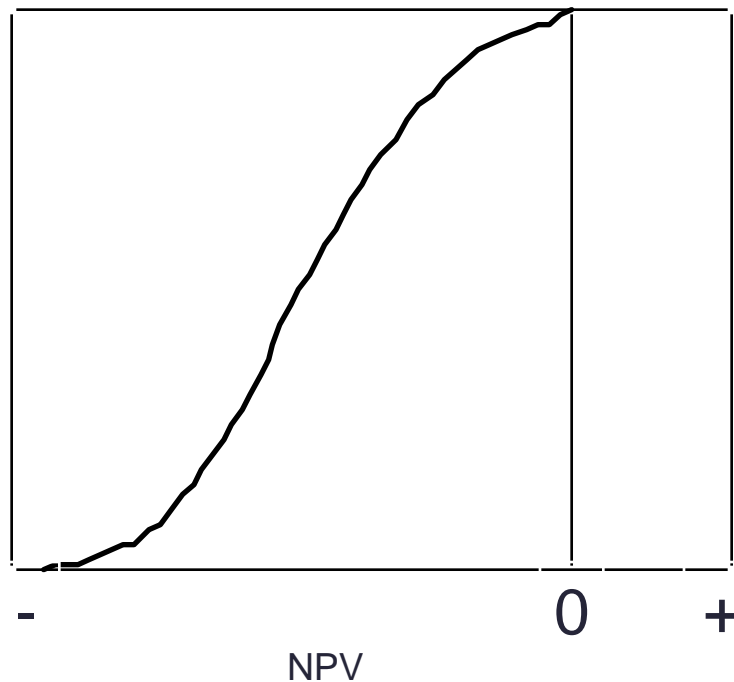
**Note:** Đầu thấp hơn của phân phối xác suất tích lũy nằm về bên phải của điểm NPV zero

**Decision: Accepted**

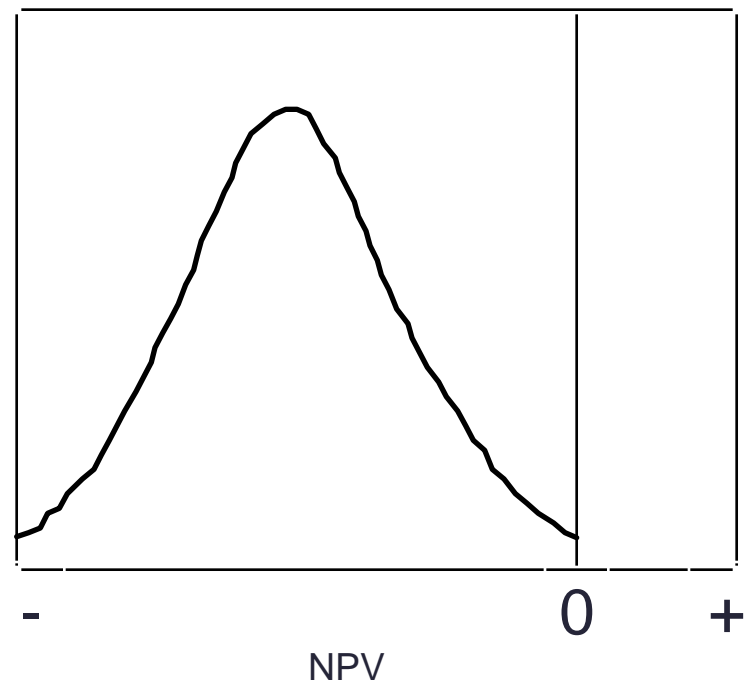
# Quantitative Risk Analysis

## Case 2 - Probability of positive NPV = 0

Cumulative Probability



Probability



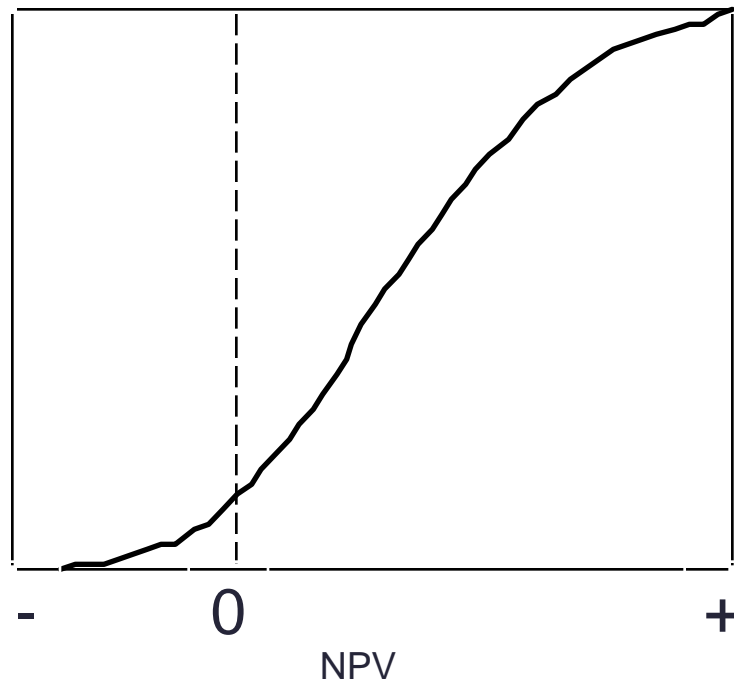
**Note:** Đỉnh cao hơn của phân phối xác suất tích lũy nằm về phía bên trái của điểm NPV zero

**Decision: Reject**

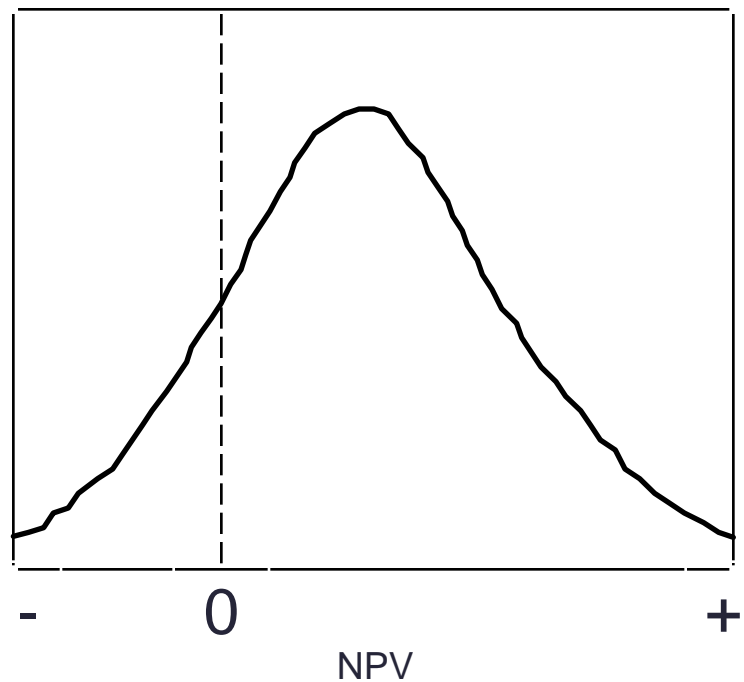
# Quantitative Risk Analysis

## Case 3 - Probability of zero NPV $> 0$ and less than 1

Cumulative Probability



Probability



**Note:** NPV zero cắt ngang phân phối xác suất tích lũy

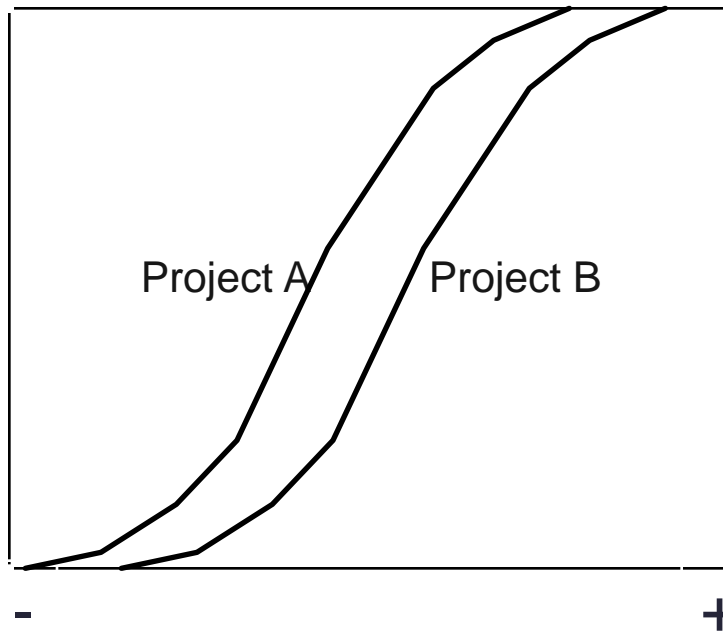
**Decision: Indeterminate(trung dung)**

# Quantitative Risk Analysis

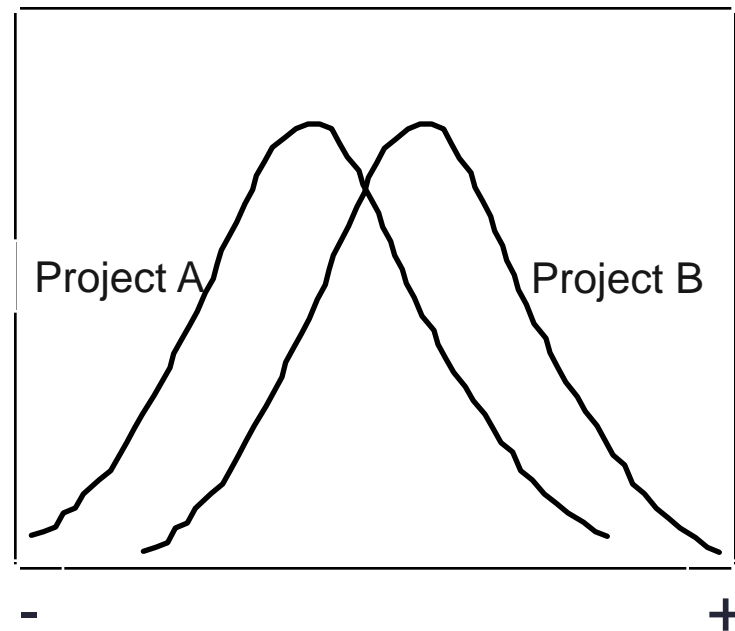
## Case 4 - Mutually exclusive projects

(given the same probability, one project always shows a higher return)

Cumulative Probability



Probability

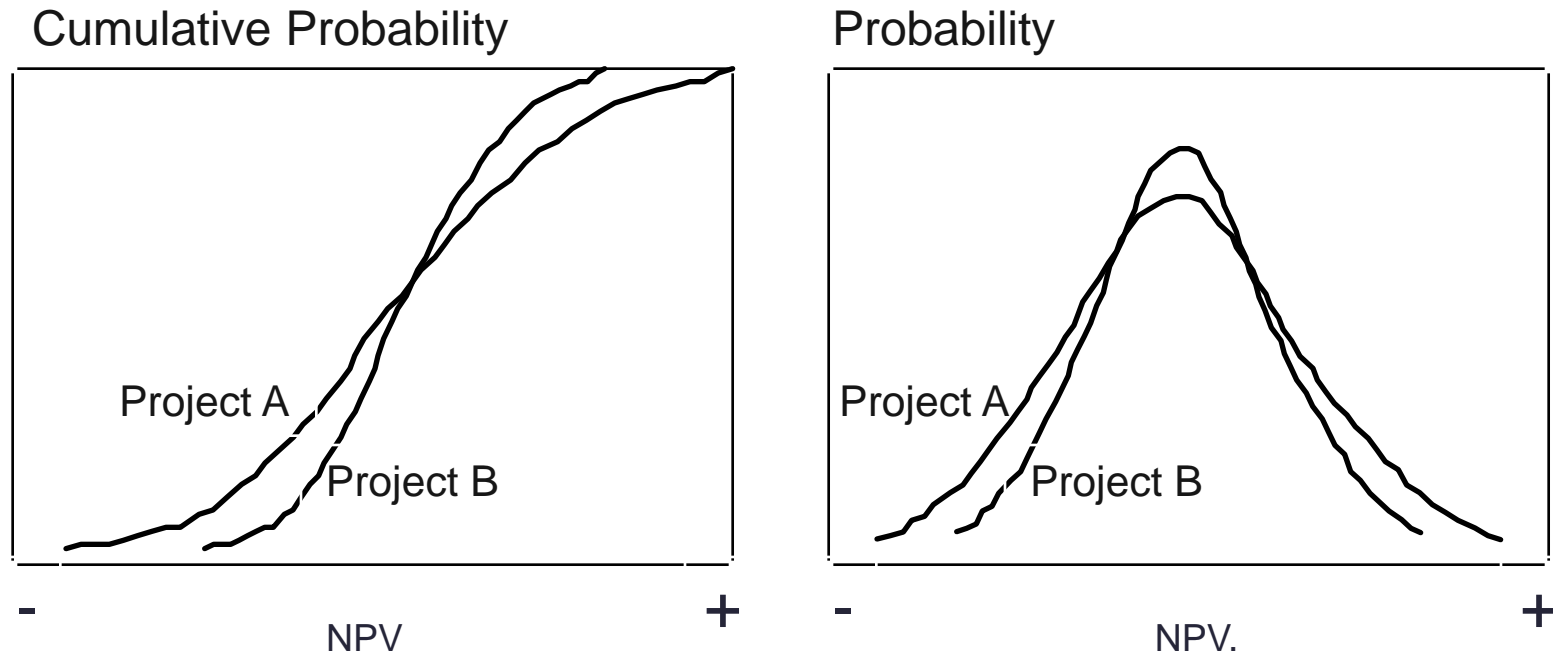


**Note:** Các phân phối xác suất tích lũy không cắt nhau tại bất cứ điểm nào.

**Decision: Choose Project B**

# Quantitative Risk Analysis

## Case 5 - Mutually exclusive projects (high return vs. low loss)



**Note:** Intersecting cumulative probability distributions of project return for mutually exclusive projects

**Cần biết thái độ đối với rủi ro**

A. Nếu trung lập với rủi ro, thì không chắc chắn là tốt nhất.

B. Nếu sợ rủi ro, thì thích B hơn A.

C. Nếu thích rủi ro, thì có thể thích A hơn B.

**Decision:**  
Trung dung

# Quantitative Risk Analysis

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## How to reduce the cost of risk

- ❑ Use the capital market to diversify the risk to equity owners
- ❑ Chọn bảo hiểm cho rủi ro cụ thể của dự án
- ❑ Use Contractual Arrangements to Reallocate Risks and Returns
  - Risk Shifting
  - Risk Management.

# Quantitative Risk Analysis

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## Capital market

Risk-sharing contracts that reduce the risk borne by investors by increasing the correlation between sales revenue and some cost items, e.g.,

- Profit sharing contract with labor
- Bonds with interest rates indexed to the product's sales price.

# Quantitative Risk Analysis

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## Risk shifting

1. Contracts that limit the range of values of a particular cash flow item, or of net cash flow.

Example: Purchaser agree to purchase a minimum quantity or to pay a minimum price in order to be sure of delivery (chuyển rủi ro cho người mua).

## Other methods

2. A limited product price range (floor price)

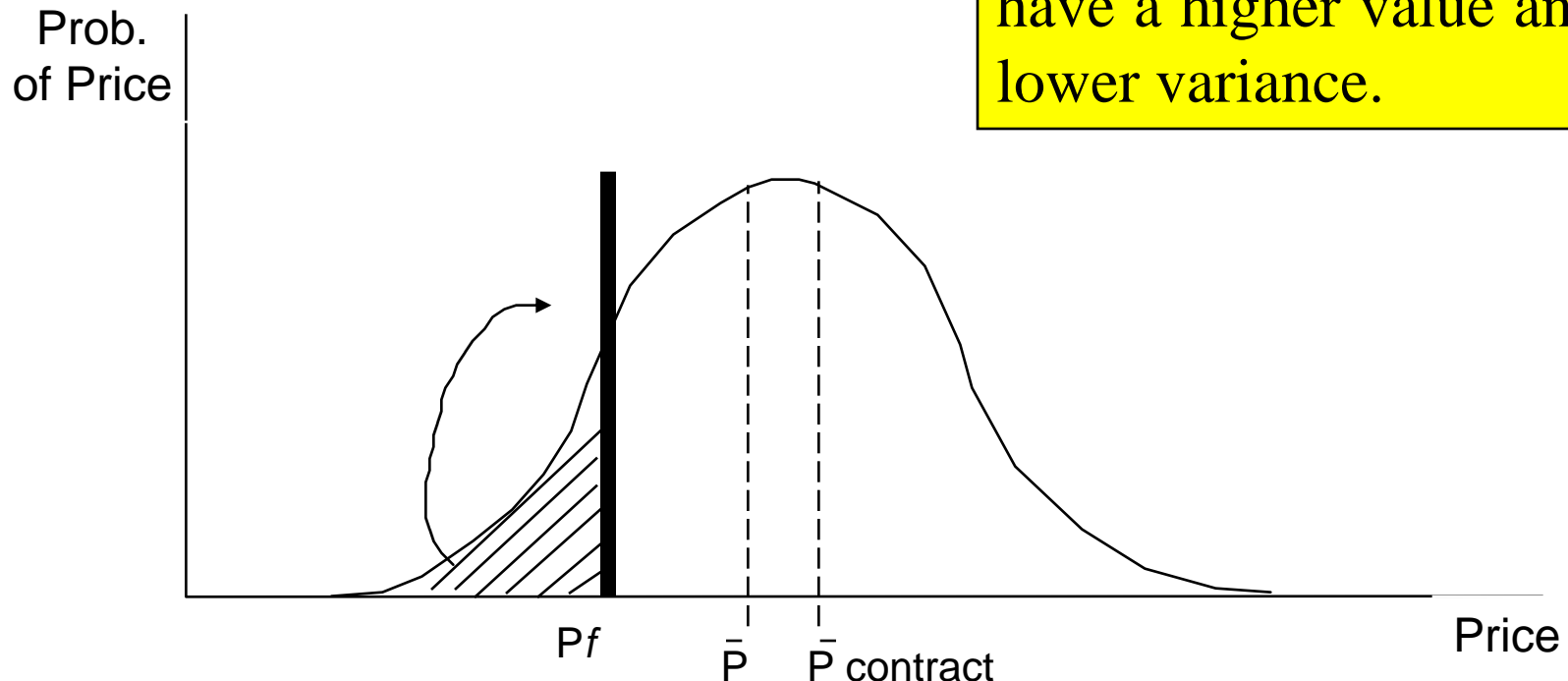
3. A fixed price growth path

4. Các điều khoản nâng giá cụ thể nhưng giữ vững tính cạnh tranh của sản phẩm.



# Quantitative Risk Analysis

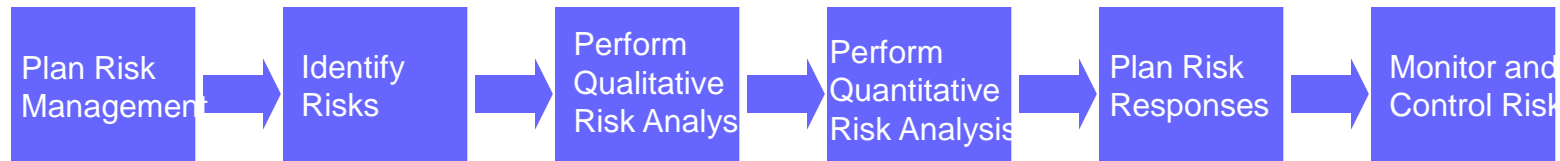
A floor price -  $P_f$



**Result: Project revenues**  
The expected NPV will have a higher value and a lower variance.

Contract offers price equal to market price unless market falls below  $P_f$ ; it pays guaranteed floor price of  $P_f$ .

# Plan Risk Responses



# Risk Response Planning

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- ❑ After identifying and quantifying risks, you must decide how to respond to them
- ❑ Four main response strategies for **Negative risks** (or Threats)
  - **Avoidance** – don't use human/work if unfamiliar with them
  - **Acceptance** – prepare for risk with backup plan or contingency reserves
  - **Transference** – to deal with *financial* risk exposure, a company may purchase insurance.
  - **Mitigation** – reduce probability of occurrence e.g., use proven technology, buy maintenance or service contract.

# Risk Response Planning

## Risk Mitigation (for Technical, Cost, and Schedule Risks)

TECHNICAL RISKS	COST RISKS	SCHEDULE RISKS
Emphasize team support and avoid stand-alone project structure	Increase the frequency of project monitoring	Increase the frequency of project monitoring
Increase project manager authority	Use WBS and CPM	Use WBS and CPM
Improve problem handling and communication	Improve communication, project goals understanding, and team support	Select the most experienced project manager
Increase the frequency of project monitoring	Increase project manager authority	
Use WBS and CPM		

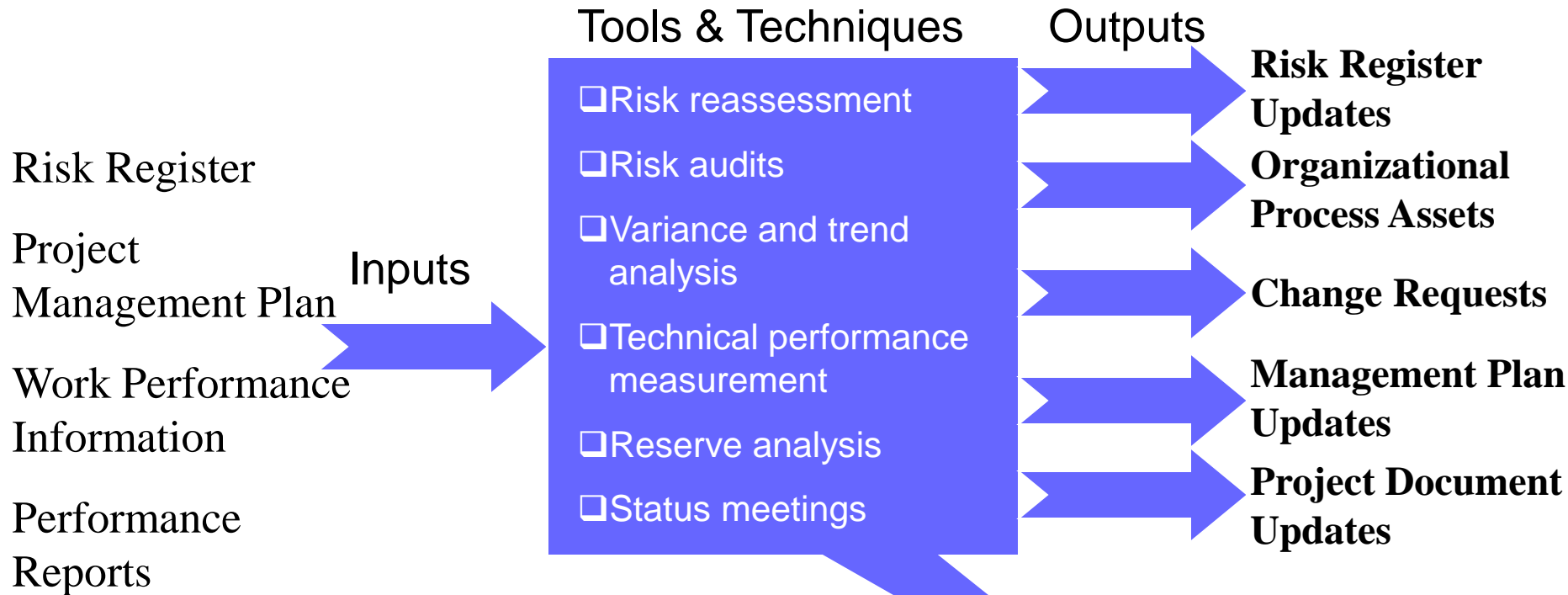
# Risk Response Planning

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## **Response Strategies for Positive Risks (or Opportunities)**

- ❑ Exploitation – do whatever you can to make sure the risk occurs, call press conference to advertise new product, take out ads, etc
- ❑ Sharing – allocating ownership of the risk to another party. Hire an outside firm to do your advertising and PR
- ❑ Enhancement – identify and maximize key drivers of the risk. Encourage your employees or users of your product to spread the word of your product
- ❑ Acceptance – don't take any action with regard to positive risk. Assume the product will speak for itself

# Monitor and Control Risks



# Risk Monitoring and Control

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- ❑ Monitoring risks involves knowing their status
- ❑ Controlling risks involves carrying out the risk management plans as risks occur
- ❑ Workarounds are unplanned responses to risk events that must be done when there are no contingency plans
- ❑ The main outputs of risk monitoring and control are corrective action, project change requests, and updates to other plans

# Risk Monitoring and Control

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## **Risk response control**

- ❑ Risks must be monitored based on defined milestones and decisions made regarding risks and mitigation strategies
- ❑ Sometimes workarounds or unplanned responses to risk events are needed when there are no contingency plans.

## **Results of Good Project Risk Management**

- ❑ Unlike crisis management, good project risk management often goes unnoticed
- ❑ Well-run projects appear to be almost effortless, but a lot of work goes into running a project well
- ❑ Project managers should strive to make their jobs look easy to reflect the results of well-run projects.



# Home work

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Creating the risk management plan for your project

- a. Use Risk breakdown structure to chose the category of risk
- b. Update Rish category use SWOT
- c. Determine the high priority risk use Probability and Impact Matrix
- d. Simulation and Sensitivity analysis for your identified risks
- e. Creating the risk response plan.