P3 Project Risk Assessment

P3-VALUE Webinar
March 7, 2015

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U.S. Department of Transportation
Federal Highway Administration

Instructors
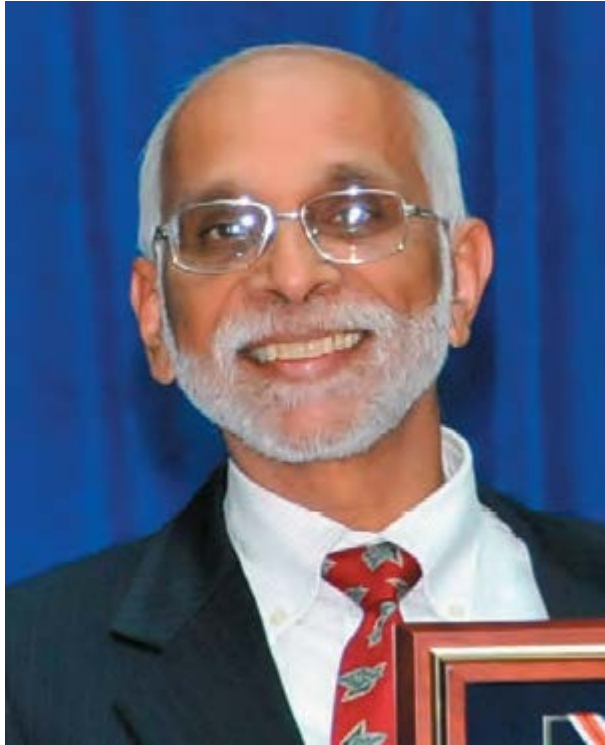
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P3-VALUE 2.0 Webinars

- **P3:** Public Private Partnership

- **P3-VALUE 2.0:** Analytical tool to help practitioners understand processes used to quantitatively evaluate P3 options

- This is one of a series of webinars on P3-VALUE

  - P3 Evaluation Overview (January 25, 2016)

  - Value for Money Analysis (February 8, 2016)

    - Value for Money Exercise (Feb. 16, 2016)

  - Project Delivery Benefit-Cost Analysis (Feb. 22)

    - Project Delivery BCA Exercise (Feb. 29, 2016)

  - **Risk Valuation (today)**

  - Financial Viability Assessment

Webinar Outline

Part 1	Categorizing Risk
Part 2	Risk Management Process
Part 3	Pure Risk Assessment
Part 4	Lifecycle Performance and Revenue Uncertainty Risk Assessment
Part 5	Risk Allocation
Part 6	Using P3-VALUE 2.0 for Risk Assessment
Summary	

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Webinar Objectives

After taking this course you should be able to:

- Categorize P3 risks

- List the steps in the risk management process

- Explain the methods for quantifying and monetizing various type of risks

- Describe the risk allocation process

- Use P3-VALUE 2.0 to perform risk assessment

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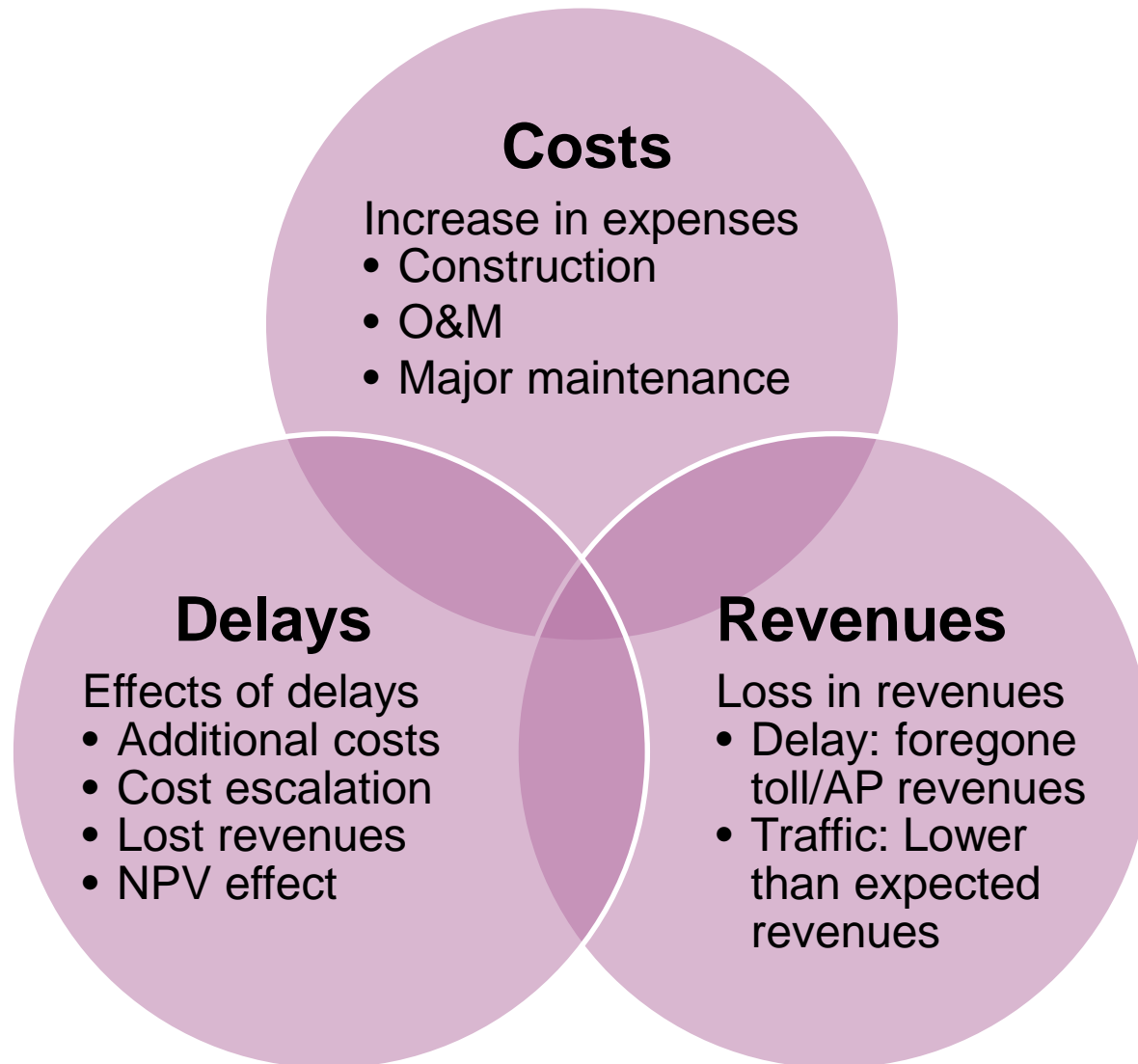Federal Highway Administration
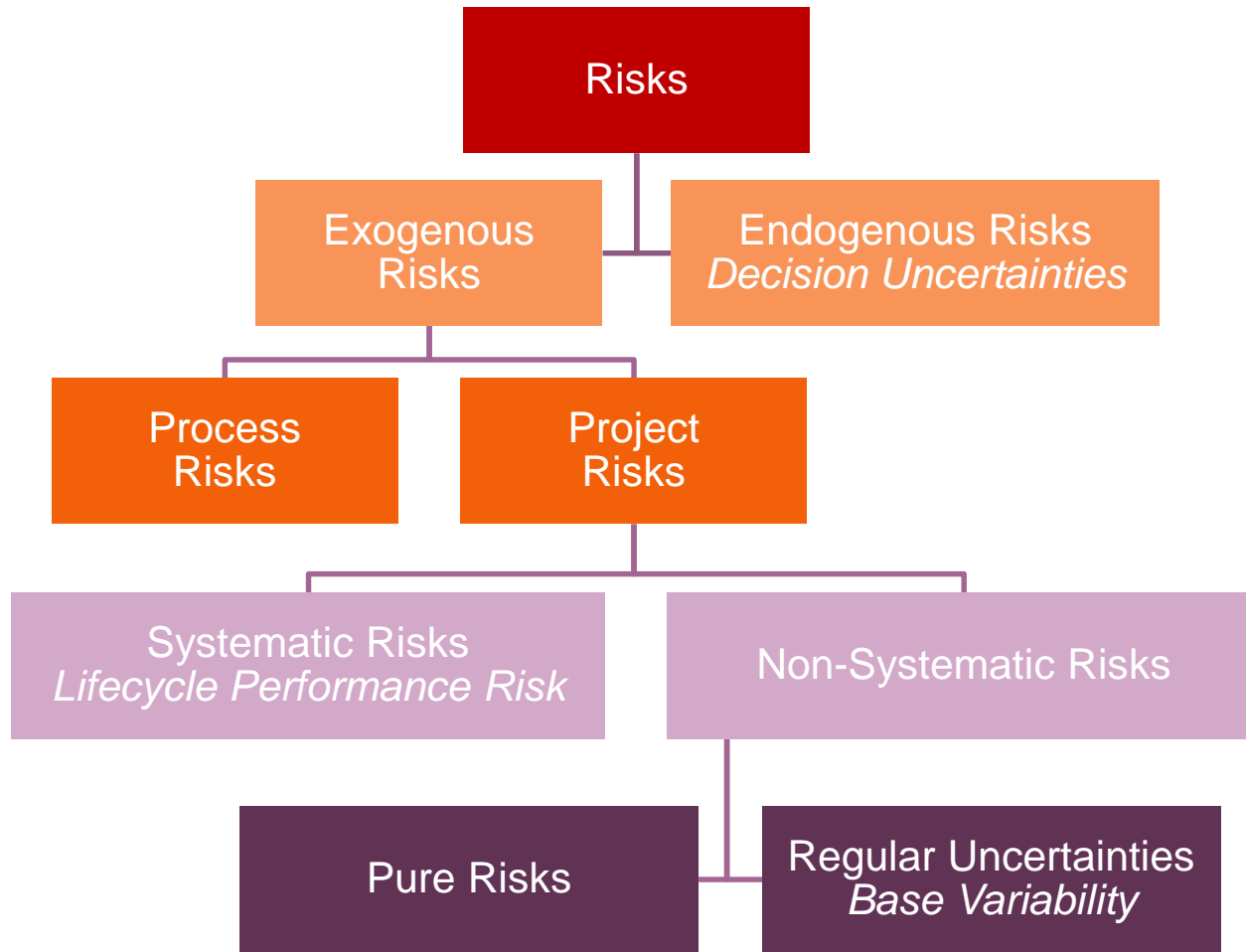
Part 1

Categorizing P3 Risks

Purpose of Risk Assessment

- To calculate value of risks

- To design *draft agreement* for RFP

- To assist in *negotiation* with bidders

- To develop *risk management plans*

Financial Impacts of Project Risks

Costs
Increase in expenses
- Construction
- O&M
- Major maintenance

Delays
Effects of delays
- Additional costs
- Cost escalation
- Lost revenues
- NPV effect

Revenues
Loss in revenues
- Delay: foregone toll/AP revenues
- Traffic: Lower than expected revenues

Categories of Risk

P3-VALUE 2.0 Project Risk Categories

- **Base Variability**
  Example: Uncertainty in volume of asphalt

- **Pure Risks**
  Example: Accident at construction site, causing cost overrun and/or delays

- **Lifecycle Performance Risks & Revenue Uncertainty**
  Example: Conflicts between DB and O&M contractors, supervening events exceeding liability caps, inflation, T&R risk (for toll concessions)
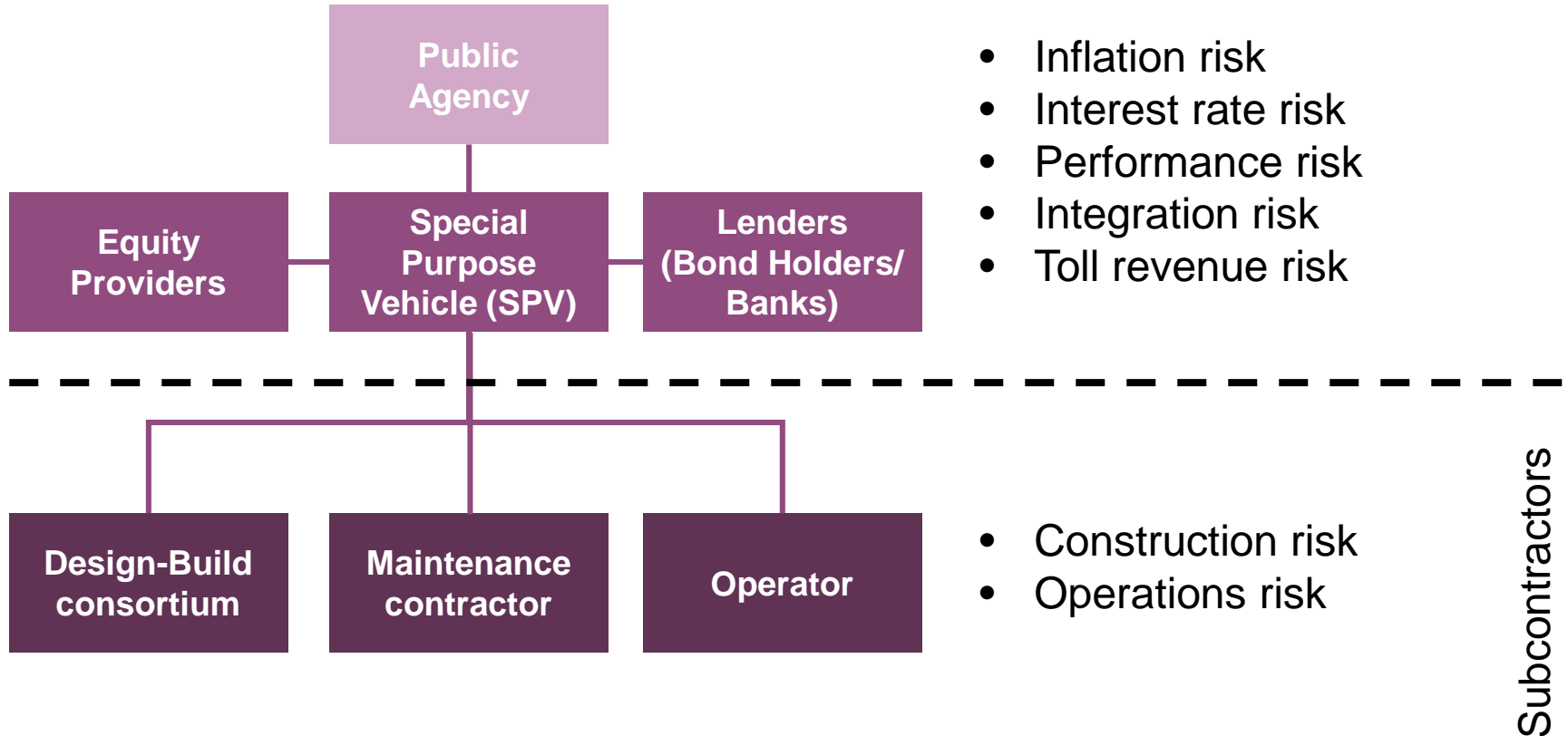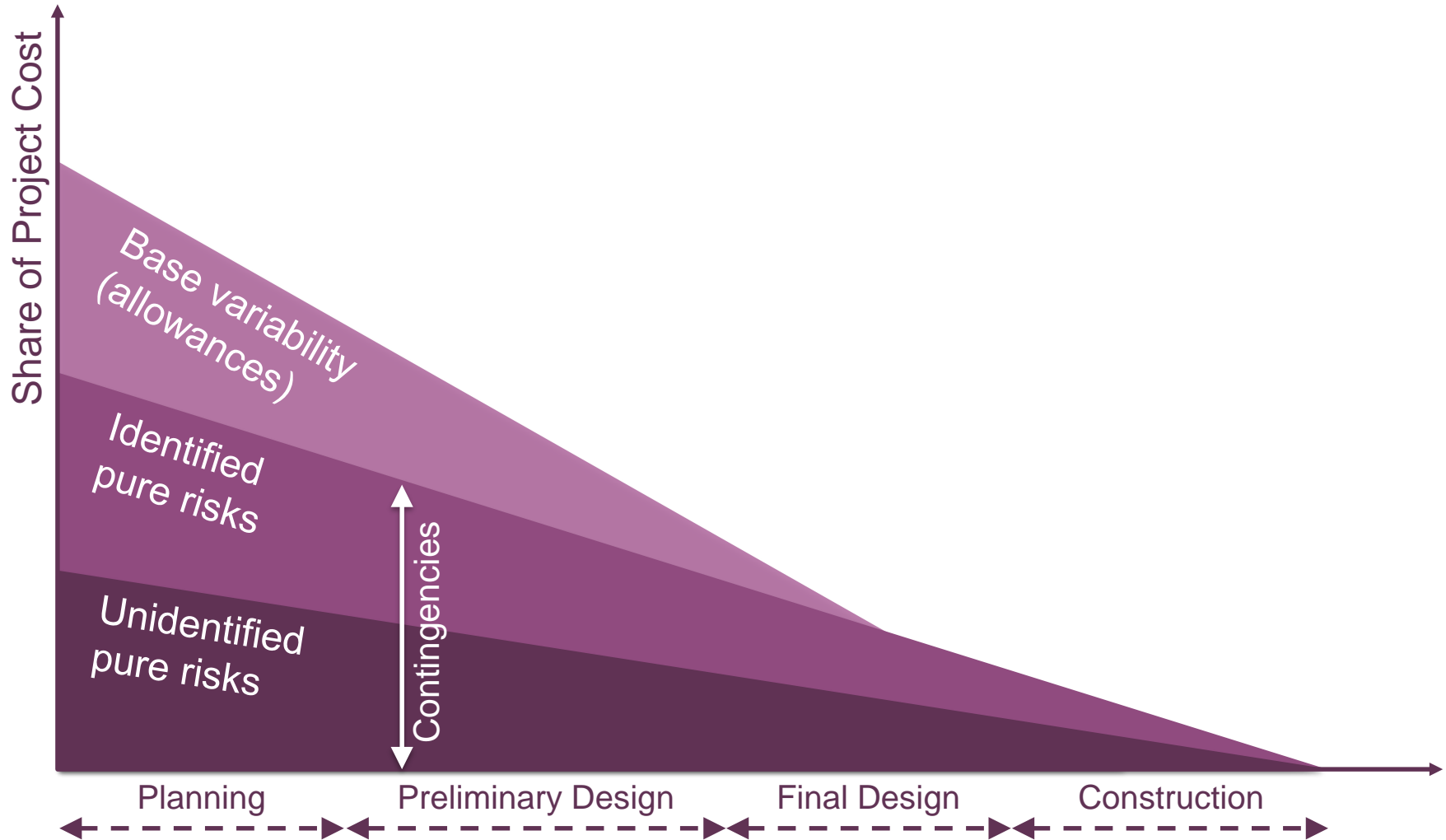
Valuing Base Variability

- Typically a percentage of costs (+ or - variation)

- May differ by project phase

- Reflects the uncertainty in cost estimates – will reduce as the design level becomes more detailed

- P3-VALUE 2.0 uses a factor (percentage of base cost) to estimate cost impact

- Example:
  - Base variability: 20% of construction cost
  - Construction cost: $200M
  - Value of base variability: 20% X $200M = $40M

Who Bears Project Risks in a P3?

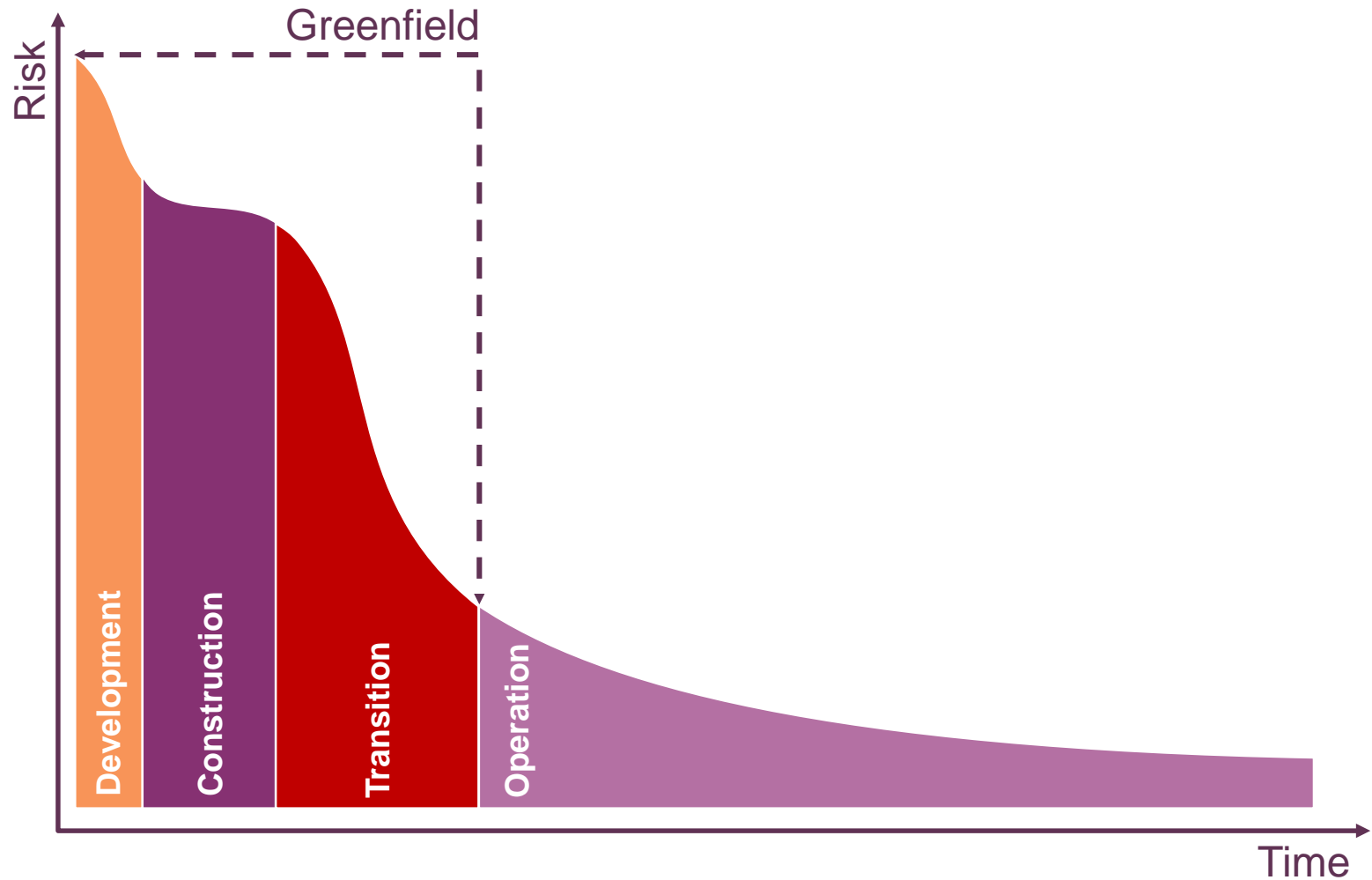Includes both systematic and some non-systematic risks

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                    │    Public    │
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                           │
┌──────────┐        ┌──────┴───────┐        ┌──────────────┐
│  Equity  │────────│   Special    │────────│   Lenders    │
│Providers │        │   Purpose    │        │(Bond Holders/│
│          │        │ Vehicle (SPV)│        │    Banks)    │
└──────────┘        └──────┬───────┘        └──────────────┘
```

- Inflation risk
- Interest rate risk
- Performance risk
- Integration risk
- Toll revenue risk

```
        ┌───────────────┬───────┴──────┬──────────────┐
┌───────────────┐  ┌──────────────┐  ┌──────────┐
│ Design-Build  │  │ Maintenance  │  │ Operator │
│  consortium   │  │  contractor  │  │          │
└───────────────┘  └──────────────┘  └──────────┘
```

- Construction risk
- Operations risk

Subcontractors

Risk though Project Completion

Share of Project Cost (y-axis)

- Base variability (allowances)
- Identified pure risks
- Unidentified pure risks
- Contingencies

Planning | Preliminary Design | Final Design | Construction

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Risk over Project Life

Greenfield

Risk

Development | Construction | Transition | Operation

Time

Audience Feedback

True or False

- All project risks are pushed down to subcontractors of the concessionaire.

Questions?

Submit a question using the chat box

Part 2

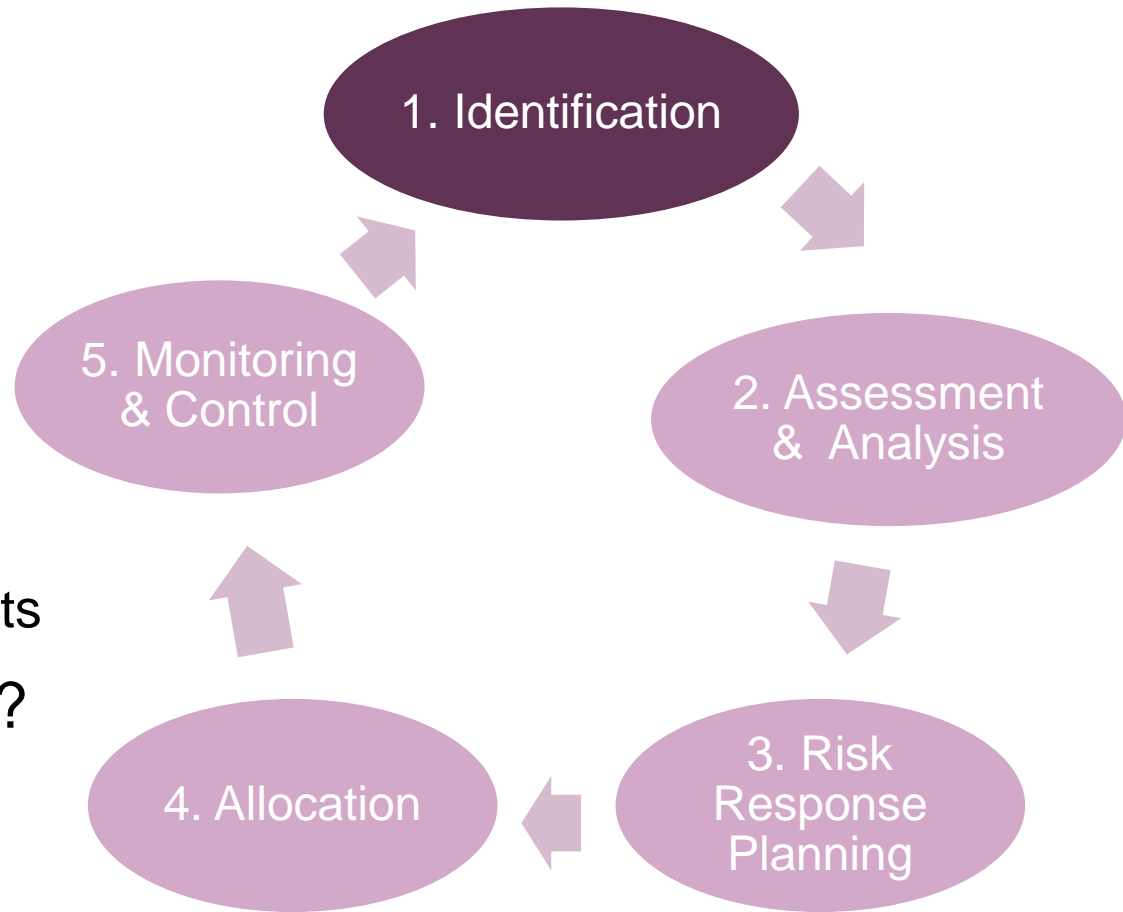# Risk Management Process

# Risk Management Process Overview

1. Identification

2. Assessment & Analysis

3. Risk Response Planning

4. Allocation

5. Monitoring & Control
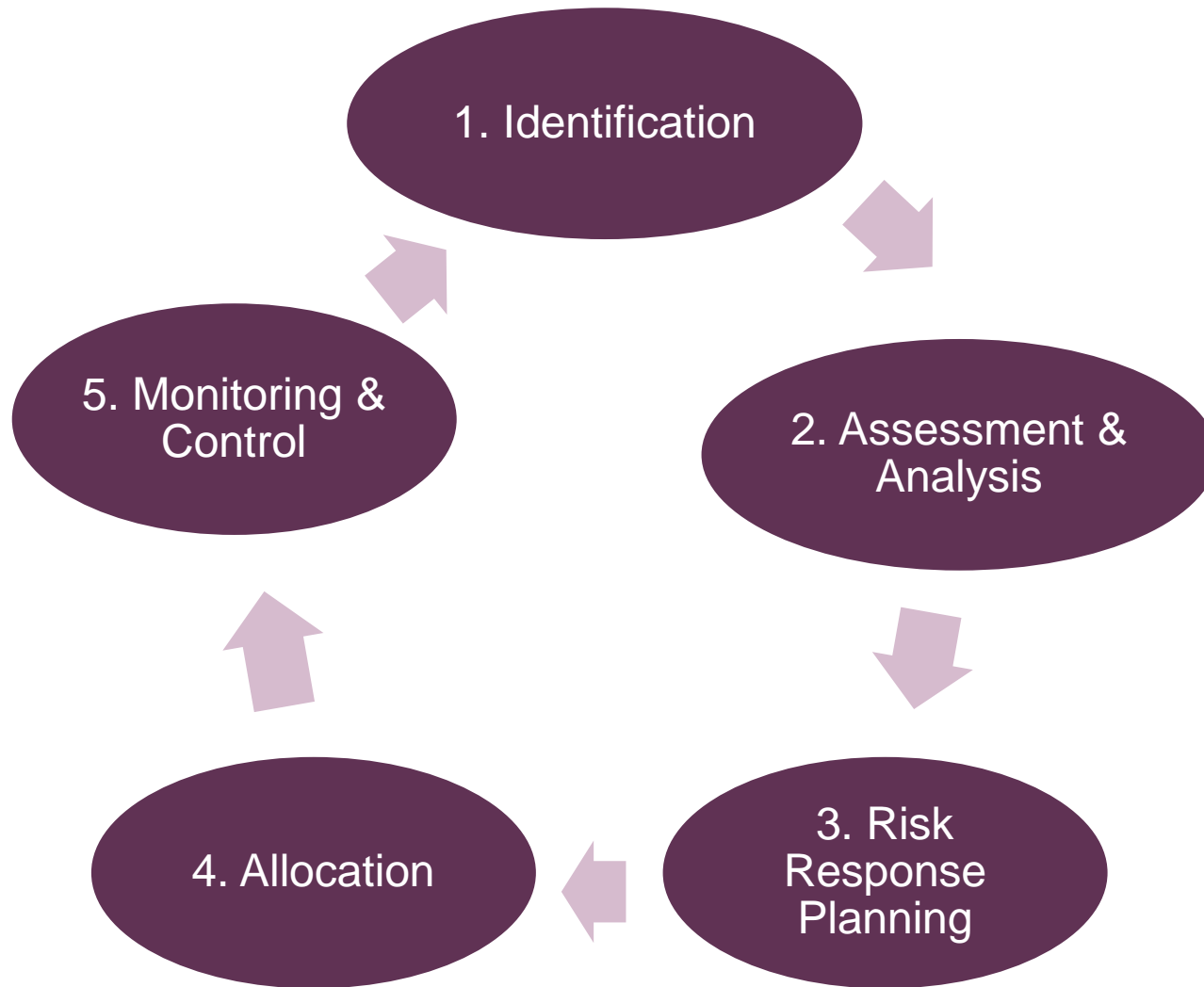
1. Risk Identification

Risks:

- Threats
- Opportunities

Risk Workshops

- Who?
  - Facilitator
  - Subject matter experts
- What tools are used?
  - Risk checklist
  - Risk register

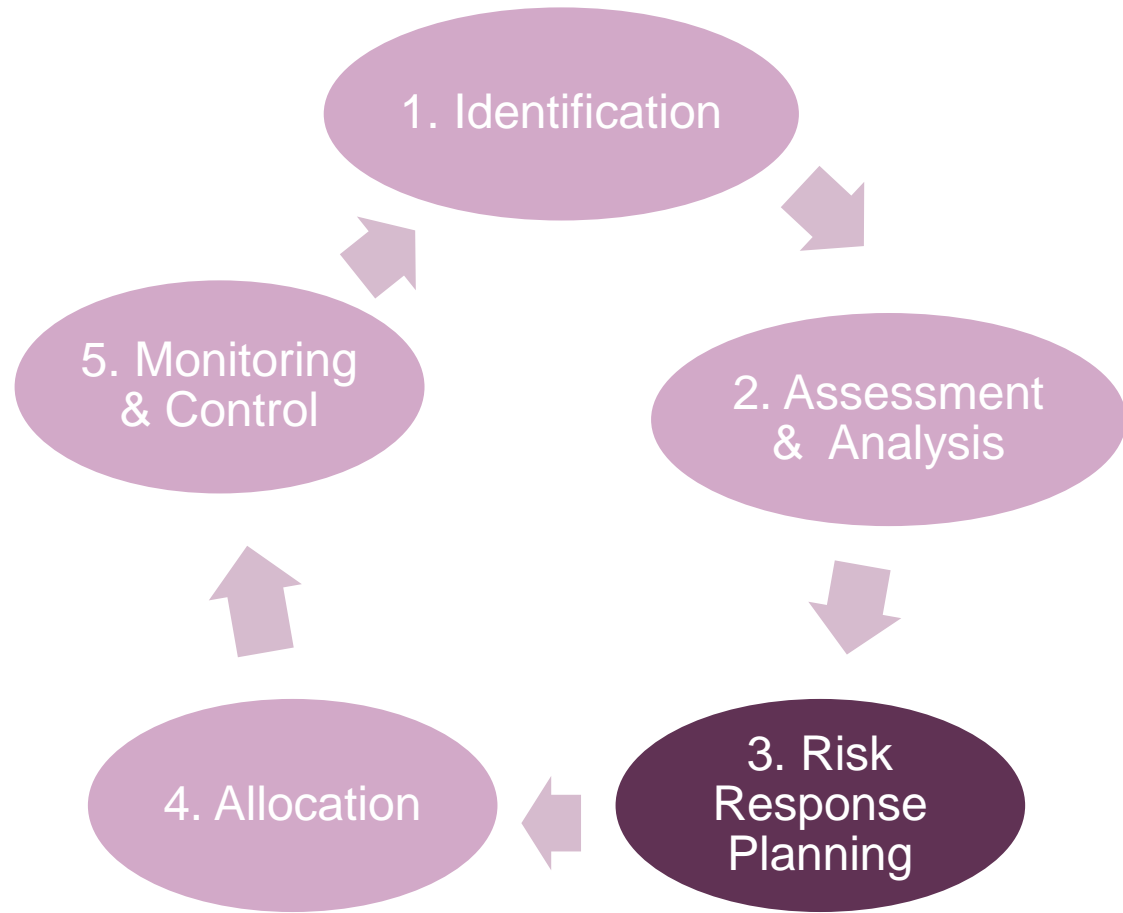1. Identification

5. Monitoring & Control

2. Assessment & Analysis

4. Allocation

3. Risk Response Planning

2. Risk Assessment

- **Probability**

- **Potential consequences**
  - Cost
  - Schedule
  - Scope/Quality
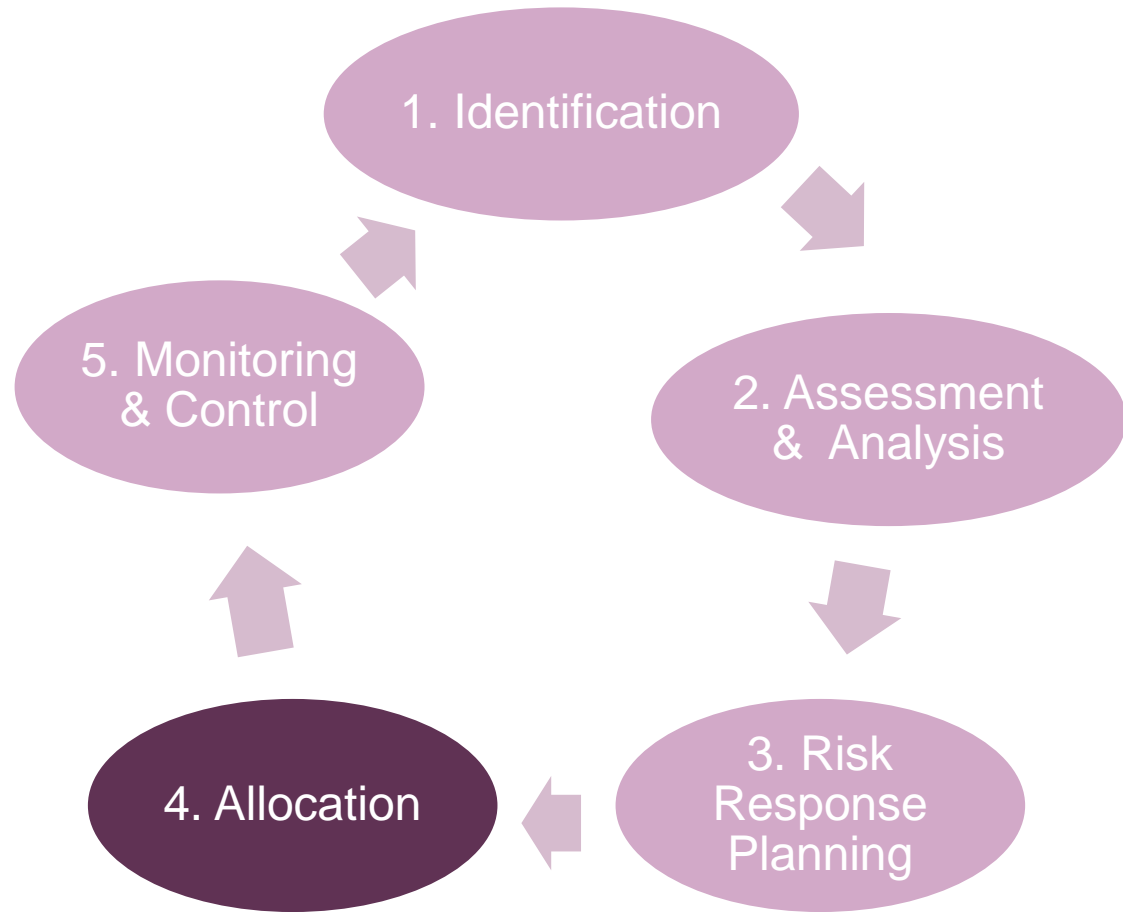 - Revenue

- **Value**
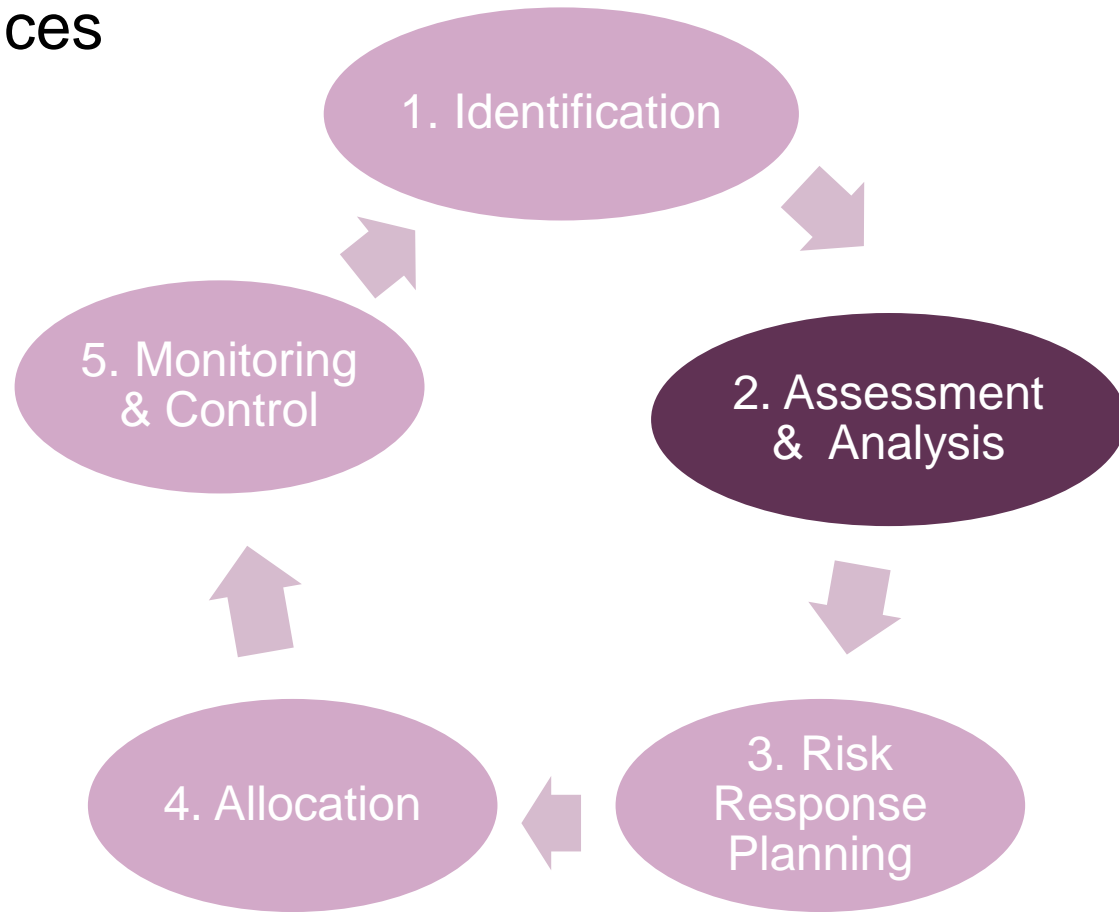
3. Risk Response Planning

Risk Response Strategies

- Avoid

- Mitigate

- Transfer/Share

- Accept

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4. Risk Allocation

- Transfer or retain
- Share

5. Risk Monitoring & Control

- Performance metrics to monitor risk

- Understand P3 risk management provisions

- Avoid taking back transferred risks

- Validate previous risk identification, risk assessment, and risk response planning

1. Identification

2. Assessment & Analysis

3. Risk Response Planning

4. Allocation

5. Monitoring & Control
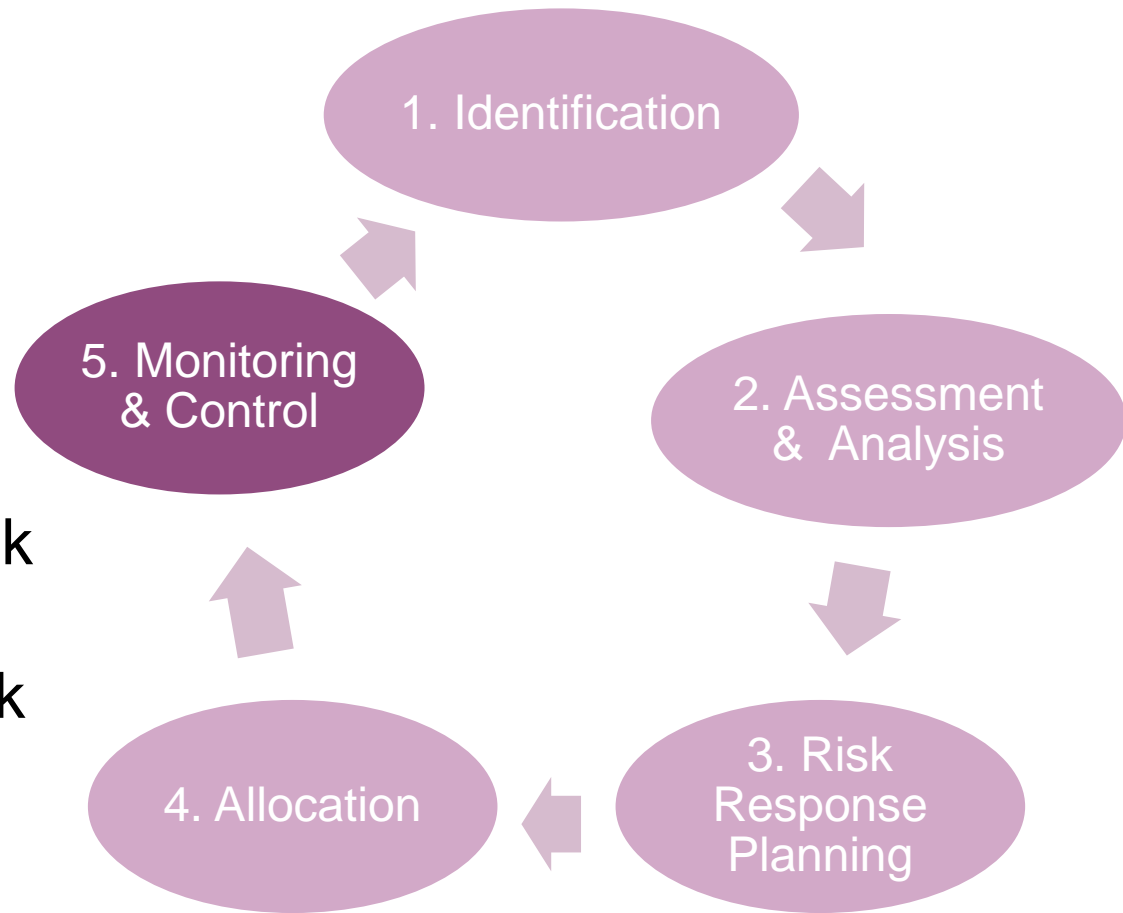
Audience Feedback

True or False

- The probability and potential consequences of a specific risk must be quantified in order to estimate its cost impact

Questions?
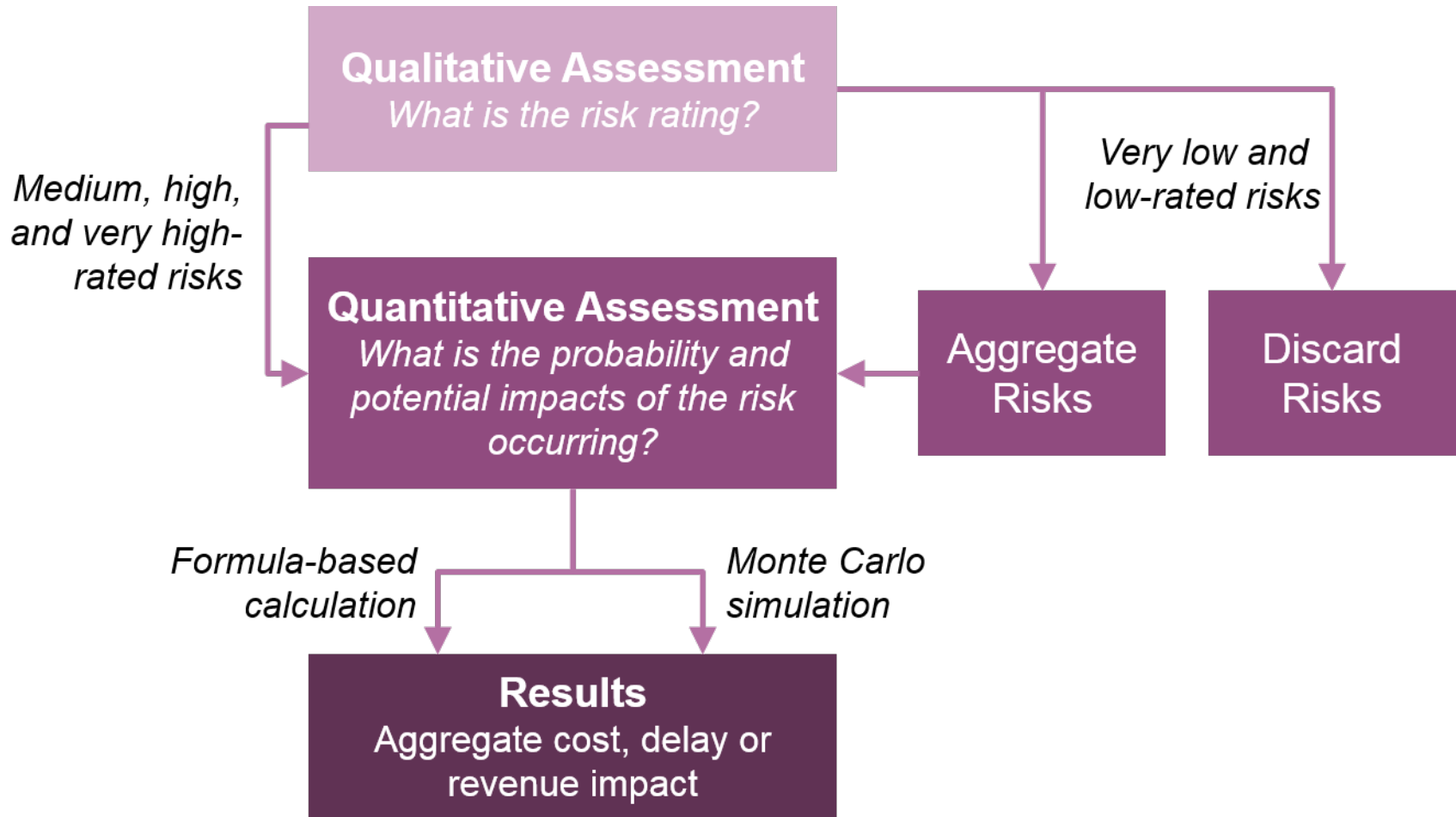
Submit a question using the chat box

Part 3

Pure Risk Assessment

Pure Risk Assessment Process

Qualitative Assessment
What is the risk rating?

Medium, high, and very high-rated risks

Very low and low-rated risks

Quantitative Assessment
What is the probability and potential impacts of the risk occurring?

Aggregate Risks

Discard Risks

Formula-based calculation

Monte Carlo simulation

Results
Aggregate cost, delay or revenue impact

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Qualitative Assessment

- Probability of risk occurrence
  - Very low
  - Low
  - Medium
  - High
  - Very high
- Scale of impact if risk occurs
  - Very low
  - Low
  - Medium
  - High
  - Very high

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Qualitative Assessment Matrix

Example

Representative Cost Impact Assessment Matrix

Cost Consequence

		5	4	3	2	1
	Scale	> 25%	10% - 25%	3% - 10%	1% - 3%	<1%
Probability	5 - > 70%	High	High	High	Medium	Low
	4 - 40% - 70%	High	High	Medium	Medium	Low
	3 - 20% - 40%	High	Medium	Medium	Low	Low
	2 - 5% - 20%	Medium	Medium	Low	Low	Low
	1 - 0% - 5%	Low	Low	Low	Low	Low

Representative Schedule Impact Assessment Matrix

Schedule Consequence

		5	4	3	2	1
	Scale	> 365 days	120 - 365 days	30 - 120 days	7 - 30 days	< 7 days
Probability	5 - > 70%	High	High	High	Medium	Low
	4 - 40% - 70%	High	High	Medium	Medium	Low
	3 - 20% - 40%	High	Medium	Medium	Low	Low
	2 - 5% - 20%	Medium	Medium	Low	Low	Low
	1 - 0% - 5%	Low	Low	Low	Low	Low

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Quantitative Assessment

- Probability of risk occurrence
  - % probability (0% - 100%)

- Scale of impact if risk occurs
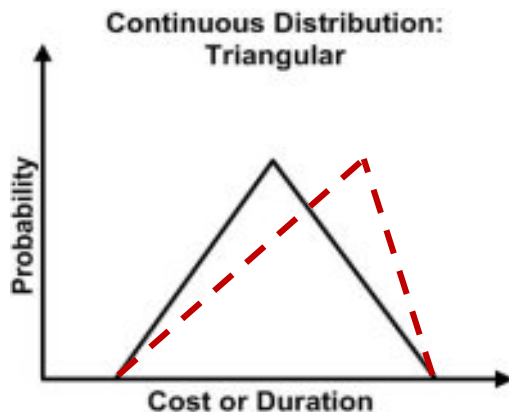 - Dollar amount or number of days of delay

Valuing Pure Risks (Formula-Based)

- Risk Value = Probability X Impact (distribution)

- Example for *uniform* probabilistic impact distribution:

  - Probability of occurrence: 10%

  - Minimum impact: $2M

  - Maximum impact: $4M

  - Value = 10% x ½ x ($2M + $4M) = $0.3M
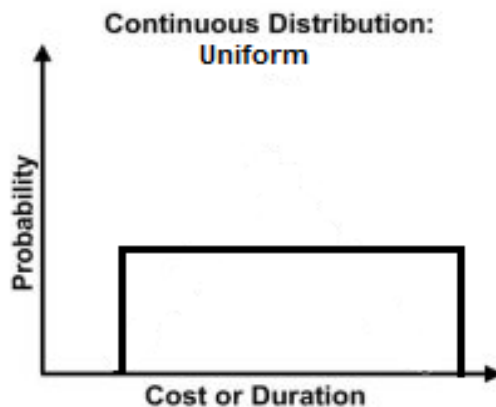
Continuous Distribution: Uniform

(Probability vs. Cost or Duration)

Valuing Pure Risks (Formula-Based)

- Risk Value = Probability X Impact (distribution)

- Example for *triangular* impact distribution:

  - Probability of occurrence: 10%

  - Minimum impact: $2M

  - Maximum impact: $4M

  - Most likely impact = $3.5

  - Value = 10% x ($2M + 3.5 + $4M)/3 = $0.32M

Continuous Distribution: Triangular

Probability (vertical axis)

Cost or Duration (horizontal axis)

Aggregate of Pure Risks

- Central limit theorem can be used if pure risks are independent:

  - Distribution of the sum of a sufficiently large number of independent random variables is approximately normal

- To apply central limit theory, variance and mean value of each individual risk must be calculated and added

Central Limit Theorem Applied

Example using uniform risk distributions (P3-VALUE 2.0)

Risk Item	Probability A	Most likely Impact B	Most likely value C = A x B	Minimum value D	Maximum value E	Shape
Risk 1	20%	$10,000k	$2,000k	-20%	+50%	Uniform
Risk 2	25%	$4,000k	$1,000k	-20%	+50%	Uniform
Risk 3	50%	$4,000k	$2,000k	-20%	+50%	Uniform

Risk Item	Minimum value F = C − D%	Maximum value G = C + E%	Mean value* H = ½ x (F + G)	Variance* I = (G − F)^2 / 12
Risk 1	$1,600k	$3,000k	$2,300k	$163,333k
Risk 2	$800k	$1,500k	$1,150k	$40,833k
Risk 3	$1,600k	$3,000k	$2,300k	$163,333k
Total	**$4,000k**	**$7,500k**	**$5,750k**	**$376,500k**

- Mean value: $5,750k, standard deviation of $606k

- Using Excel NORMINV function, P70 risk value: $6,068k

Valuing Pure Risks (Monte Carlo)

Monte Carlo simulation

- Simulation of large number of scenarios based on probabilities of risk occurrence and probability distribution of magnitude of impact

- Result is a probability distribution of aggregate risk value

- Provides estimates at confidence levels
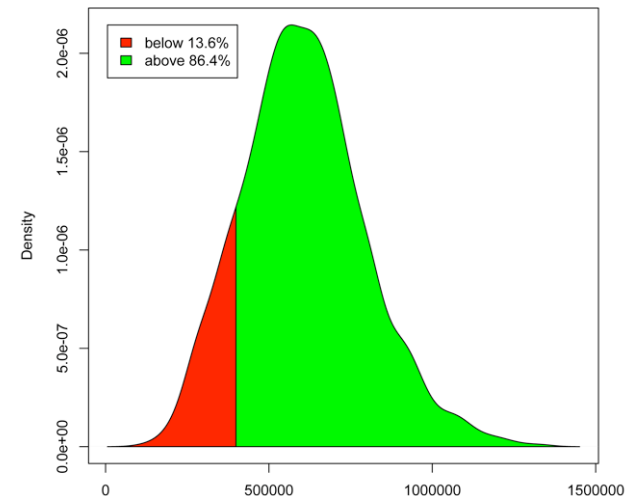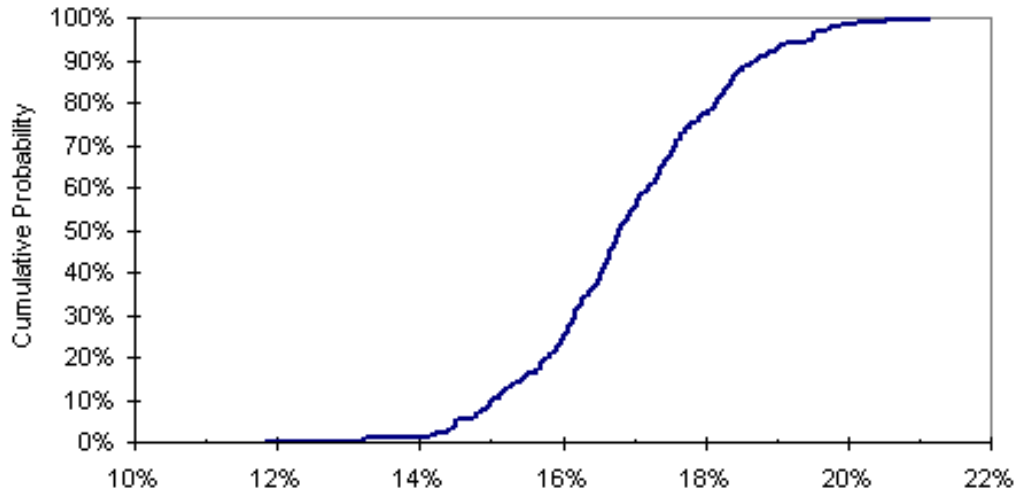
Audience Feedback

True or False

- The aggregate impact of pure risks on costs may be estimated either by using a formula-based method or by using Monte Carlo simulation.

Questions?

Submit a question using the chat box

Part 4

Assessment of Lifecycle Performance Risk and Revenue Uncertainty Adjustment

Valuing Lifecycle Performance Risks

Ways to value lifecycle performance risk

- Use information available to Agency on lifecycle performance risk costs/cash flows

- Use market-based P3 financing conditions as a proxy to determine the value of lifecycle performance risk
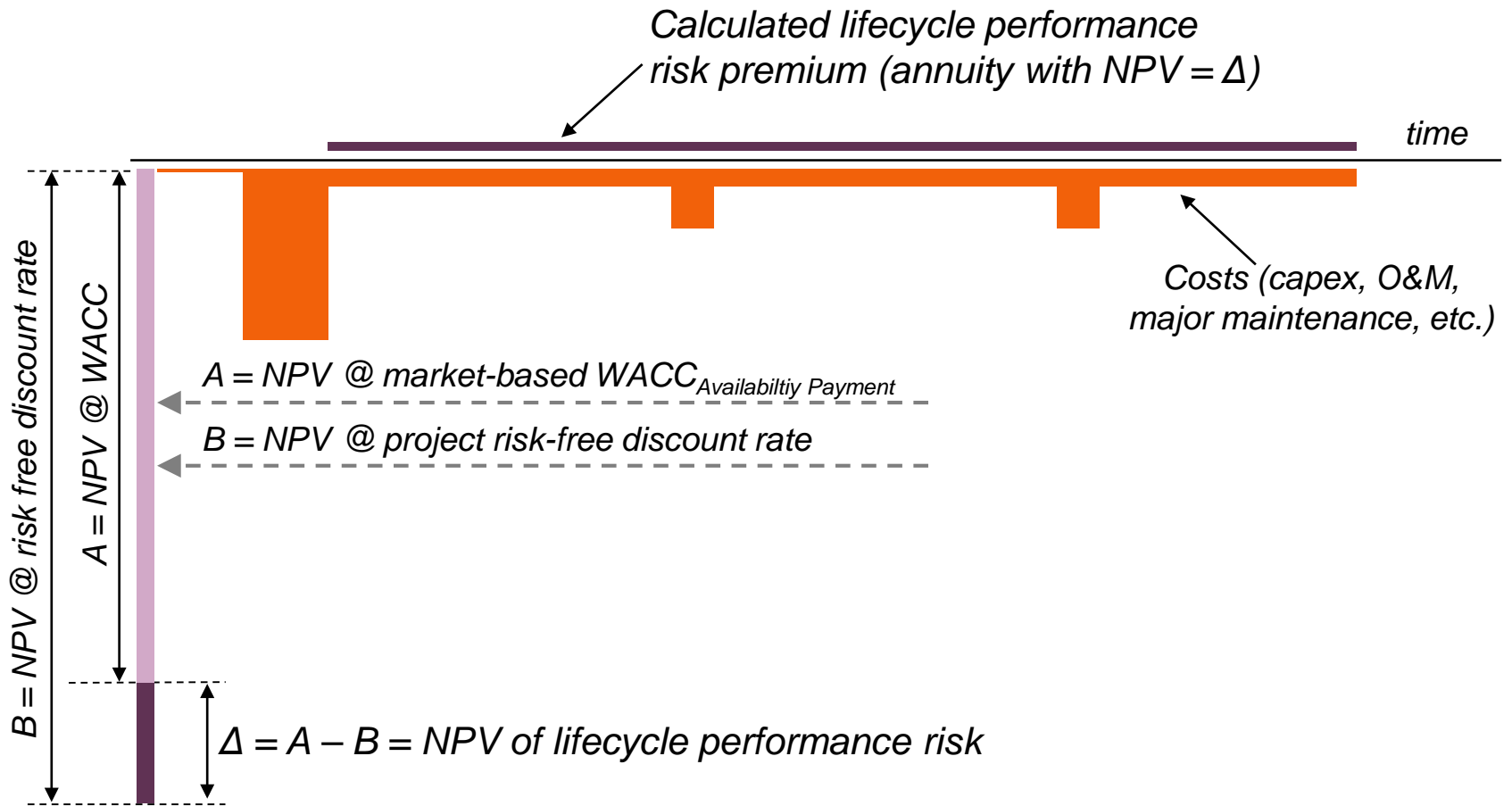
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Valuing Lifecycle Performance Risks

Market-based valuation:

- Calculate NPV of cost cash flows*, excluding financing:
  A. Using a market-based weighted average cost of capital (WACC) that excludes revenue risk (Availability Payment WACC)
  B. Using project risk-free discount rate

- Calculate difference in NPVs ($\Delta = A - B$)

Use PSC cash flows for PSC lifecycle performance risk, and P3 cash flows for P3 lifecycle performance risk (used only in PDBCA and risk outputs)

Lifecycle Performance Risk Valuation

Calculated lifecycle performance risk premium (annuity with NPV = Δ)

time

Costs (capex, O&M, major maintenance, etc.)

$A = NPV$ @ market-based $WACC_{Availabiltiy\ Payment}$

$B = NPV$ @ project risk-free discount rate

$B = NPV$ @ risk free discount rate

$A = NPV$ @ WACC

$Δ = A − B = NPV$ of lifecycle performance risk

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Valuing Revenue Uncertainty
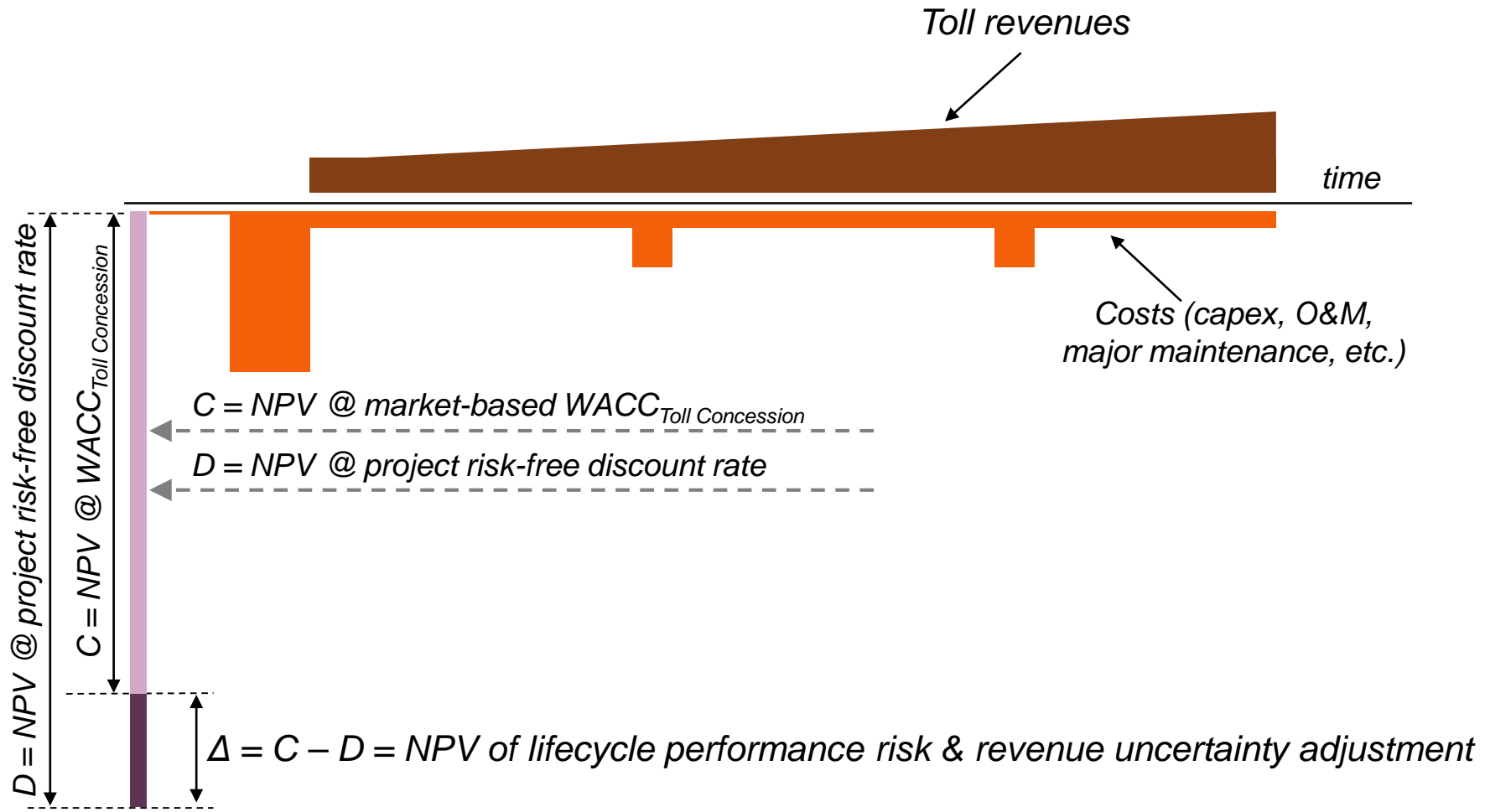
Ways to value revenue uncertainty

- Apply percentage haircut to P50 traffic/revenues

- Use market-based P3 financing conditions as a proxy to determine the value of revenue uncertainty

Valuing Revenue Uncertainty

Market-based valuation:

- Calculate NPV of revenue and cost cash flows, excluding financing:

  C. Using a market-based weighted average cost of capital (WACC) that *includes* revenue risk

  D. Using project risk-free discount rate

- Calculate difference in NPVs (Δ = C – D), which equals the lifecycle performance risk and revenue uncertainty adjustment combined

- NPV of revenue risk is the difference between this Δ and the lifecycle performance risk calculated previously
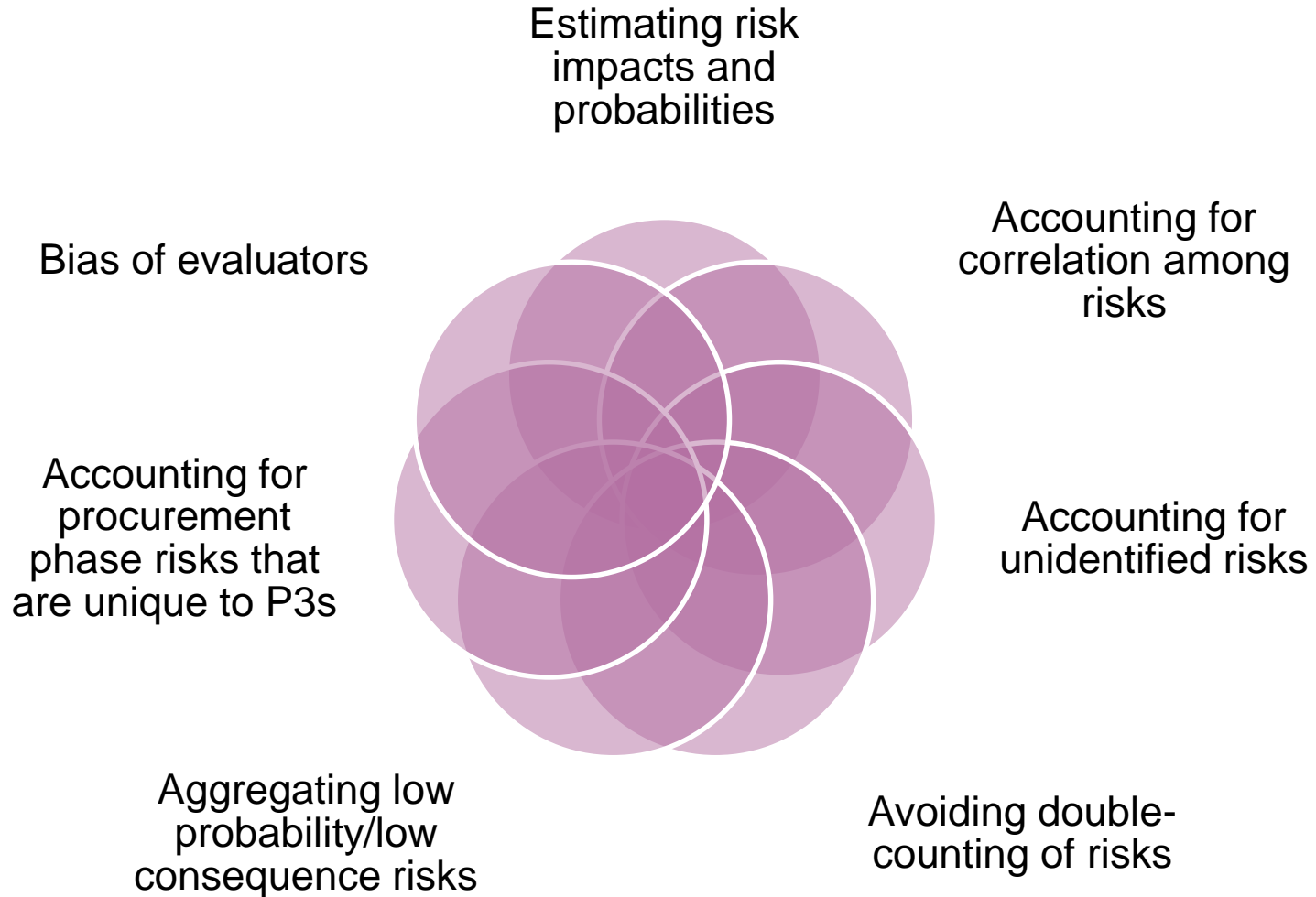
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Revenue Uncertainty Adjustment

Toll revenues

time

Costs (capex, O&M, major maintenance, etc.)

$C = NPV$ @ market-based $WACC_{Toll\ Concession}$

$D = NPV$ @ project risk-free discount rate

D = NPV @ project risk-free discount rate

C = NPV @ $WACC_{Toll\ Concession}$

$\Delta = C - D = NPV$ of lifecycle performance risk & revenue uncertainty adjustment

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Accounting for Risk in P3-VALUE 2.0

Risk Type	VfM PSC	VfM P3	PDBCA PSC	PDBCA P3
Base variability	✓	✓	✓	✓
Pure risk	✓	✓	✓	✓
Lifecycle performance risk	✓		✓	✓
Revenue risk	✓			

Risk Analysis Challenges

Estimating risk impacts and probabilities

Accounting for correlation among risks

Bias of evaluators

Accounting for procurement phase risks that are unique to P3s

Accounting for unidentified risks

Aggregating low probability/low consequence risks

Avoiding double-counting of risks

Test Your Knowledge

True or False

- The WACC for a toll concession includes a risk premium that accounts for revenue risk as well as for lifecycle performance risks

Questions?

Submit a question using the chat box

Part 5

Risk Allocation

Risk Transfer by Delivery Type

Procurement Type	Design Risk	Construction Risk	Financial Risk	O&M Risk	T&R Risk
Design-Build (DB)	✓	✓			
Design-Build-Finance (DBF)	✓	✓	✓		
Design-Build-Finance-Operate-Maintain (DBFOM) with Availability Payment	✓	✓	✓	✓	
Design-Build-Finance-Operate-Maintain (DBFOM) with Toll Concession	✓	✓	✓	✓	✓

Typical DBFOM Risk Allocation

Risk	Design-Bid-Build	Availability Payment DBFOM	Toll Concession DBFOM
Design errors	Public	Contractor	Contractor
Change in scope	Public	Public	Public
Delay in permits	Public	Shared	Shared
Delay in right-of-way acquisition	Public	Public	Public
Construction cost overruns	Contractor	Contractor	Contractor
Construction risks	Contractor	Contractor	Contractor
Archeological findings	Public	Public	Public
Delay in relocation of cables & pipes	Public	Contractor	Contractor
Unknown ground conditions	Public	Contractor	Contractor
Hazardous materials	Public	Shared	Shared
Security	Public	Contractor	Contractor
Major maintenance cost overruns	Public	Contractor	Contractor
Snow & ice removal cost overruns	Public	Contractor	Contractor
Regular maintenance	Public	Contractor	Contractor
Traffic information systems	Public	Public	Public
Incident management	Public	Contractor	Contractor
Toll revenue risk	Public	Public	Contractor
Financing risks	Public	Contractor	Contractor
Force majeure	Public	Shared	Shared

Risk Allocation Steps

Step 1: Likelihood
- Which party is best able to control the likelihood of the risk occurring?
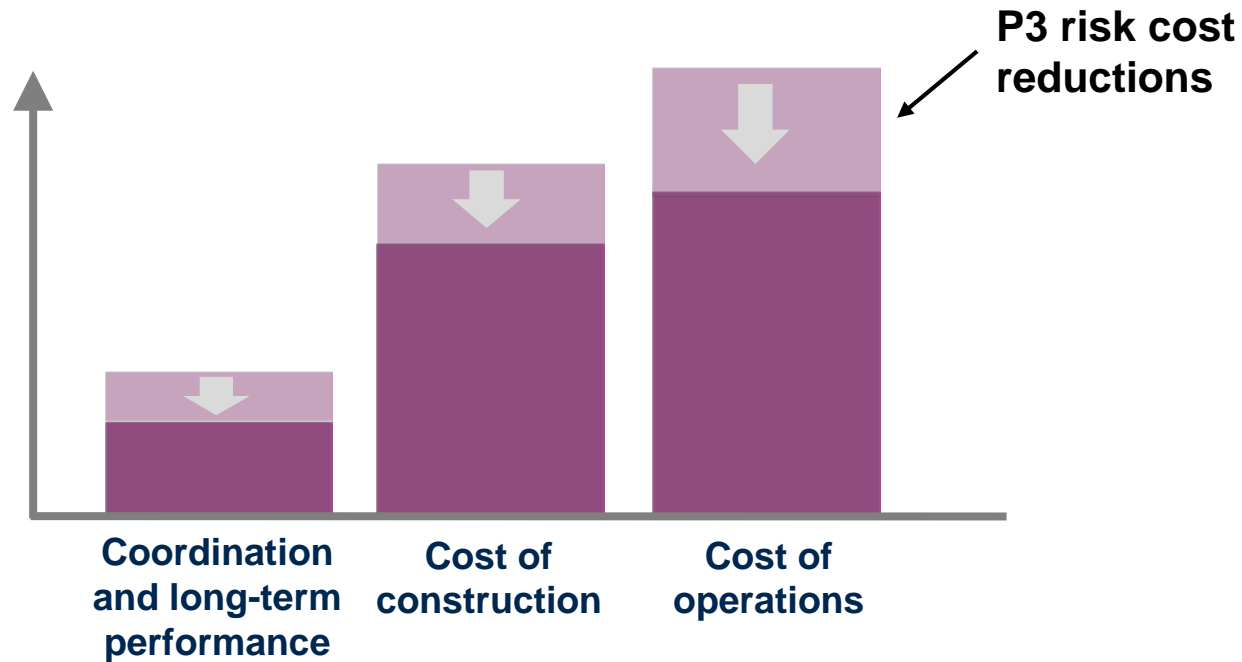
Step 2: Impact
- Which party is best able to control the impact of the risk?

Step 3: Lowest Cost
- Which party is best able to absorb the risk at lowest cost if the likelihood and impact cannot be controlled?

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Transferred Risks

- Transferred risks include risks pushed down to subcontractors

- Efficient P3 risk management may reduce overall risk valuation and contingencies

P3 risk cost reductions

Coordination and long-term performance   Cost of construction   Cost of operations

Example Tunnel Project

Risk Category	Risk Allocation		
	Public	**Private**	**Shared**
Political	✓		
Financial		✓	
Traffic and Revenue	✓		
Right of Way	✓		
Planning and Permitting			✓
Utilities			✓
Procurement	✓		
Construction		✓	
Operations and Maintenance		✓	
Hand-Back		✓	
Force Majeure			✓
Change in Law	✓		
Geotechnical			✓

Test Your Knowledge

True or False

- The public agency's goal in risk allocation should be to transfer all risks to the private partner in a P3.

Questions?

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Part 6

Using P3-VALUE 2.0 for Risk Assessment

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FHWA's P3-VALUE 2.0

Training Modules

Value for
Money
Analysis

Risk
Assessment

Project
Delivery
Benefit-Cost
Analysis

Financial
Viability
Assessment
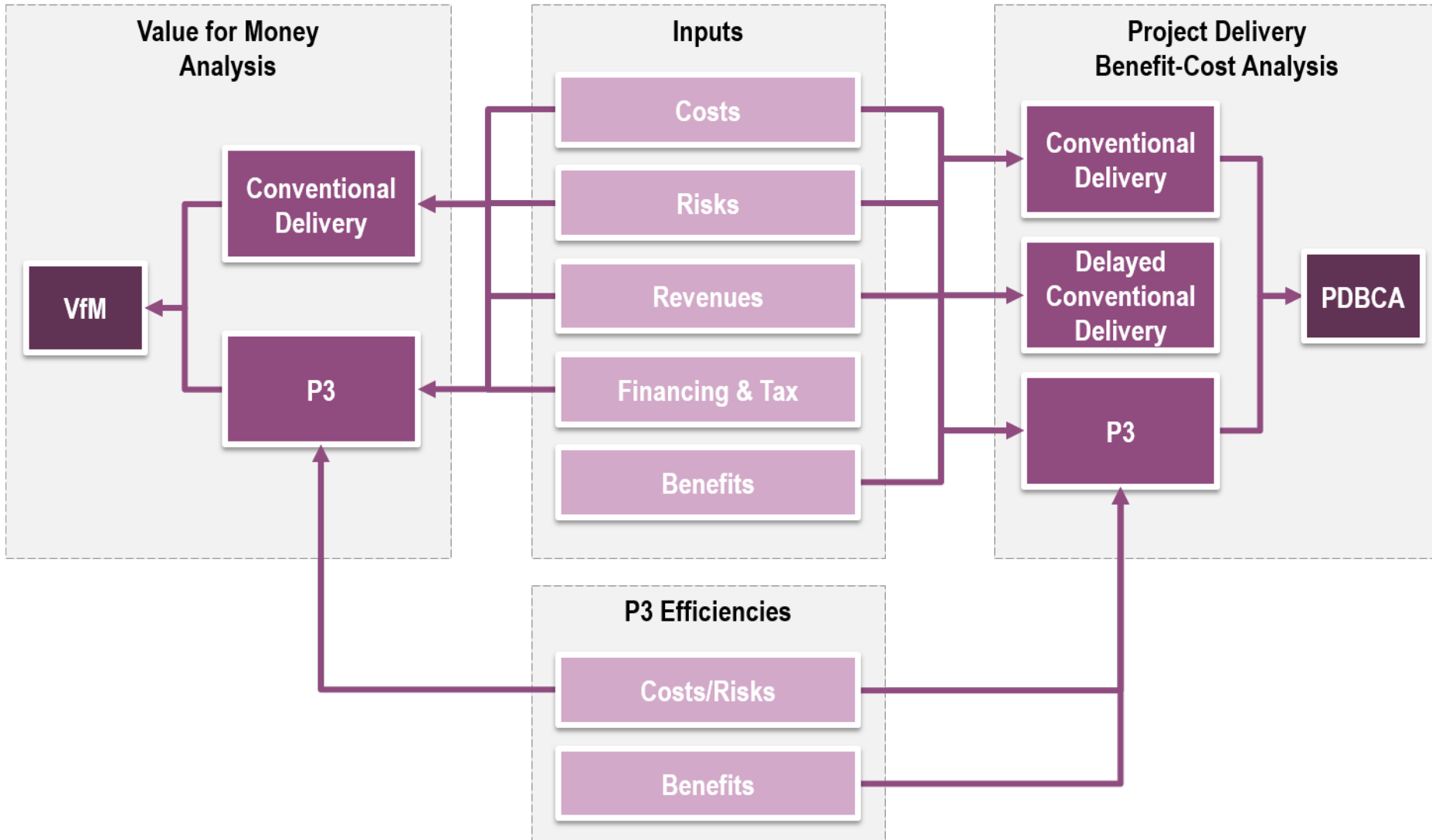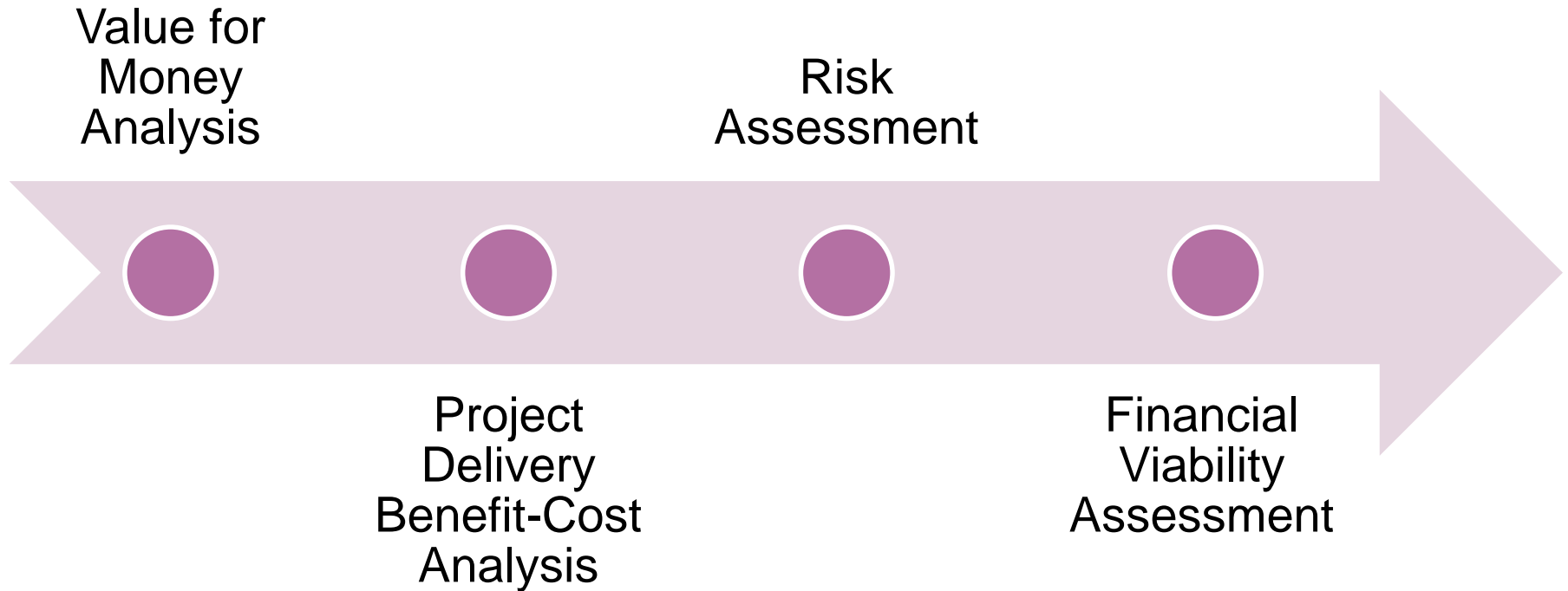
Training Navigator User Interface

Demonstration of Risk Module

Please stand by as we open the Excel file

Questions?

Submit a question using the chat box

Webinar Summary

Webinar Recap

Part 1 Categorizing Risk

Part 2 Risk Management Process

Part 3 Pure Risk Assessment

Part 4 Lifecycle Performance and Revenue Uncertainty Risk Assessment

Part 5 Risk Allocation

Part 6 Using P3-VALUE 2.0 for Risk Assessment

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Tool and References

P3-VALUE 2.0 Excel Spreadsheet

User Guide

Risk Assessment Primer & Guidebooks

Upcoming P3-VALUE Training

- **Exercise review – March 14 at 12:30pm EST**

- **March 21**   Financial Viability Assessment

- Exercise instructions may be downloaded from the web room

- Technical assistance options:
  - E-mail questions to: patrick.decorla-souza@dot.gov
    - Or call (202)-366-4076
  - Participate in "Exercise Review" webinar

To access the Exercise Review webinar, please use the following link and telephone number:

- *Link:* **https://connectdot.connectsolutions.com/p3**

- *Telephone: 1-888-363-4749, Passcode: 6139168#*

Resources

FHWA's Office of Innovative Program Delivery Website:
http://www.fhwa.dot.gov/ipd/

P3 Website:
http://www.fhwa.dot.gov/ipd/p3/

Questions?

Submit a question using the chat box

Contact Information

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