Flexibility as a Decision Support Strategy for Asset Risk Management

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CPCS

Solutions for growing economies
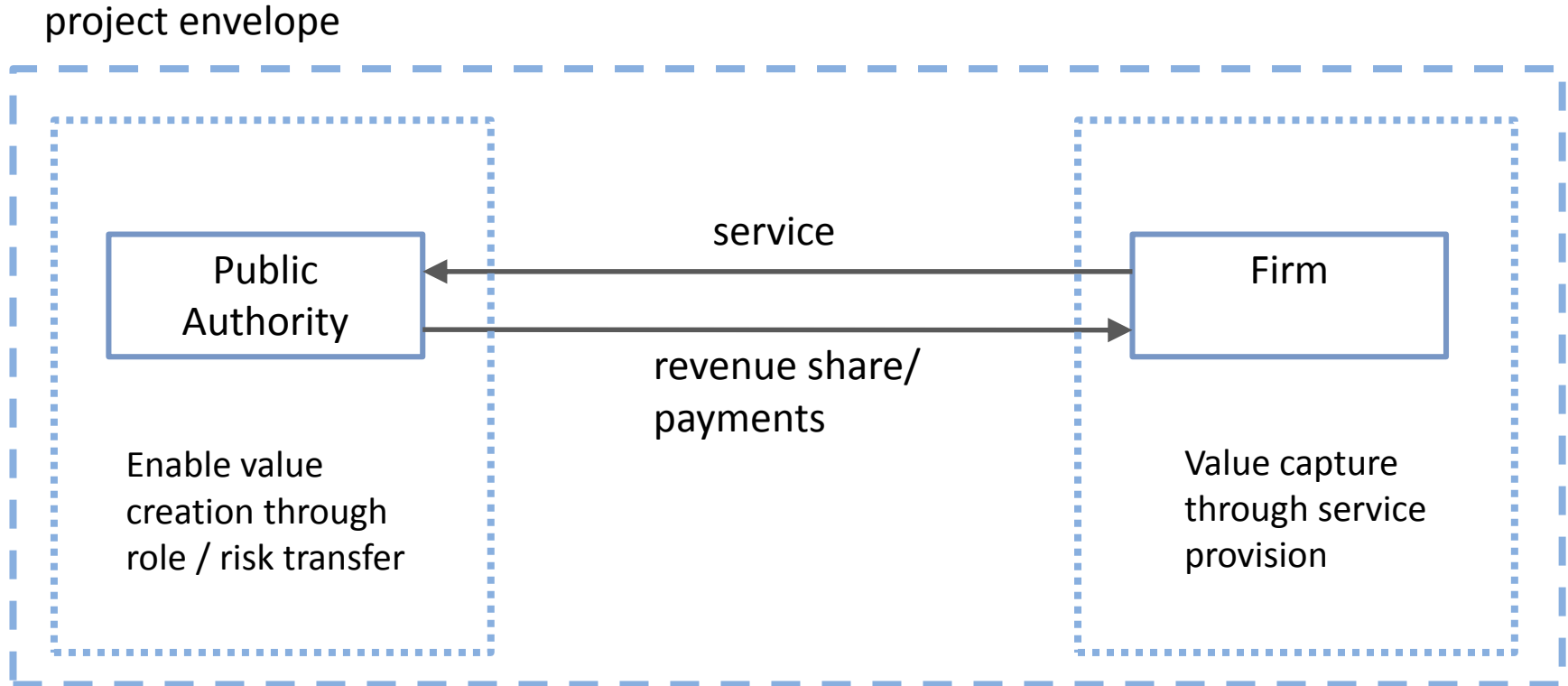
Acknowledgments

This research was funded by MIT's Tata Center for Technology and Design, and executed in collaboration with Prof. Richard de Neufville

Overview

- Context: Concept stage P3 design evaluation
- Objective: Life-cycle value assessment
- Method: Risk-based valuation through MCS
- Case study: Delhi's IGI Airport
- Results: Post-hoc analysis of project P3 value

- Contributions: The effect of flexible technical design
                           A case for contractual flexibility

A stylized P3 model

project envelope

Public Authority — Enable value creation through role / risk transfer

service

revenue share/ payments

Firm — Value capture through service provision

Concession contract links actors and governs value creation and capture

Objective: Life-cycle Value Assessment

- Discounting: time-value and risk
  - Time Value: Money now is more valuable than money in the future
  - Risk: the future is uncertain
  - Risk increases the discount of the future

- Value is probabilistic: Projects can be successes or failures

- Contracts allocate risk between the public and private partners

  Can flexible design insure and enhance project value by helping manage risk?

DIAL – Delhi International Airport Limited

- 30 – year concession awarded in 2006

- Designed for 62 million ppa

- Upgraded terminals, new runway (11-29)

- Option to expand to 100 million ppa

- 46% gross revenue transfer to public authority

Source: Report of the CAG of India (2013) on Implementation of PPP in IGI Airport

DELHI INDIRA GANDHI INTERNATIONAL AIRPORT

Source: www.delhimetro.net

CPCS Solutions for growing economies
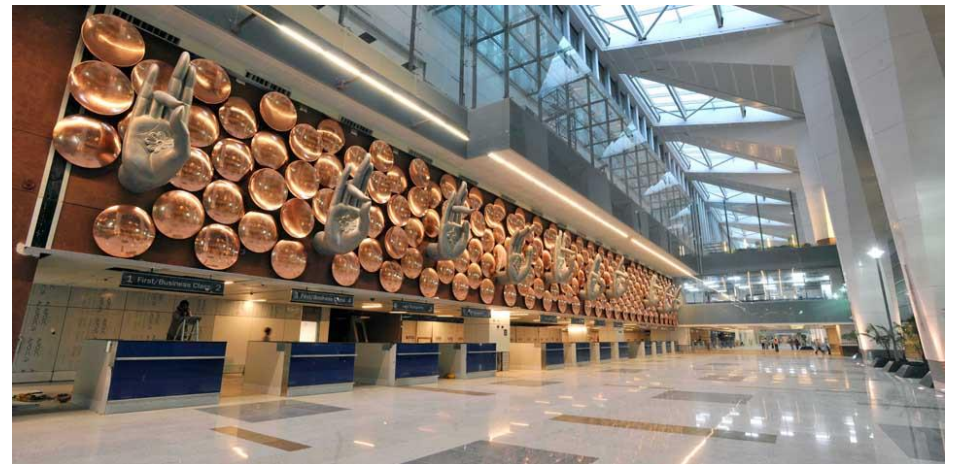
Method: Monte-Carlo Simulations

1. Identify the stream of project cash flows

2. Calculate project value for the stream of cash flows

3. Perform sensitivity analysis

4. Explore probabilistic value combinations

5. Compare the effect of flexible design concepts

Establish demand projection
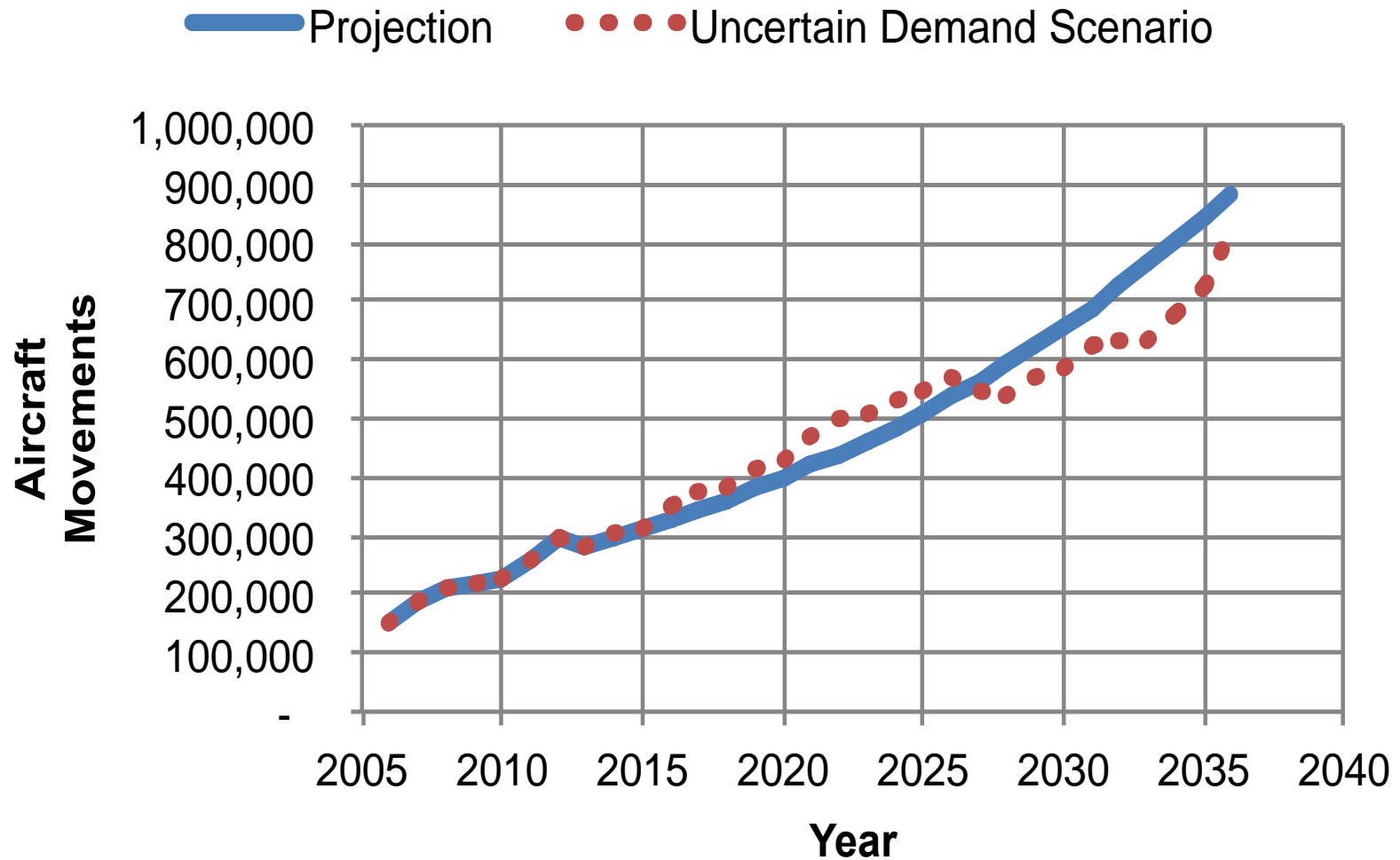
Source: Sakhrani & de Neufville

Develop static project NPV calculator

Step 1. Identify input parameters for spreadsheet model including fixed costs, operating costs, capacity and other technical constraints

Step 3. Vary key assumptions such as discount rate, revenue share to assess impact on value

Step 2. Calculate overall project value and value shares to contracting partners

KEY INPUTS	UNITS
Demand projections	time series
Capacity cost	INR crores
Land lease and other fixed costs	INR crores
Construction time	years
Revenue projections	time series
Operating costs	INR crores / year
Capacity limit (movements) - first 10 years	number
Capacity limit (movements) - second 10 years	number
Capacity limit (movements) - second 10 years	number
Capacity limit (passengers)	number
Capacity	multiplier
Time horizon	years
Discount rate	% / year
Public partner Revenue Share	%

cost inputs with their units

technical and design constraints

economic and contractual variables affecting risk

CASH FLOWS

project time dimension / horizon

Calendar Year	2001	2002	2003 --->	2030
Project Year	1	2	3	30
Demand (movements)				
Capacity (movements)				
Demand (passengers)				

demand projections - - - - - - - ->

Aero Revenue (Crores)
Non-Aero Revenue (Crores)
Gross Revenue (Crores)

overall project cash flows - - - - - ->

Net Income to partner
DCF Partner
Operating costs
Land leasing and fixed costs
Cashflow
DCF Company
Present value of cashflow to Public partner
Present value of cashflow to Airport Company
Total Project Value

discounted and allocated cash flows - - - - - - ->

present value calculations for project and contracting parties

Source: Sakhrani & de Neufville

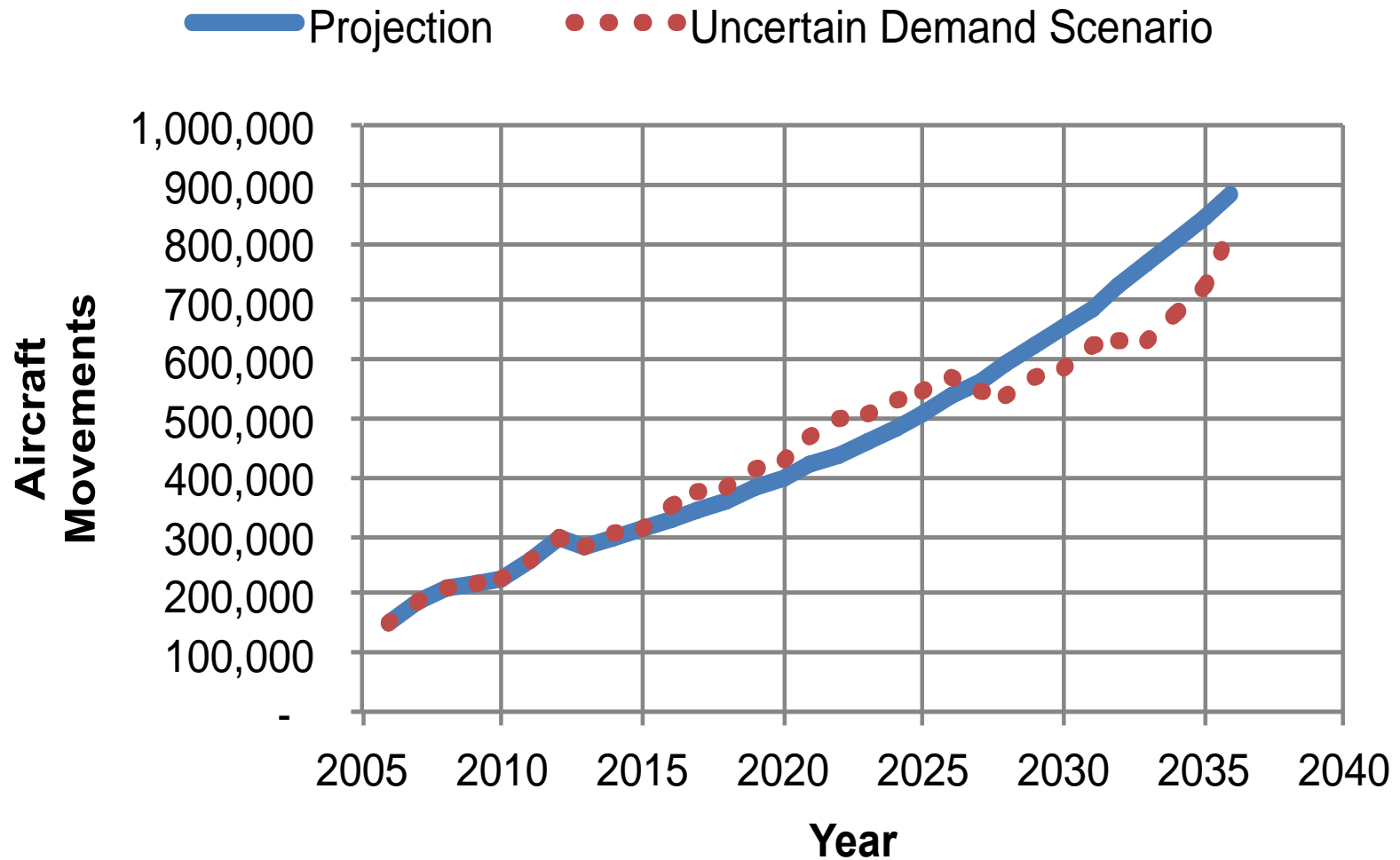# Test sensitivity of project value to assumptions
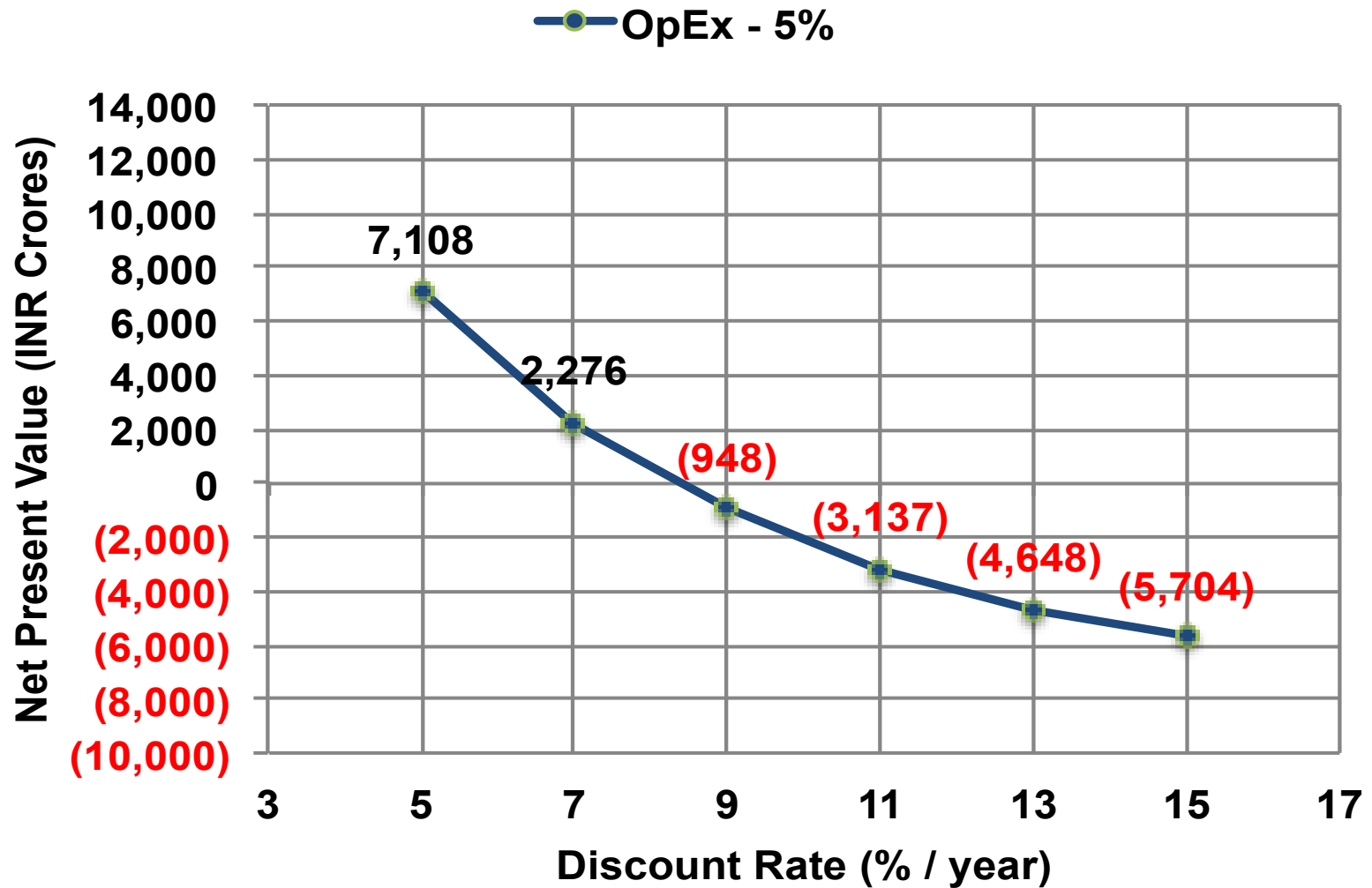
Source: Sakhrani & de Neufville

Sensitivity analysis can be multi-variate
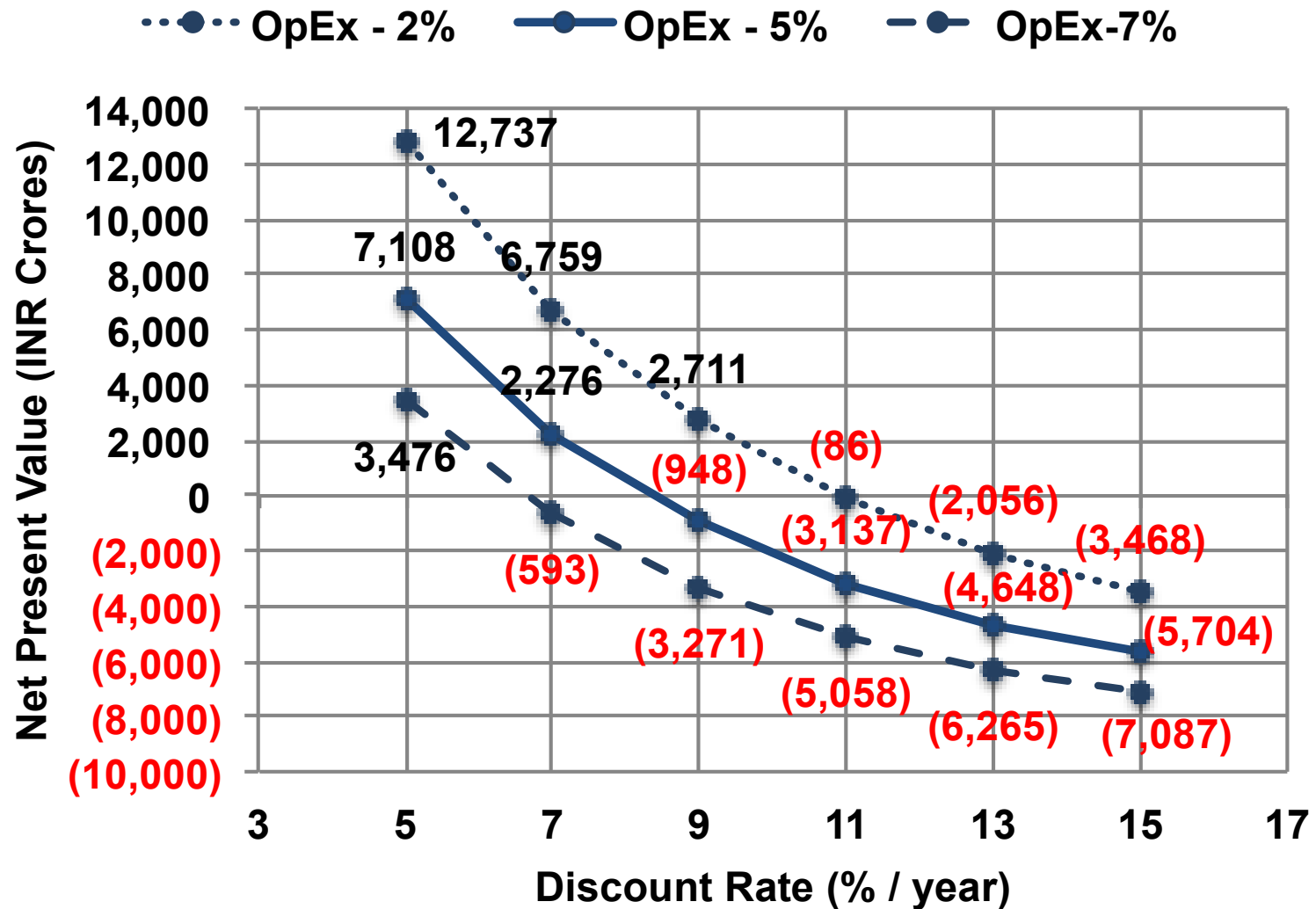
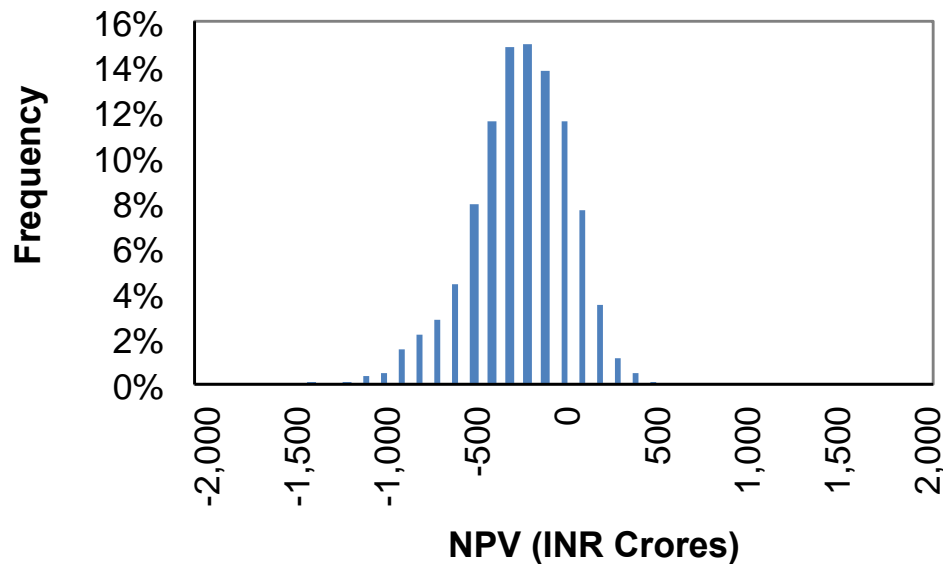Source: Sakhrani & de Neufville

But the future is uncertain

Source: Sakhrani & de Neufville

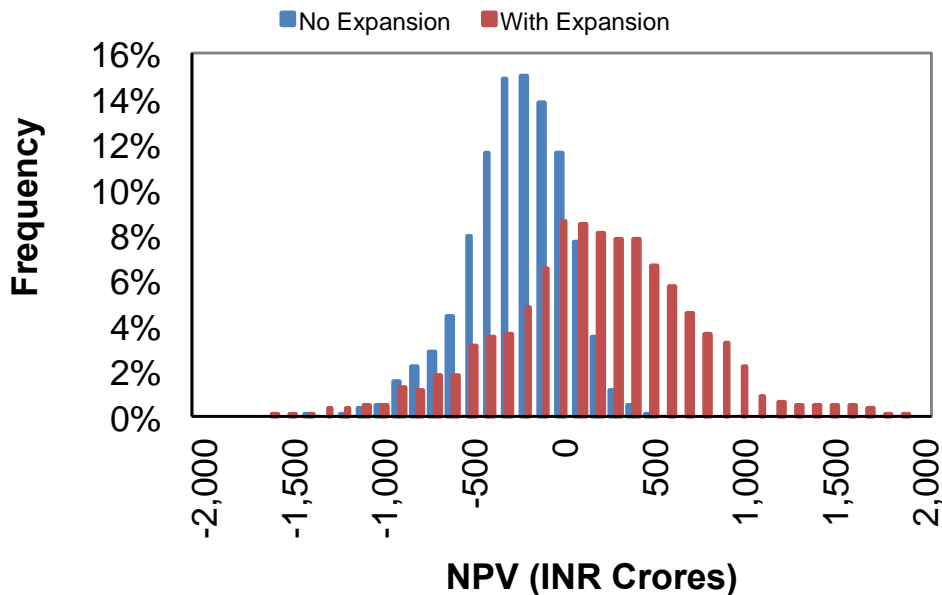# Develop probabilistic view of project success

Histogram

Frequency vs NPV (INR Crores)
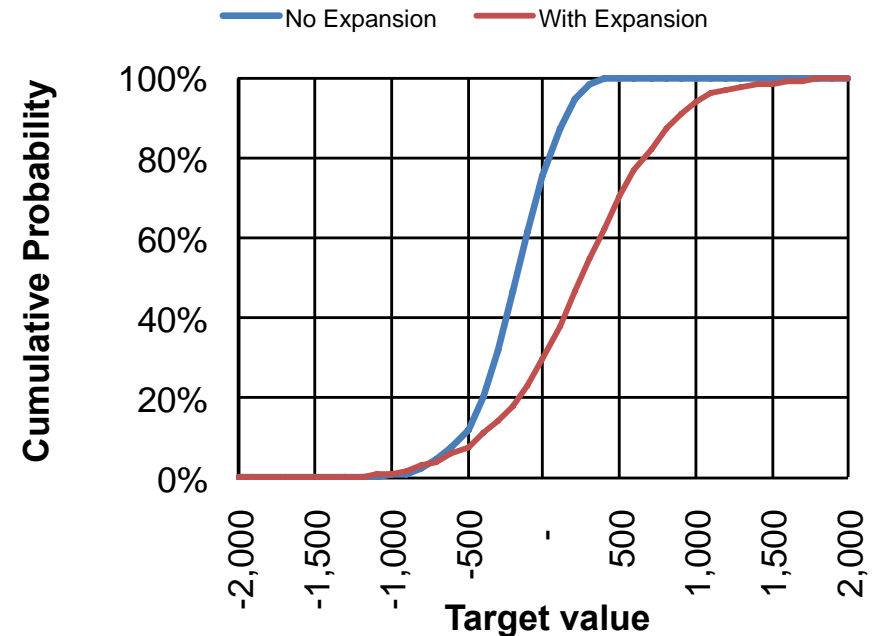
Target Curve
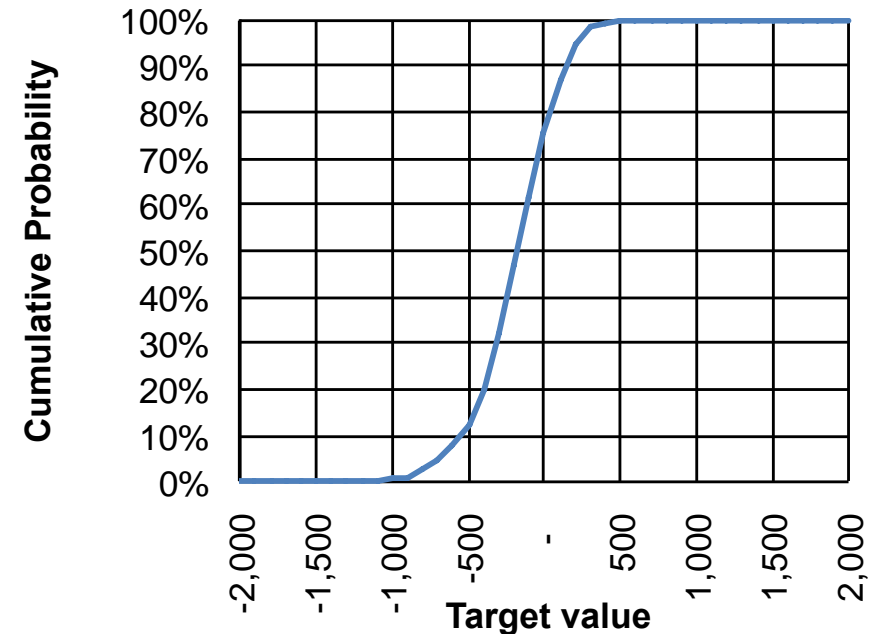
Cumulative Probability vs Target value

Future runway addition (flexibility) adds value

Source: Sakhrani & de Neufville

Contract allocates risks: winners and losers

NPV Share for AAI as a function of AAI Revenue Share and Discount Rate

			Discount Rate			
	5%	7%	9%	11%	13%	15%
30%	9,204	7,110	5,663	4,638	3,894	3,341
31%	9,485	7,322	5,827	4,768	4,000	3,428
32%	9,767	7,534	5,992	4,899	4,105	3,516
33%	10,049	7,747	6,156	5,029	4,211	3,603
34%	10,331	7,959	6,320	5,159	4,316	3,690
35%	10,613	8,171	6,484	5,289	4,422	3,778
36%	10,894	8,383	6,648	5,419	4,527	3,865
37%	11,176	8,596	6,813	5,550	4,633	3,952
38%	11,458	8,808	6,977	5,680	4,739	4,040
39%	11,740	9,020	7,141	5,810	4,844	4,127
40%	12,022	9,232	7,305	5,940	4,950	4,214
41%	12,303	9,444	7,469	6,070	5,055	4,302
42%	12,585	9,657	7,633	6,201	5,161	4,389
43%	12,867	9,869	7,798	6,331	5,266	4,476
44%	13,149	10,081	7,962	6,461	5,372	4,563
45%	13,431	10,293	8,126	6,591	5,478	4,651
46%	13,712	10,505	8,290	6,721	5,583	4,738
47%	13,994	10,718	8,454	6,852	5,689	4,825
48%	14,276	10,930	8,619	6,982	5,794	4,913
49%	14,558	11,142	8,783	7,112	5,900	5,000
50%	14,839	11,354	8,947	7,242	6,005	5,087

(Left axis: AAI Revenue Share)

NPV Share for Airport Company as a function of AAI Revenue Share and Discount Rate

			Discount Rate			
	5%	7%	9%	11%	13%	15%
30%	(2,096)	(4,834)	(6,611)	(7,775)	(8,542)	(9,045)
31%	(2,378)	(5,046)	(6,775)	(7,906)	(8,647)	(9,132)
32%	(2,660)	(5,258)	(6,939)	(8,036)	(8,753)	(9,220)
33%	(2,941)	(5,470)	(7,103)	(8,166)	(8,858)	(9,307)
34%	(3,223)	(5,682)	(7,268)	(8,296)	(8,964)	(9,394)
35%	(3,505)	(5,895)	(7,432)	(8,426)	(9,070)	(9,482)
36%	(3,787)	(6,107)	(7,596)	(8,557)	(9,175)	(9,569)
37%	(4,068)	(6,319)	(7,760)	(8,687)	(9,281)	(9,656)
38%	(4,350)	(6,531)	(7,924)	(8,817)	(9,386)	(9,744)
39%	(4,632)	(6,743)	(8,088)	(8,947)	(9,492)	(9,831)
40%	(4,914)	(6,956)	(8,253)	(9,077)	(9,597)	(9,918)
41%	(5,196)	(7,168)	(8,417)	(9,208)	(9,703)	(10,006)
42%	(5,477)	(7,380)	(8,581)	(9,338)	(9,809)	(10,093)
43%	(5,759)	(7,592)	(8,745)	(9,468)	(9,914)	(10,180)
44%	(6,041)	(7,805)	(8,909)	(9,598)	(10,020)	(10,268)
45%	(6,323)	(8,017)	(9,074)	(9,728)	(10,125)	(10,355)
46%	(6,605)	(8,229)	(9,238)	(9,859)	(10,231)	(10,442)
47%	(6,886)	(8,441)	(9,402)	(9,989)	(10,336)	(10,529)
48%	(7,168)	(8,653)	(9,566)	(10,119)	(10,442)	(10,617)
49%	(7,450)	(8,866)	(9,730)	(10,249)	(10,548)	(10,704)
50%	(7,732)	(9,078)	(9,894)	(10,379)	(10,653)	(10,791)

(Left axis: AAI Revenue Share)

Total Project NPV = AAI NPV Share + Airport Company NPV Share

5%	7%	9%	11%	13%	15%
7,108	2,276	(948)	(3,137)	(4,648)	(5,704)

Contributions

- The study conducted a post-hoc analysis of the DIAL concession arrangement to assess life-cycle value implications

- Flexible technical design (capacity addition) changes value distribution and truncates value-at-risk

- Contractual flexibility (adjusting revenue transfer) can enable positive value shares to partners

- Increase size of pie through technical design; increase size of slices through concession design