Using Real Options to Estimate the Value of an Investment in Energy Storage

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Abstract

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Estimating the value of investments in capital projects resulting in improved power quality and reliability is highly uncertain when the analysis is limited to simple payback and discounted cash flow valuation techniques. The uncertainty results from the fact that many of the costs of poor power quality and reliability are not formally measured, and the fact that the future benefits from the investment are variable and uncertain, due to a general lack of good information about historical and forecasted future power quality and reliability.

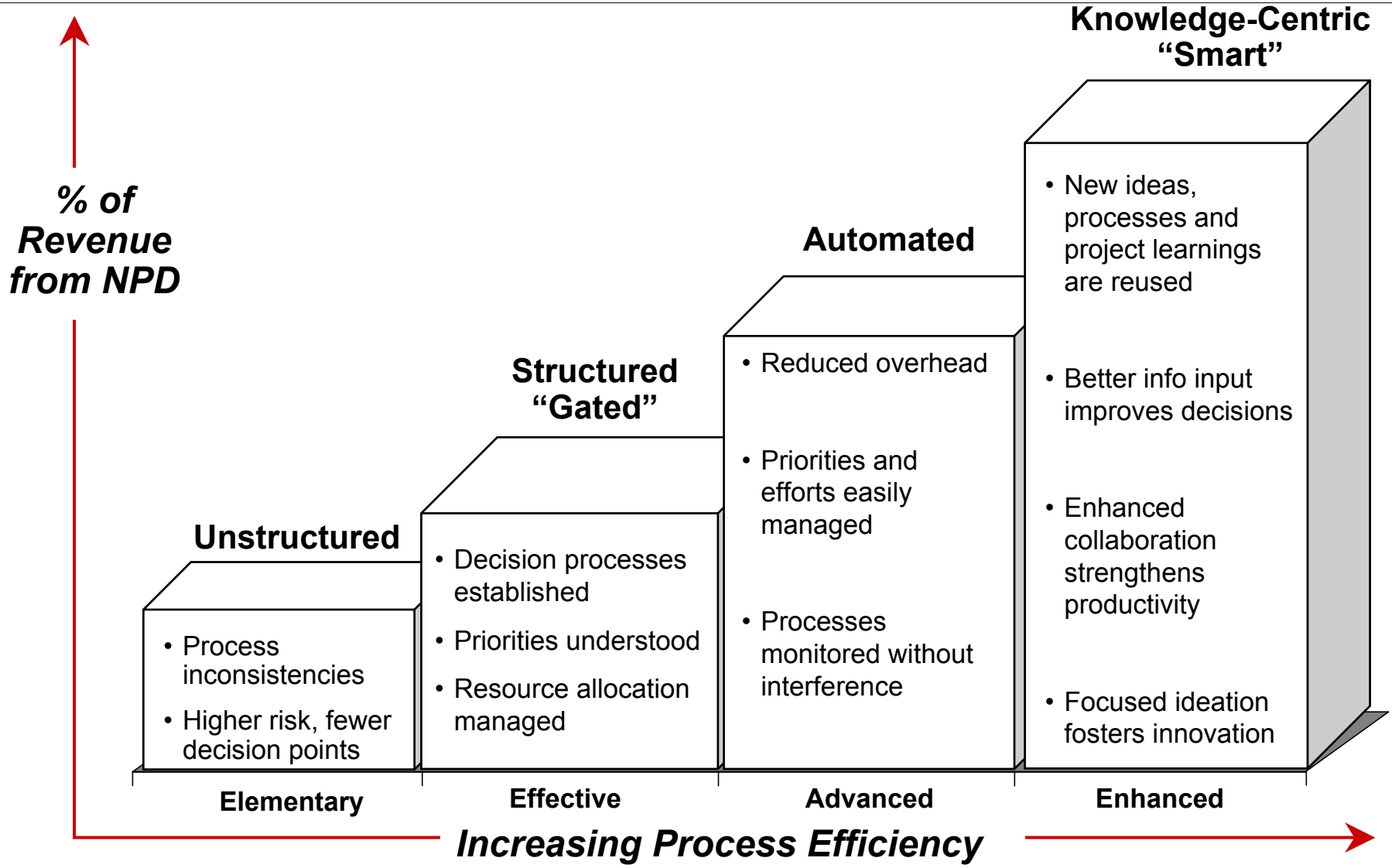
Real Options is a technique used increasingly by the energy industry to value projects dependent on one or more volatile parameters. The technique has been used to value financial options for many years and when Real Options is applied to physical assets, an analyst can make a credible estimate of the strategic value of the initiative in addition to the economic value predicted by traditional valuation techniques.

The presenter will show how the value of an investment in an example fuel cell product development project can be enhanced by identifying the options embedded in the project, and how the value of the project is impacted by changing volatility in the model assumptions. The economic value will be estimated using discounted cash flow techniques and the strategic value will be estimated using Real Options.

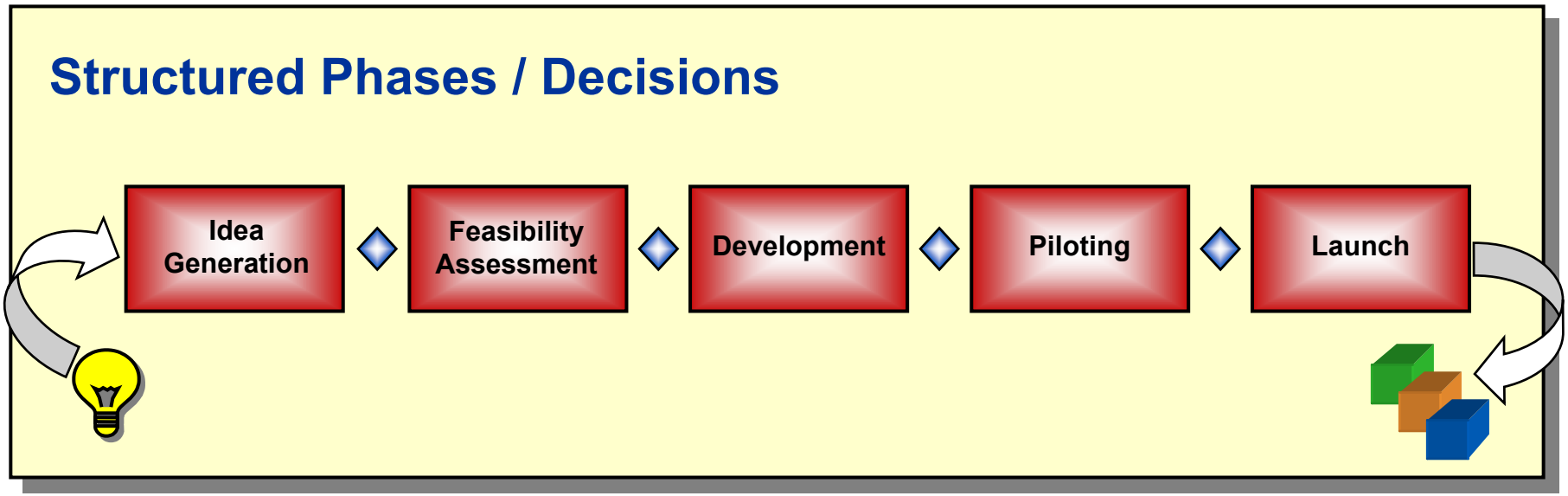
Agenda

- New Product Development and Valuation
- Distributed Generation Example using Discounted Cash Flow
- Financial and Real options overview
- Distributed Generation Example using Real Options
- Real options application to Flywheel UPS example

Evolution of New Product Development Processes



Typical New Product Development Process



◆ **Decision point – Commitment of resources for next phase**

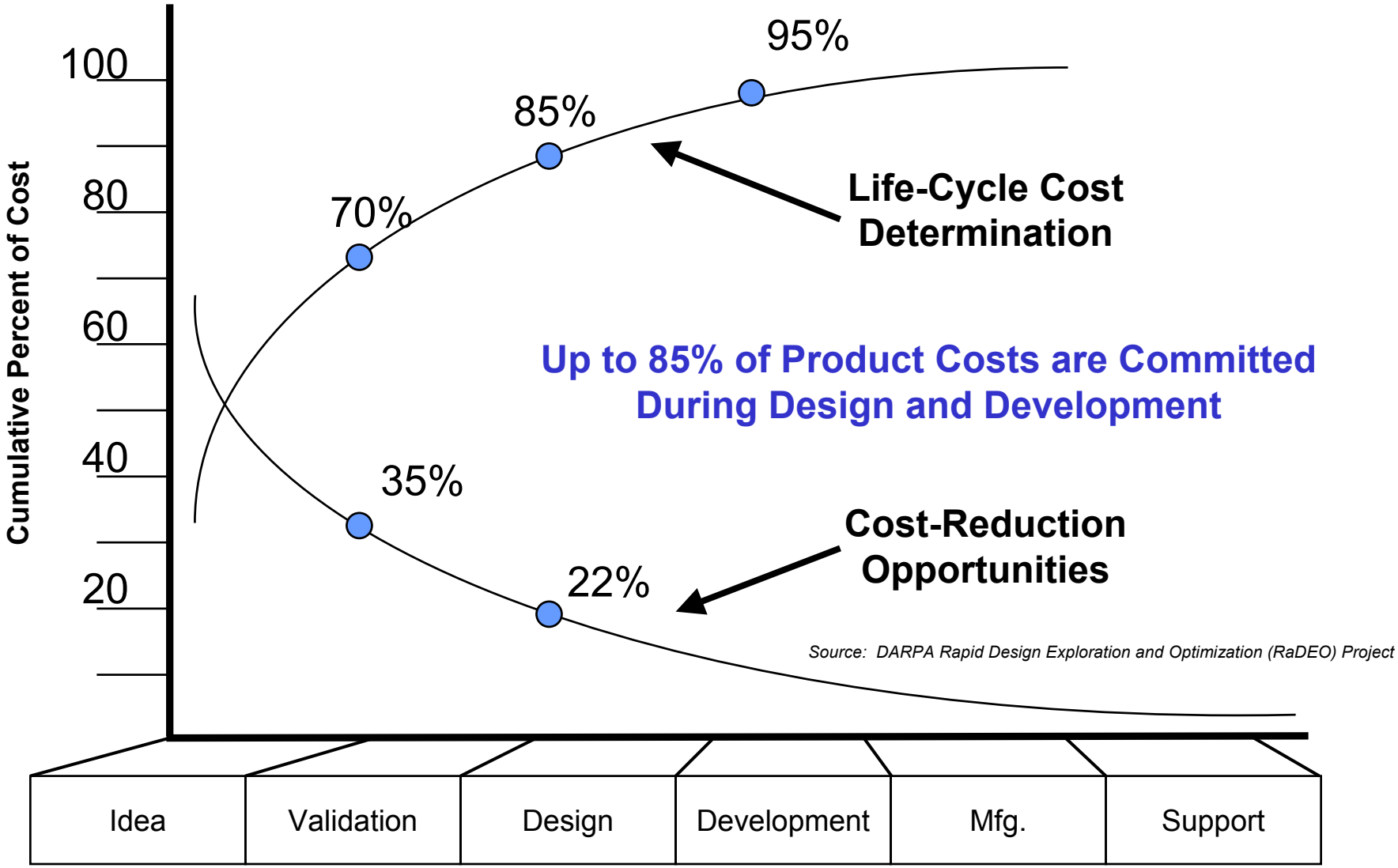
New Product Development Problems

- **Companies are too slow in getting new products to market**
  - More than 70% of projects take longer than expected
  - 45% of new products miss market share, profit and ROI objectives
  - NPD professionals spend 60% of their time just on communications
  - Not enough innovation

- **Companies don't "kill" bad product ideas early enough**
  - 46% of NPD resources are spent on products that fail commercially or never make it to market.
  - 40% of products launched fail
  - 75% of new product screening decisions are wrong

Source: Booz Allen & Hamilton
Cap Gemini
Cooper & Edgett
The Performance Measurement Group

New Product Development Costs



Traditional Investment Decision Making

- Discounted Cash Flow most widely used
- Weighted Average Cost of Capital is used for the discount rate
- Discount rate is sometimes adjusted to account for perceived risk
- Decisions between competing investments favor projects with lower risk

Limitations of DCF for New Product Development Decisions

- Implicitly assumes only one investment decision
- Not applicable for comparing competing projects with different risks
- Not applicable for comparing competing projects of different scale
- Value of learning is not quantified
- Value of managerial flexibility is not quantified

Fuel Cell Valuation Example – Retail Service Provider

Assumptions

2,000,000 residential customers in service territory

$1500/KW fuel cell cost

20% gross margin

Indirect costs 15% of revenues

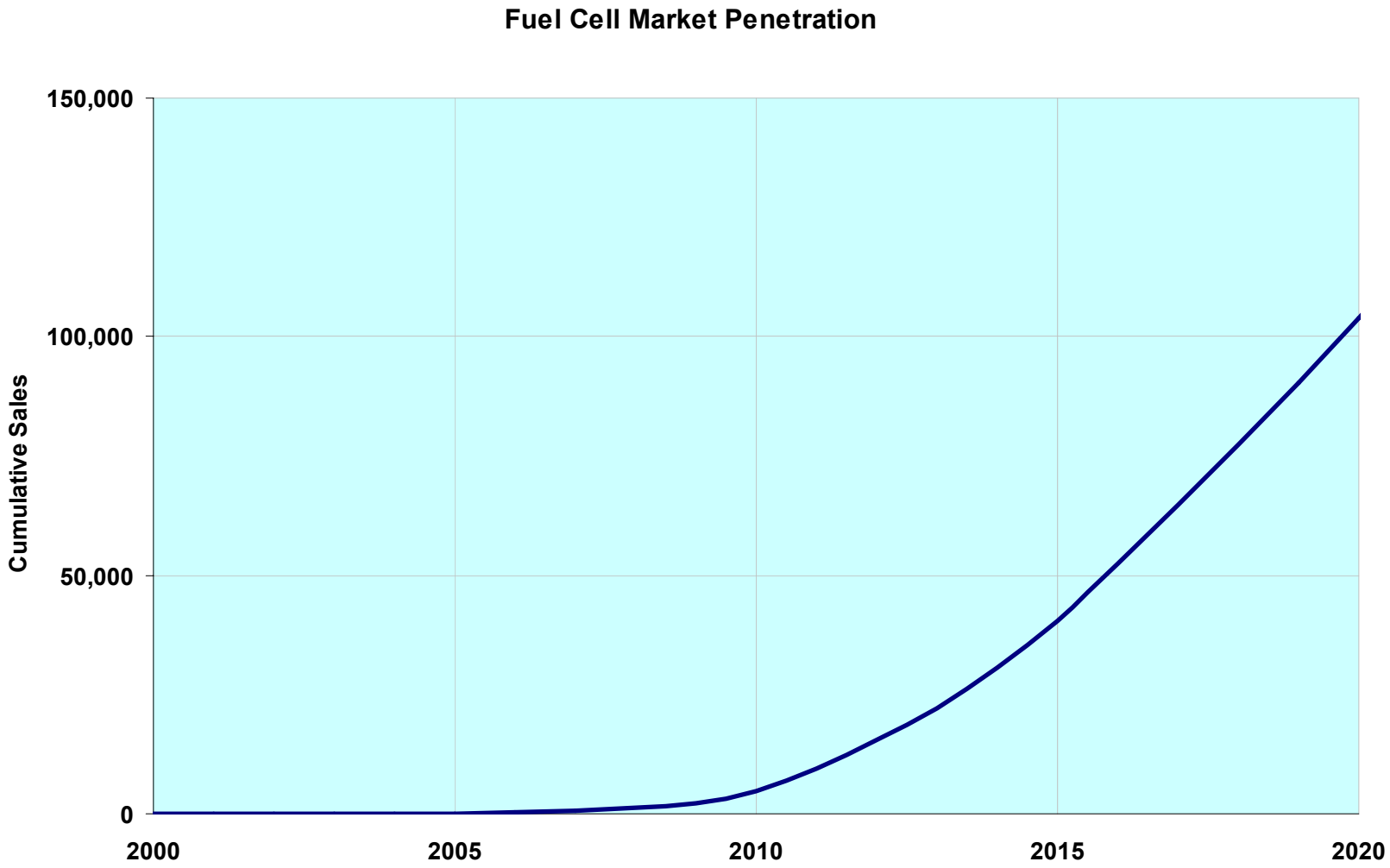
5% market share achieved by 2016

$3,000,000 in unrecoverable launch costs

15% discount rate

Launch product in 2003

Product Adoption Rate



Discounted Cash Flow Valuation

Year 10 unit sales:	5,700
Year 10 Revenues:	$75 M
Year 10 Earnings:	$4 M
Year 10 Free Cash Flow:	$0.8 M
NPV @ 15%:	($1.1 M)
NPV @ 20%:	($2.2 M)

Investment Decision: **Reject Project**

Financial Option Definition

A contract conveying the right, but not the obligation, to buy or sell designated securities or commodities at a specified price during a stipulated period.

Call option – a contract to buy

Put option – a contract to sell

A *European option* gives the owner of the option contract the right to buy the designated securities only on the expiration date for the option.

An *American option* gives the owner of the option contract the right to buy the designated securities at any time before the expiration date.

Value of the Option

There are several methods for estimating the value of a financial option (such as a stock option), but the most commonly used is the ***Black-Scholes***[1] equation, which expresses the value as a function of six variables:

1. The stock price
2. The exercise price (or, strike price)
3. The risk-free rate of return
4. The volatility of the underlying security
5. The time to expiration
6. The dividend yield

Fischer Black and Myron Scholes of the MIT Sloan School of Management developed the original option valuation model using five variables. The dividend yield variable was added by Robert Merton in 1975. Fischer Black and Robert Merton won the Nobel Prize in Economics for their work on the option valuation model in 1997. Fischer Black, who died in 1995, was mentioned in the award citation.

Real Options

Stewart Myers of the Massachusetts Institute of Technology observed that the Black-Scholes model could be used to value investment opportunities in real markets-the markets for products and services.

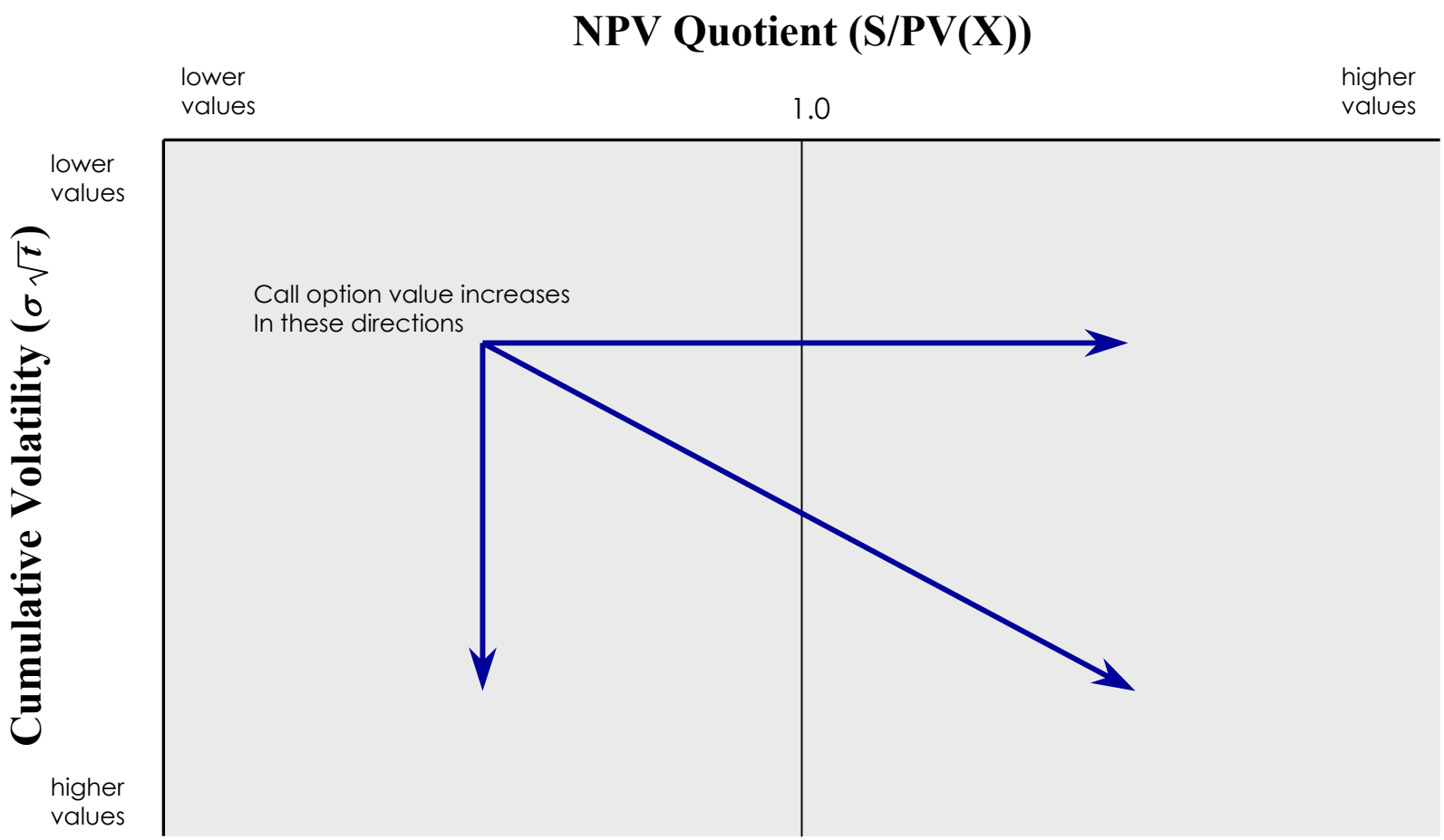
Today, this technique is commonly used in industries such as:

- **Oil and Gas Exploration**
- **Pharmaceuticals**
- **Chemicals**
- **Semiconductors**

Correspondence in the Valuation Models

Real Options Value for New Product Development		Call Option Value
Present Value of the cash flows from the project	S	Stock price
Required new investment	X	Exercise price
Length of time until decision must be made	t	Time to expiration
Time value of money	r_f	Risk-free rate of return
Risk of the expected returns	σ^2	Variance of returns on stock
Annual cost of preserving the option	D	Dividend Yield

Valuation Matrix Using the Black-Scholes Call Option Method



Real Options Valuation

Revised Assumptions

Delay launch by five years

Invest $200,000/year in product development

Assumed volatility: 100% (standard deviation in the cash flows)

Risk free interest rate: 3%

Present value of unrecoverable launch costs: $2.7 M

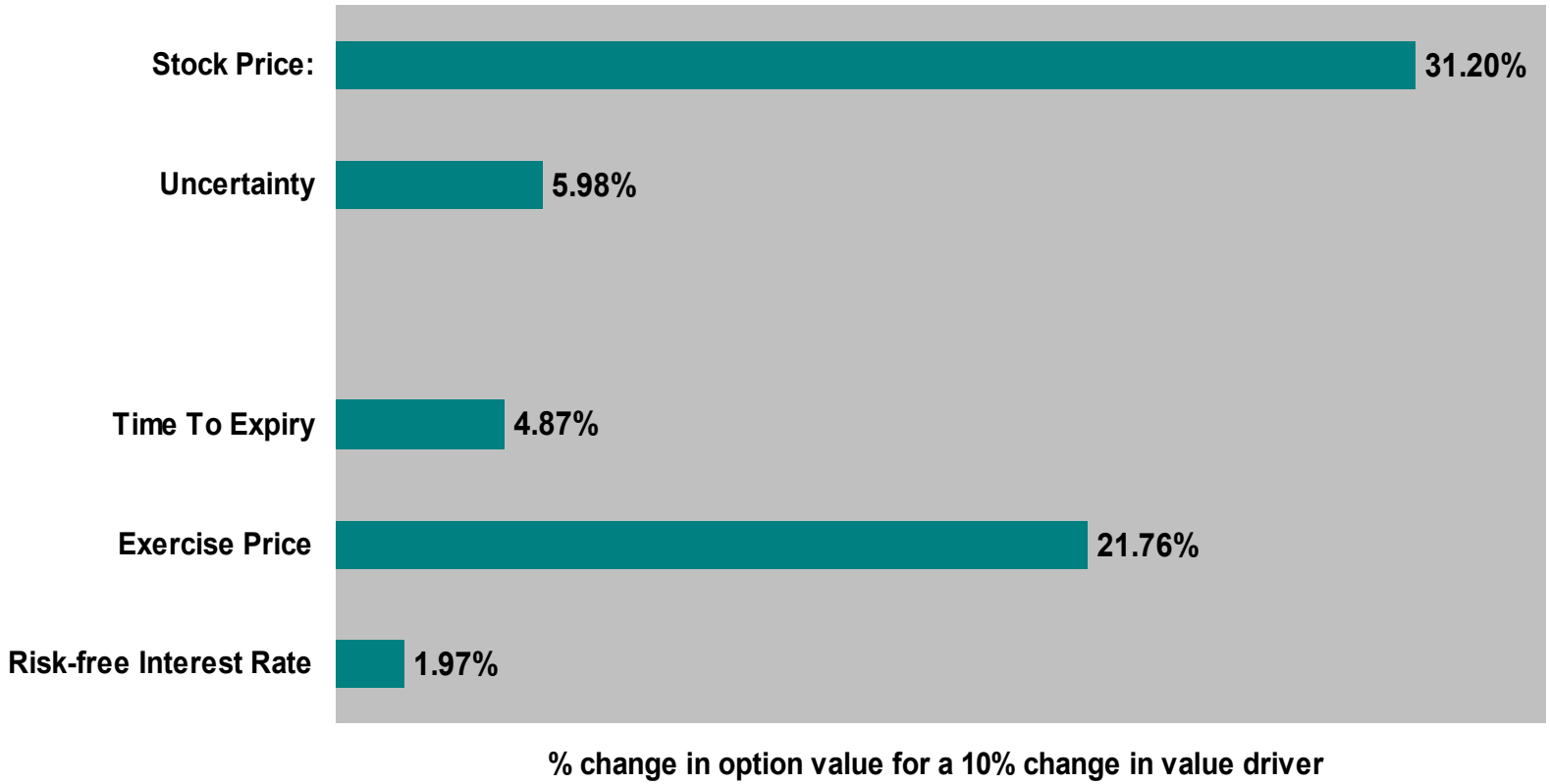
Present value of free cash flows from project: $1.6 M

Value of the option to delay the launch: **$540,000**

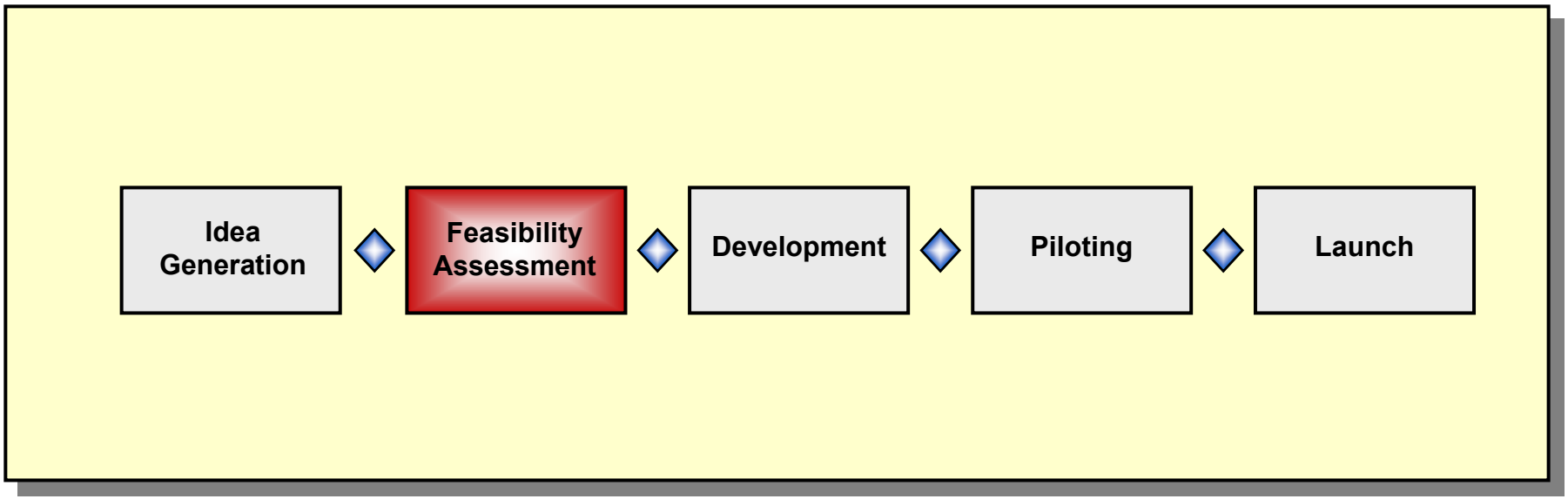
Value of the option @ 50% volatility: **$150,000**

Investment Decision: **Invest in the Feasibility Phase of Product Development**

Value Drivers for the Option to Delay Launch



Feasibility Stage Investments



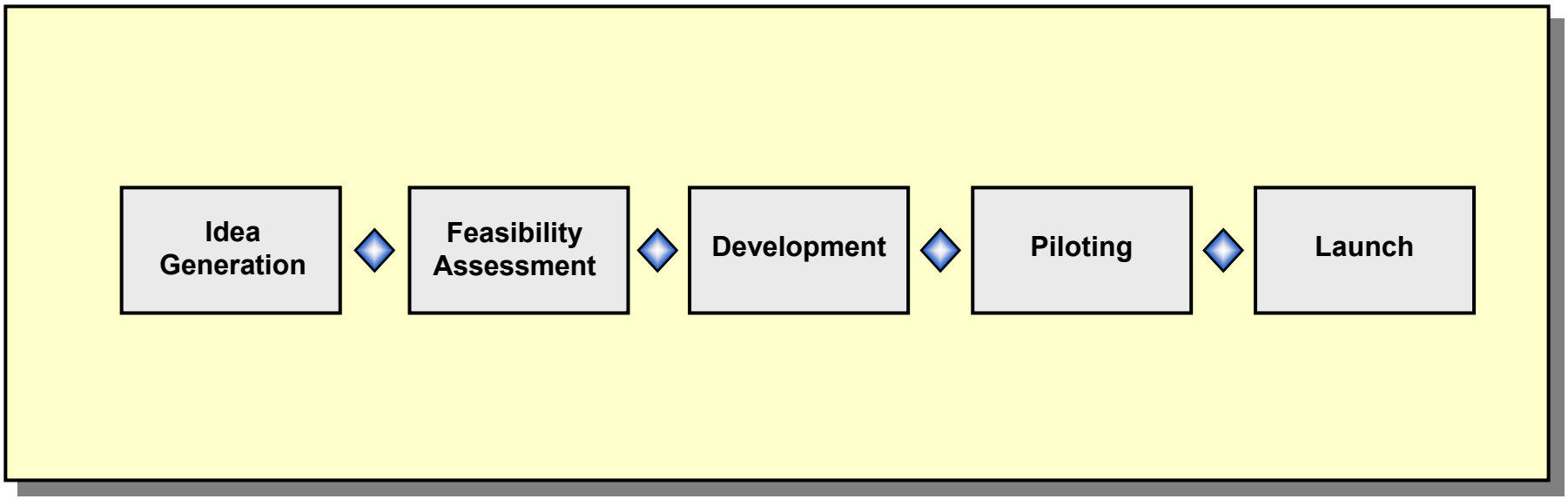
Task	
Primary market research	**$50,000**
Customer pilot	**$50,000**
Identification of potential fuel cell suppliers	**$20,000**
Creation of a business plan	**$50,000**
Investigation of technical issues	**$30,000**
Total	**$200,000**

Objectives for the Feasibility Gate

- **Maximize the value of the option to invest in the Development Phase**

- Assemble a business plan to preserve the option
- Identify sources of sustainable competitive advantage
- Organizational learning documented
- Voice of the customer research
- Reassess the value of the option in light of Feasibility Phase knowledge
- Identify embedded options

Value of Successive New Product Development Phases



Uncertainty	100%	80%	50%	30%
Real Option Value	High	High	Low	0
Discounted Cash Flow Value	Negative	Negative	0	Positive

Other Options that can be Modeled

- Option to abandon
- Option to enter new markets
- Synergies with other NPD efforts

Using Real Options to Plan New Business Development

"When the business unit leader comes forward with a business plan,
they have a number of quarterly milestones in terms of market development and profitability.

To the extent that those milestones are met, we deploy more capital resources
toward that business unit. If the market is not developing at the rate that is assumed
in the business plan, we dial it back.

It's more an incremental approach than seeing an opportunity, throwing 2,000 people
and a billion dollars at it, and hoping that the timing's right."

Kieth Stamm

Vice President of Operations

Aquila Corporation

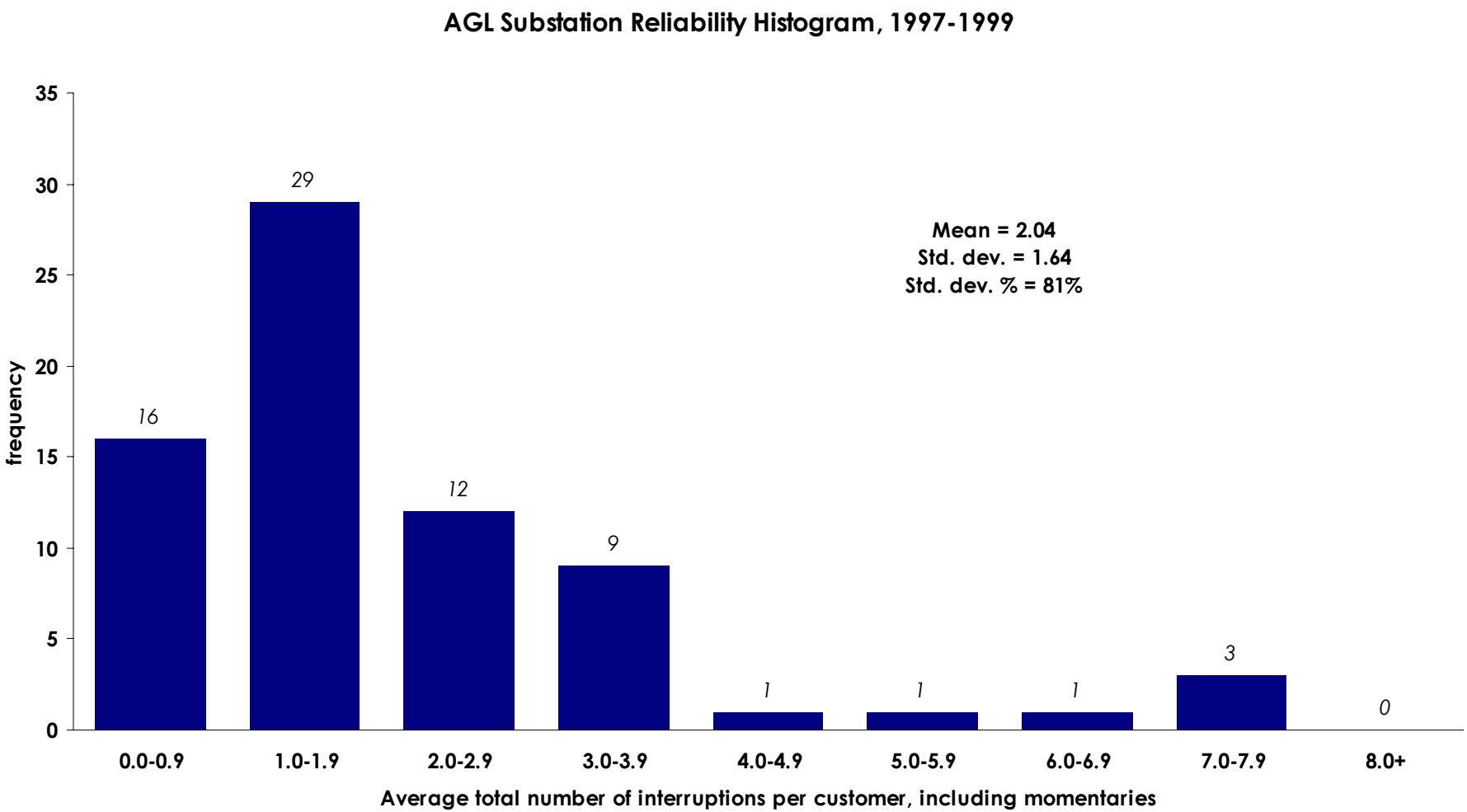
Use of Real Options for Energy Services Product Development

"Xcel Energy is evaluating the use of Real Options to estimate the strategic value of initiatives in our new product portfolio, and to plan investments in product development resources, market research, pilots and market trials.

By using real options with a structured new product development process, this technique is invaluable for estimating the appropriate investments in successive development phases, and to ensure that we risk only the amount of money justified by the sum of the economic value derived from discounted cash flow analysis and the strategic value derived from real options analysis."

Doug Jaeger
Vice President of Sales and Marketing
Xcel Energy Corporation

Substation Reliability Volatility



American Superconductor Stock Price Volatility

Why should real options be used for valuation of energy storage?

- Accounts for the value of project deferral
- Traditional DCF techniques don't account for managerial flexibility
- Quantifies the value of better information-including measured reliability and power quality data
- Better estimates of the value of successive project phases
- Electric industry is changing rapidly – increased value in options
- Highly volatile value drivers result in high systemic risk

Q&A

Reading List

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