

Solving for Project Risk Management: Understanding the Critical Role of Uncertainty in Project Management

by

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GALORATH



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IT'S ALWAYS RISKIER THAN YOU EXPECT

EVEN TAKING INTO ACCOUNT IT IS RISKIER THAN YOU EXPECT!

COMPUTER CHESS



Computer programs were first developed in the 1950s
Belief was that, in ten years, a computer program would be able to defeat the world champion
This prediction was continually updated to be ten years away
Did not occur until the 1990s

HOFSTADTER'S LAW

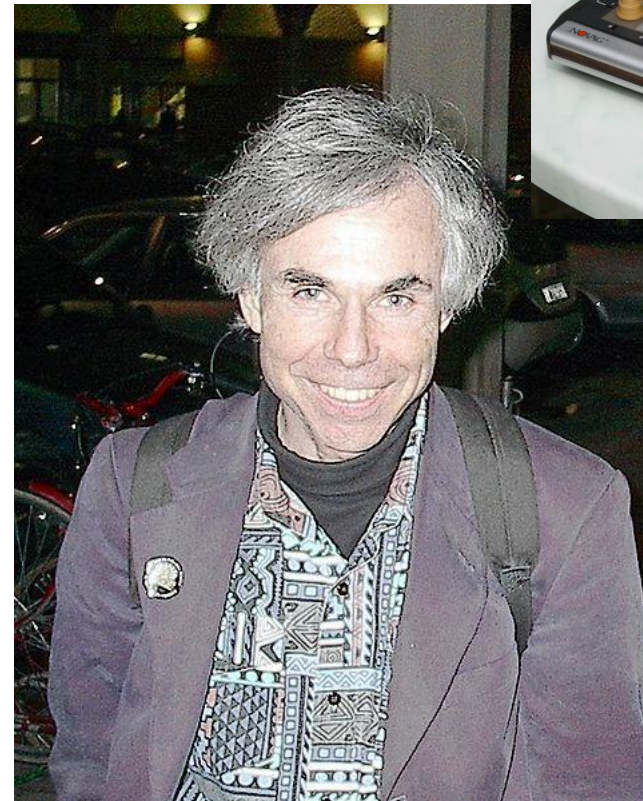


Inspired by this example, the cognitive scientist Douglas Hofstadter coined the recursive and eponymous Hofstadter's Law:
If always takes longer than you expect, even when you take into account Hofstadter's Law

CONNECTION WITH COST AND RISK



As time is money, Hofstadter's Law applies to cost
Entropy is the general tendency towards disorder in the universe – more can (and does) go wrong than go right
Due to entropy, a similar law applies to risk



PROJECT RISK MANAGEMENT

OPPORTUNITY IN RISK

PROJECTS ARE INHERENTLY RISKY

Projects of all types, large and small, experience regular amounts of significant cost and schedule growth

This growth is strong evidence not only of risk, but lack of proper risk management

Risk is often considered just another a four-letter word

QUANTITATIVE RISK ASSESSMENT

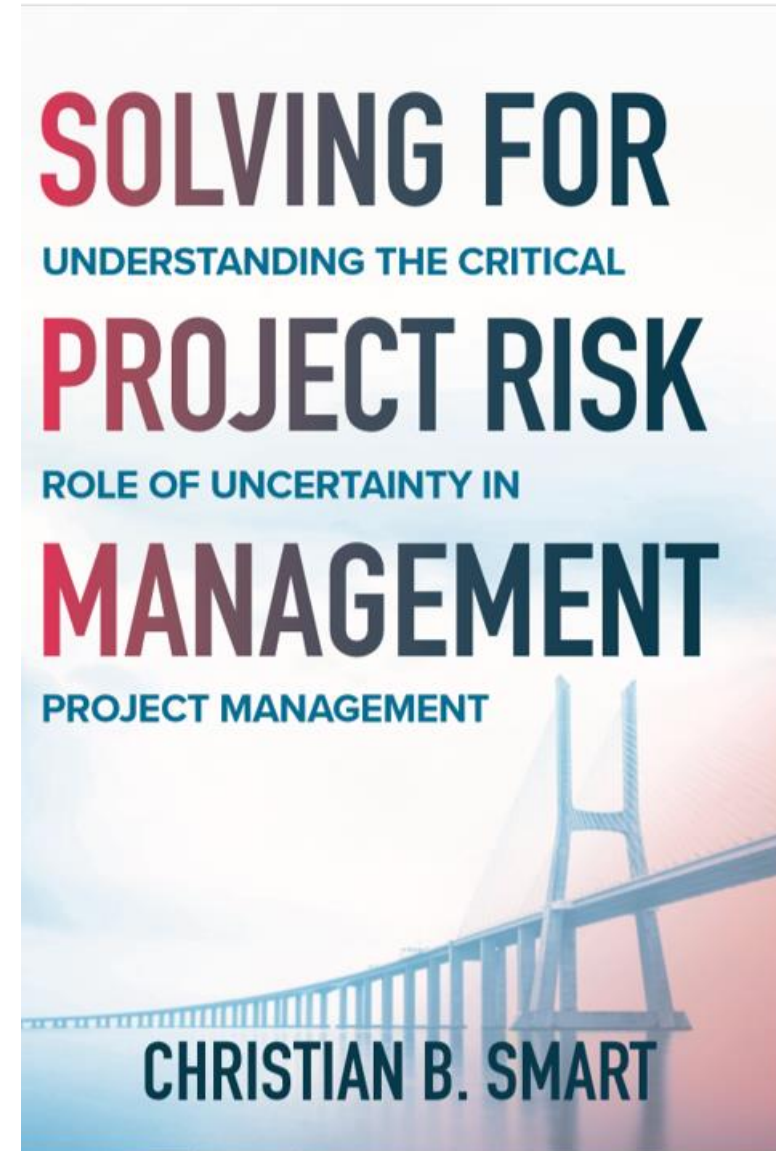
Projects need to conduct quantitative cost and schedule risk analysis

The application of quantitative methods is fraught with obstacles

HOW TO DO IT BETTER

This book, written for a general project management audience, discusses these problems and prescribes solutions

There is the opportunity to achieving a competitive advantage by adopting credible risk management practices



Available now for pre-order on Amazon:

<http://tiny.cc/j7xbpz>

HIGH COST AND SCHEDULE GROWTH

Cost and schedule growth is universal across all types of projects – it is frequent, high, and extreme

WHY COST AND SCHEDULE GROWTH OCCUR

Cost and schedule growth occur for a multitude of reasons – we discuss a few and provide examples

THE QUANTITATIVE RISK MANAGEMENT IMPERATIVE

Averages are not enough, nor are qualitative methods – quantitative risk assessment is a must, not just a nice to have

COVERED WITH OIL: REALISM IN RISK ANALYSIS

Even when risk is measured, it is unrealistically low

AGENDA



THE PORTFOLIO EFFECT AND THE FREE LUNCH

Funding for government systems relies on a portfolio effect, which like a “free lunch,” does not exist

HERE BE DRAGONS – CONSIDERING THE RIGHT TAIL IN RISK MANAGEMENT

Risk measurement does not typically incorporate the right tail, which is where the risks we want to guard against lurk (“dragons”)

TRYING TO DO TOO MUCH WITH TOO LITTLE

Portfolio management is not conducted consistently Results in organization shooting themselves in their own proverbial foot due to trying to fund too many programs with too few dollars

THINKING STRATEGICALLY

A little strategic thinking could go a long way – incentives can achieve better outcomes

Poll: Is uncertainty analysis a crucial step in the development of a credible estimate?

COST AND SCHEDULE GROWTH

A LEGACY OF DISASTER

	Olympics	Software/ IT	Dams	NASA/ DoD	Rail	Bridges/ Tunnels	Roads
Average Cost Growth	156%	43-56%	24-96%	52%	45%	34%	20%
Frequency of Occurrence	10/10	8/10	8/10	8/10	9/10	9/10	9/10
Frequency of Doubling	1 in 2	1 in 4	1 in 5	1 in 6	1 in 12	1 in 12	1 in 50
Average Schedule Delay	0%	63-84%	27-44%	27-52%	45%	23%	38%
Frequency of Schedule Delay	0/10	9/10	7/10	9/10	8/10	7/10	7/10

1

COMMON

Multiple Industries Experience Significant Cost and Schedule Growth – Has Been a Problem for a Long Time

2

FREQUENT

70-80% of Projects Experience Cost and Schedule Growth

3

HIGH

Cost: 50% or More on Average (Mean)
Schedule: 30% or More on Average (Mean)

4

EXTREME (FOR COST)

Cost Growth in Excess of 100% Is a Common Occurrence in Most Projects (1 in 6)

Why Cost and Schedule Growth Occur

Numerous Reasons, Both Internal and External:

- Optimism
- Cost, Schedule, and Technical Misalignment
- Errors in Estimation
- Moore's Law
- Black Swans

“The Non-Secret of Good Cost [and Schedule] Estimating: Don't Drink the Kool-Aid” - Lawrence Goeller, OSD Cost Analysis Improvement Group

1

OPTIMISM

Innate bias - Planning Fallacy
Prospect Theory - Project managers are risk-seeking

2

COST, SCHEDULE, TECHNICAL MISALIGNMENT

Like a three-legged stool, all need to be consistent in order for a project to balance

3

MOORE'S LAW

Exponential growth in technology
Paired with projects that take a decade or longer to complete means that either requirements are continually updated or the product is obsolete on delivery

4

BLACK SWANS

Unpredictable, rare, unprecedented events that have a huge impact

5

LAKE WOBEGON

Project managers and their staff are not like the children of Garrison Keillor's fictional town – they are not all above average

SOFTWARE DEVELOPMENT EXAMPLES



PHOENIX FEDERAL PAY SYSTEM

Incorporated COTS elements, intended to save money; bug in system underpaid civil servants, cost billions to fix



HEALTHCARE.GOV

Agile project; system was rolled out before it was ready; technical issues, not designed to handle the expected number of users; required billions to fix



DENVER AIRPORT BAGGAGE SYSTEM

Poor planning, aggressive schedule, and technical complexity caused this project to delay the new airport's opening and was ultimately cancelled



FOX MEYER ERP

\$5 billion pharmaceutical wholesale giant went bankrupt trying to implement an ERP system

COST AND SCHEDULE RISK IMPERATIVE

1

RISK IS A MUST, NOT AN OPTION

High degree of cost and schedule growth in completed projects means that there is a great deal of resource risk

2

MORE THAN JUST AVERAGES

It is not sufficient to develop a single point estimate of cost or schedule
“Projects that are based on averages are, on average, behind schedule and beyond budget.” – Sam Savage, *The Flaw of Averages*

3

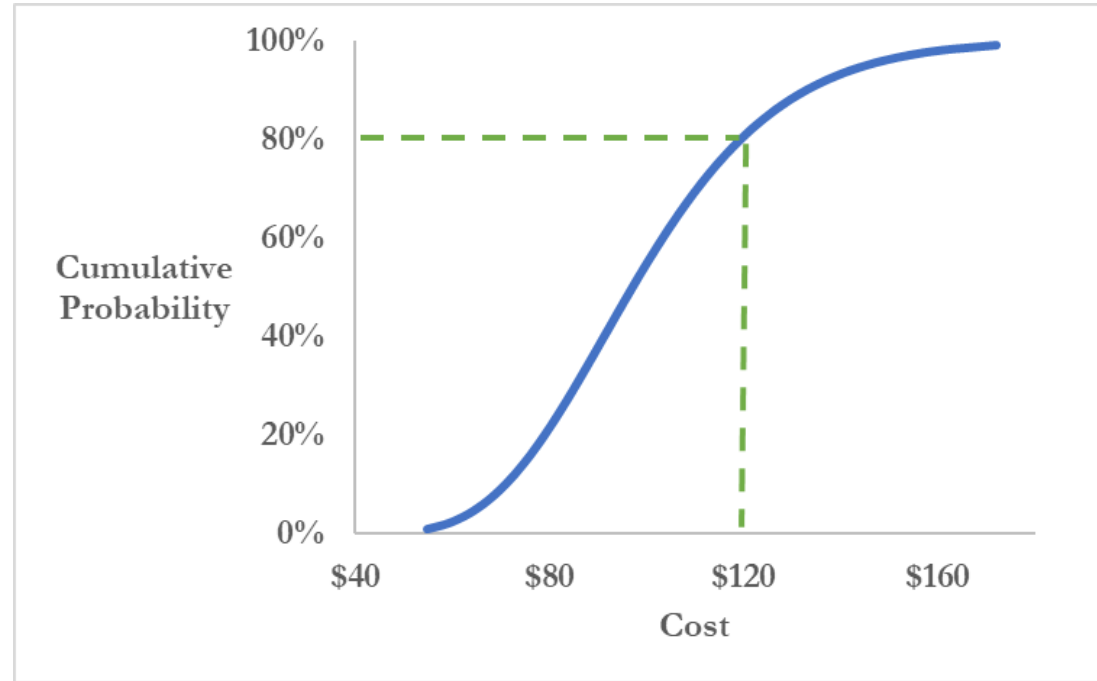
NEEDS TO BE QUANTITATIVE

Qualitative risk assessment results in significant underestimation of risk
Need to move beyond the risk matrix and robustly assess cost and schedule risk with a quantitative analysis

4

S-CURVES

Cost and schedule risk are typically displayed graphically as “S-curves”
Provides probability that cost/schedule will not exceed a specified value



“Repent, while there is still time.”
Stephen A. Book,
Ph.D.

Poll: Have you conducted a quantitative cost or schedule risk analysis for a project?

TRACK RECORD FOR RISK ANALYSIS

WORSE THAN RANDOM

Project	Cost Growth	Ratio of Actual Cost to 90% Confidence Level
1	0%	0.6
2	19%	1.1
3	31%	1.0
4	32%	1.1
5	greater than 45%	greater than 1.0
6	52%	1.5
7	84%	1.7
8	93%	1.6
9	121%	2.0
10	280%	2.2

It's hard to improve if you don't know how well you have done in the past.

1

SCARCE

The results of risk analysis are rarely compared to the actual outcome – like a darts player that turns away from the board after throwing a dart

2

WHAT LITTLE EXISTS IS NOT GOOD

The limited data available is mainly for cost

The 90 percent confidence level means there is only a 10% probability that this level will be exceeded

3

OPPOSITE OF EXPECTED

However, for the 10 risk analyses in the table, for only one was the actual cost less than the 90 percent confidence level

4

EXTREMELY UNLIKELY

While a small data set, the odds of such an occurrence is extremely remote – 1 in 2.7 million

You are more likely to be struck by lightning

COVERED WITH OIL: REALISM IN RISK ANALYSIS

1

“ALL OF THOSE TOURISTS COVERED WITH OIL”

Jimmy Buffett, in writing the song Margaritaville, probably never imagined that beach goes would be covered with crude oil
Gulf of Mexico oil spill in 2010 set records

RISK UNDERESTIMATION IS PREVELANT

Variety of reasons – correlation, overreliance on normal distribution, etc.

We do not have a good track record of estimating risk

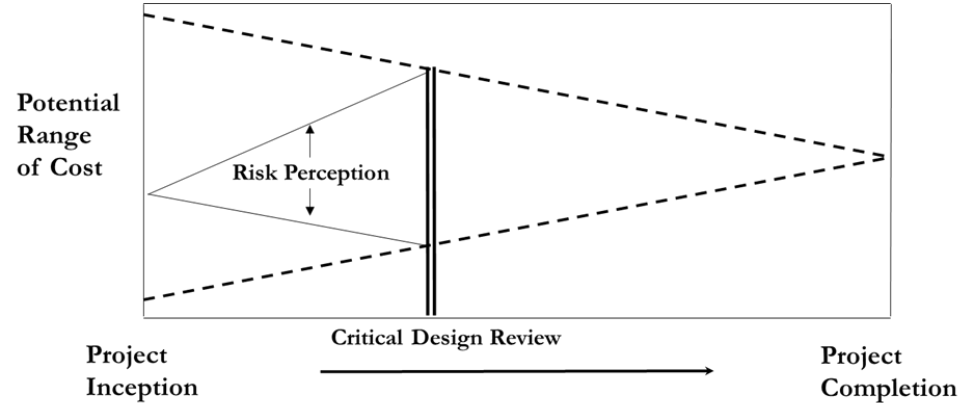
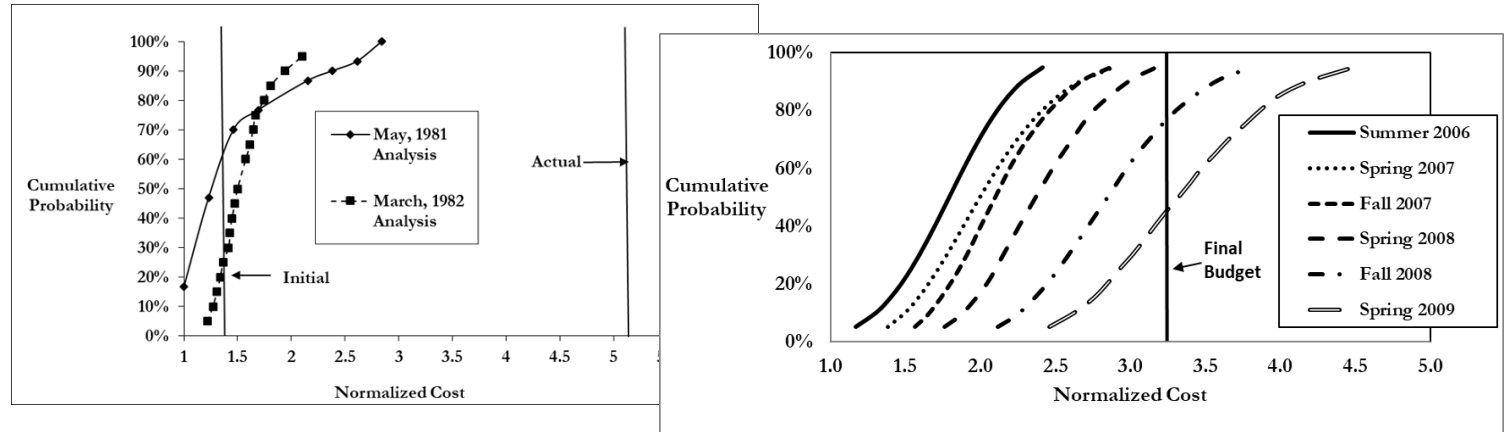
PERCEPTION VS. REALITY

Plato Vs. Diogenes

Home Economicus and the Iron Bowl
Notion is risk decreases over time, but actually risk perception increases up to critical design as risks are discovered/admitted, and then decreases as these risks are addressed

CALIBRATION IS THE ANSWER

Can calibrate cost risk analyses to historical cost and schedule growth
Provides a cross check on the realism of quantitative risk analyses



It is always riskier than you think, even taking into account that it is riskier than you think.

Poll: If you have done a quantitative risk analysis, which distributions have you used? Select all that apply.

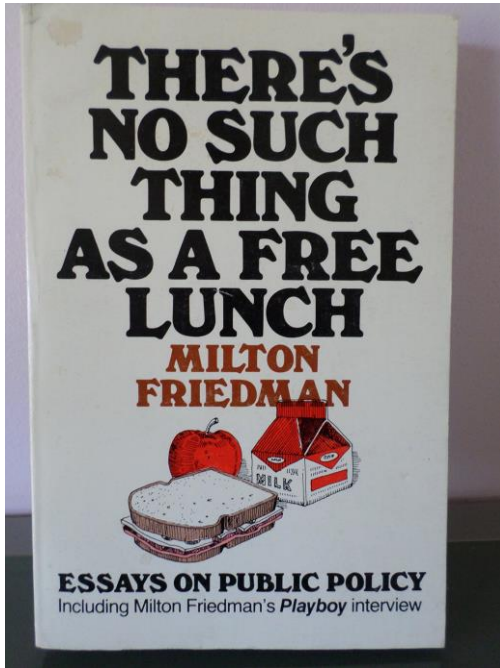
- a. Triangular
- b. Gaussian
- c. Lognormal
- d. Other

2

3

4

THE PORTFOLIO EFFECT AND THE FREE LUNCH



***Economics in nine words –
There ain't no such thing as
a free lunch.***

1

JIM CRAMER – “MAD MONEY”

Describes diversification as the only free lunch on Wall Street

But as economist Milton Friedman was fond of saying “There’s no such thing as a free lunch.”

2

PORTFOLIO EFFECT

Notion that you can fund to a low confidence level for individual projects but achieve high confidence for the portfolio

Example – fund 10 individual programs to ~60% confidence level to achieve 80% confidence for the total portfolio

3

HYPOTHESIS VS. REALITY

When you incorporate realistic assumptions, the portfolio effect vanishes

Even possible to have a negative portfolio effect

4

DEVIL IS IN THE TAILS

When funding to percentiles, it is always at the 80% confidence level or below

This is not in the tails – real risks are at the 90-95% confidence levels and above

1

A NOBEL IDEA

Harry Markowitz pioneered the idea of the benefits of diversification
Led to the notion of trading risk with reward

2

THEORY VS. REALITY

Prior to Markowitz, diversification was frowned upon on Wall Street
Highly successful investors like Warren Buffet only hold a few investments at a time

3

INVESTING IN JUNK

Michael Milken sold investors on the idea that if you invest in enough high-risk investments, your overall investment is not risky

This approach led to the failure of Executive Life Insurance Company in 1990

4

SKEWED RISKS

More can go wrong than go right - entropy

Funding below the mean leads to a negative portfolio effect – adding programs increases risk of overrunning total budget

THE BENEFITS OF DIVERSIFICATION DEPEND ON RISK VS. REWARD



Poll: Does your organization conduct portfolio risk analysis?

- a. Yes
- b. No

“Behold the fool saith, ‘Put not all thine eggs in the one basket’ - which is but a manner of saying, ‘Scatter your money and your attention;’ but the wise man saith, ‘Put all your eggs in the one basket and -WATCH THAT BASKET.’”

- Mark Twain

HC SVNT DRACONES



Hunt-Lenox Globe is one of the oldest known still in existence



Contains the Latin phrase “HC SVNT DRACONES” (Here Be Dragons) near the eastern coast of Asia



Represents unknown areas, which have risk and uncertainty

HERE BE DRAGONS – CONSIDERING THE RIGHT TAIL IN RISK MANAGEMENT

1

CONFIDENCE LEVEL FUNDING IS FLAWED

Only measures risk

Does not provide any risk
management

Consequence of extreme events is
ignored

2

PASCAL'S WAGER

Consequence vs. likelihood

Even if perceived likelihood of God's
existence is low, consequence of
unbelief if He exists is huge

Rational bettor should bet on God

3

THE LOGNORMAL PARADOX

Lognormal is riskier than the
overused "normal" distribution

When funding to low levels (below
84% confidence level), "normal"
appears riskier than the lognormal

4

BEYOND S-CURVES

Confidence levels do not take tail risks
into account

Coherent measures of risk take into
account tail risk and provide risk
management

Examples – Expected Shortfall, Semi-
Deviation



Image: Courtesy of the James Ford Bell Library

Poll: To what risk
measure does your
organization fund
projects?

- a. Mean
- b. 50th Percentile
- c. 80th Percentile
- d. Other
- e. N/A

**Funding to the 80th percentile is
like playing Russian Roulette –
consequence is more important
than likelihood.**

TRYING TO DO TOO MUCH WITH TOO LITTLE



“We have met the enemy and he is us” cartoon character Pogo, by Walt Kelly

1

TRAFFIC JAMS

Traffic jams in big cities are often caused by too many cars on the road at peak times (rush hour)

2

TOO MANY PROJECTS

Trying to fund too many projects with limited information is like too many vehicles on the road

Organizations start new programs with little money but as they progress they need more funds
Cheaper to conceive a child than to raise one

3

RESULT – COST AND SCHEDULE GROWTH

Too many programs cause funding constraints
Funding constraints cause schedule delays, resulting in cost growth

4

PORTFOLIO MANAGEMENT

There is a critical need for portfolio risk management
Rarely done at all

THINKING STRATEGICALLY

1

MONEY ALLOCATED IS MONEY SPENT

Writing a contract to a high confidence level will lead to all the funds getting spent

Need to hold some of the funding in reserve

Perverse incentives in cost-plus contracts

2

ASYMMETRY OF INCENTIVES AND INFORMATION

Hidden information

Incentive for contractor but none for government ("skin in the game")

3

MONOPOLY IN PRODUCTION

Government does not purchase data rights, so system developer is a monopoly producer

Leads to higher cost and lower quantities – deadweight loss

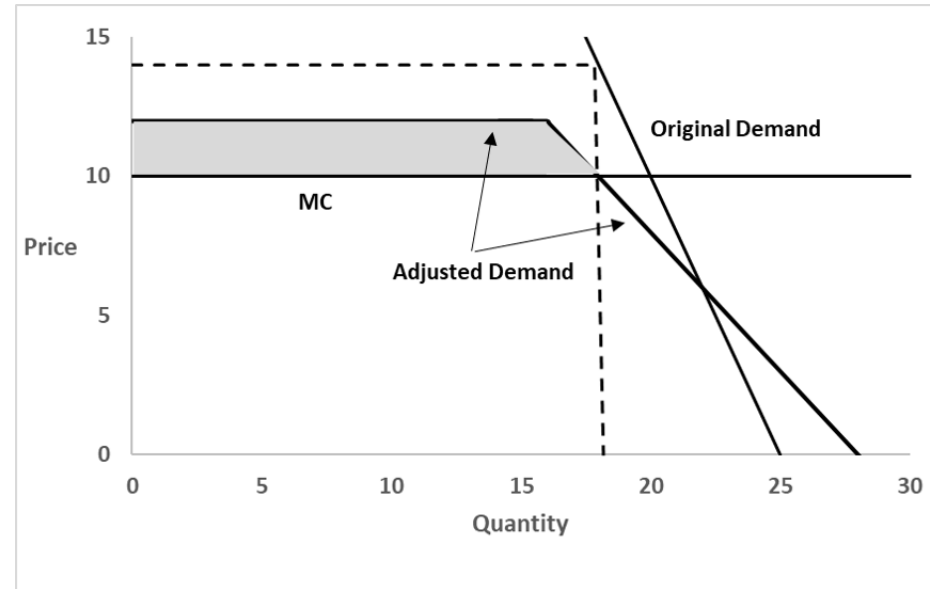
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MECHANISM DESIGN

Turns game theory on its head

Design game to achieve desired outcomes

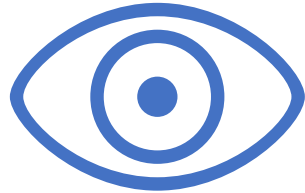
Can be used to achieve lower prices and higher quantities in bargaining with monopoly



“There is ... all the difference between deliberately creating a system within which competition will work beneficially as possible and passively accepting institutions as they are.” Friedrich Hayek, The Road to Serfdom

WHAT CAN BE DONE

THREE KEYS TO SUCCESS



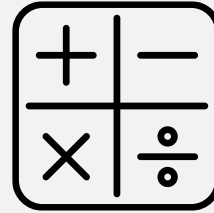
1: RECOGNIZE THE PROBLEM

Recognize that lack of planning for risk leads to hinders projects success

Don't plan for best case

Realize that you are prone to biases such as optimism – don't drink the Kool-Aid!

Look for independent and critical input



2: MEASURE RISK MORE ACCURATELY

Recognize that risk is underestimated, especially early in planning

Quantitative risk measurement is a necessity – matrices and qualitative methods are not enough!

Use methods such as calibration to ensure realism

Measure risk coherently – S-curves are not sufficient! Take the right tail into account



3: MANAGE RISK EFFECTIVELY

Projects need to manage risk, not just measure it

Need a measure of risk plus ways to address significant growth

Calculate risk at the portfolio level

Assess the impact of potential new missions over a long time frame

Think strategically

Projects must do things differently in risk management if they want to be more successful

ABOUT THE AUTHOR

- Chief Scientist with Galorath Federal
- Former Cost Director for Missile Defense Agency
- Twenty years of experience with cost and schedule risk analysis, predictive analytics, probabilistic reliability analysis, and machine learning
- Exceptional public service medal from NASA
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