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

by

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**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:
*It 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.
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 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.
COVERED WITH OIL: REALISM IN RISK ANALYSIS

Even when risk is measured, it is unrealistically low.

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.

WHY COST AND SCHEDULE GROWTH OCCUR

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

HIGH COST AND SCHEDULE GROWTH

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

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?

THE PORTFOLIO EFFECT AND THE FREE LUNCH

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

Image Source: James Ford Bell Library

Poll: Is uncertainty analysis a crucial step in the development of a credible estimate?
COST AND SCHEDULE GROWTH

A LEGACY OF DISASTER

<table>
<thead>
<tr>
<th>Common</th>
<th>Frequent</th>
<th>High</th>
<th>Extreme (For Cost)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple Industries Experience Significant Cost and Schedule Growth – Has Been a Problem for a Long Time</td>
<td>70-80% of Projects Experience Cost and Schedule Growth</td>
<td>Cost: 50% or More on Average (Mean) Schedule: 30% or More on Average (Mean)</td>
<td>Cost Growth in Excess of 100% Is a Common Occurrence in Most Projects (1 in 6)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Olympics</th>
<th>Software/IT</th>
<th>NASA/DoD</th>
<th>Rail</th>
<th>Bridges/Tunnels</th>
<th>Roads</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Cost Growth</td>
<td>156%</td>
<td>43-56%</td>
<td>24-96%</td>
<td>52%</td>
<td>45%</td>
</tr>
<tr>
<td>Frequency of Occurrence</td>
<td>10/10</td>
<td>8/10</td>
<td>8/10</td>
<td>9/10</td>
<td>9/10</td>
</tr>
<tr>
<td>Frequency of Doubling</td>
<td>1 in 2</td>
<td>1 in 4</td>
<td>1 in 5</td>
<td>1 in 6</td>
<td>1 in 12</td>
</tr>
<tr>
<td>Average Schedule Delay</td>
<td>0%</td>
<td>63-84%</td>
<td>27-44%</td>
<td>27-52%</td>
<td>45%</td>
</tr>
<tr>
<td>Frequency of Schedule Delay</td>
<td>0/10</td>
<td>9/10</td>
<td>7/10</td>
<td>9/10</td>
<td>7/10</td>
</tr>
</tbody>
</table>

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


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 WOBECON**
   - Project managers and their staff are not like the children of Garrison Keillor’s fictional town – they are not all above average
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?
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.

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—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.

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.

It’s hard to improve if you don’t know how well you have done in the past.
“ALL OF THOSE TOURISTS COVERED WITH OIL”

Jimmy Buffett, in writing the song Margaritaville, probably never imagined that beachgoers 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.
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.”

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

HYPOTHESIS VS. REALITY

When you incorporate realistic assumptions, the portfolio effect vanishes
Even possible to have a negative portfolio effect

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

Economics in nine words – There ain’t no such thing as a free lunch.
A NOBEL IDEA
Harry Markowitz pioneered the idea of the benefits of diversification
Led to the notion of trading risk with reward

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

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

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

“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

Poll: Does your organization conduct portfolio risk analysis?
- Yes
- No
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

CONFIDENCE LEVEL FUNDING IS FLAWED
Only measures risk
Does not provide any risk management
Consequence of extreme events is ignored

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

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

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

Poll: To what risk measure does your organization fund projects?
- a. Mean
- b. 50th Percentile
- c. 80th Percentile
- d. Other
- e. N/A

Image: Courtesy of the James Ford Bell Library

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
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

ASYMMETRY OF INCENTIVES AND INFORMATION
Hidden information
Incentive for contractor but none for government (“skin in the game”)

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

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

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