The Other RCA:
Restaurant Cost Analysis

ICEAA Conference, Cost Management Track

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Peter Braxton, Technomics

Technomics
The Science of Informed Decision Making

Abstract

The Weapon Systems Acquisition Reform Act (WSARA) of 2009 highlighted the importance of Root Cause Analysis, or RCA, but its conduct remains shrouded in mystery. In illustrating the central role of risk and uncertainty analysis in cost, Dick Coleman often made the provocative pronouncement to the effect of "You can't stand outside a restaurant with a menu, and the people you'll be dining with, and a calculator and get within 10% of the final bill, so what makes you think you can estimate a complex multi-billion-dollar acquisition program with that precision?!" In a perennially popular training session, Eric Druker uses dinner out with his boss as an evocative example of Monte Carlo simulation. Shamelessly borrowing from those two, this paper presents the accessible analogy of restaurant cost analysis using a readily available source real data, namely the author's extensive – much to his wife's chagrin! – collection of restaurant receipts, to clearly explicate the principles and conduct of RCA.

RCA aims to separate deterministic from probabilistic causes for variation in cost (usually growth) from initial estimates. More than just a "post mortem," it seeks to infer lessons learned (or Dr. Tzee-Nan Lo's more apt "lessons to be learned"), which can possibly be translated into mitigation strategies for future risk management. (In the spirit of the Serenity Prayer, program managers must know which decisions they can make, which external decisions they can lobby to influence, and which factors are simply beyond their, or perhaps anyone's, control.) Effective RCA requires access to the cost model itself, preferably incorporating uncertainty and as it evolved over time, and the inputs thereto. Thus, we need to know not just what the diners ordered, but the entire menu, capturing the range of possible inputs and outputs. This relates to Dr. Christian Smart's notion of a progression of conditional estimates. Also essential for RCA are well-defined growth categories and an accompanying order of operations.

The potential for analogies within this framework are virtually limitless. The courses of the meal are life-cycle phases. The basic commodity is the type of meal (breakfast, brunch, lunch, happy hour, dinner), and sub-type is context (family meal, date, group travel, solo travel). The type of restaurant represents the stringency of requirements. Number of diners is quantity, and acquisition strategy is reflected in a la carte vs. prix fixe, and the use coupons or frequent diner programs. And so on.

No analogy is perfect, and the paper will briefly touch on the dissimilarities between the two RCAs. Primarily, restaurants reflect more of a fixed-price environment, where the multitude of meals and diners enables invoking the law of large numbers, with variations in cost priced in to the offerings, assuming financial solvency, which is hardly a certainty in the restaurant business! By contrast, defense acquisition is typified by a cost-reimbursable environment and specialized industrial base often verging on monopoly/monopsony. Still, if this level of insight can be gained by an individual analyst using his own personal data, certainly it is achievable by a well-funded acquisition program.

Acknowledgments

- Many thanks to:
  - Dick Coleman, for the Laws of Restaurants, and a lifelong love of analogies
  - Eric Druker, for Monte Carlo simulation of dinner out with the boss, and a zeal for doing things better
  - Dr. Tzee-Nan Lo, for the notion of Lessons to be Learned
  - Dr. Christian Smart, for the notion of conditional S-curves
  - My wife, for putting up with a drawer or two full of receipts!

The Point of Restaurant Cost Analysis

- To provide an accessible analogy for understanding Root Cause Analysis (RCA)
  - Similar data requirements
  - Similar approaches
  - Similar challenges
- To illustrate that some real data (and the determination to document, normalize, and analyze them fully) can go a long way
- To have a little fun!

Outline

- Root Cause Analysis (RCA)
- The Restaurant Analogy
- Restaurant Cost Analysis Framework
- The (Author's) Data
- Examples and Results
- Application to RCA
- Conclusion

Root Cause Analysis (RCA)

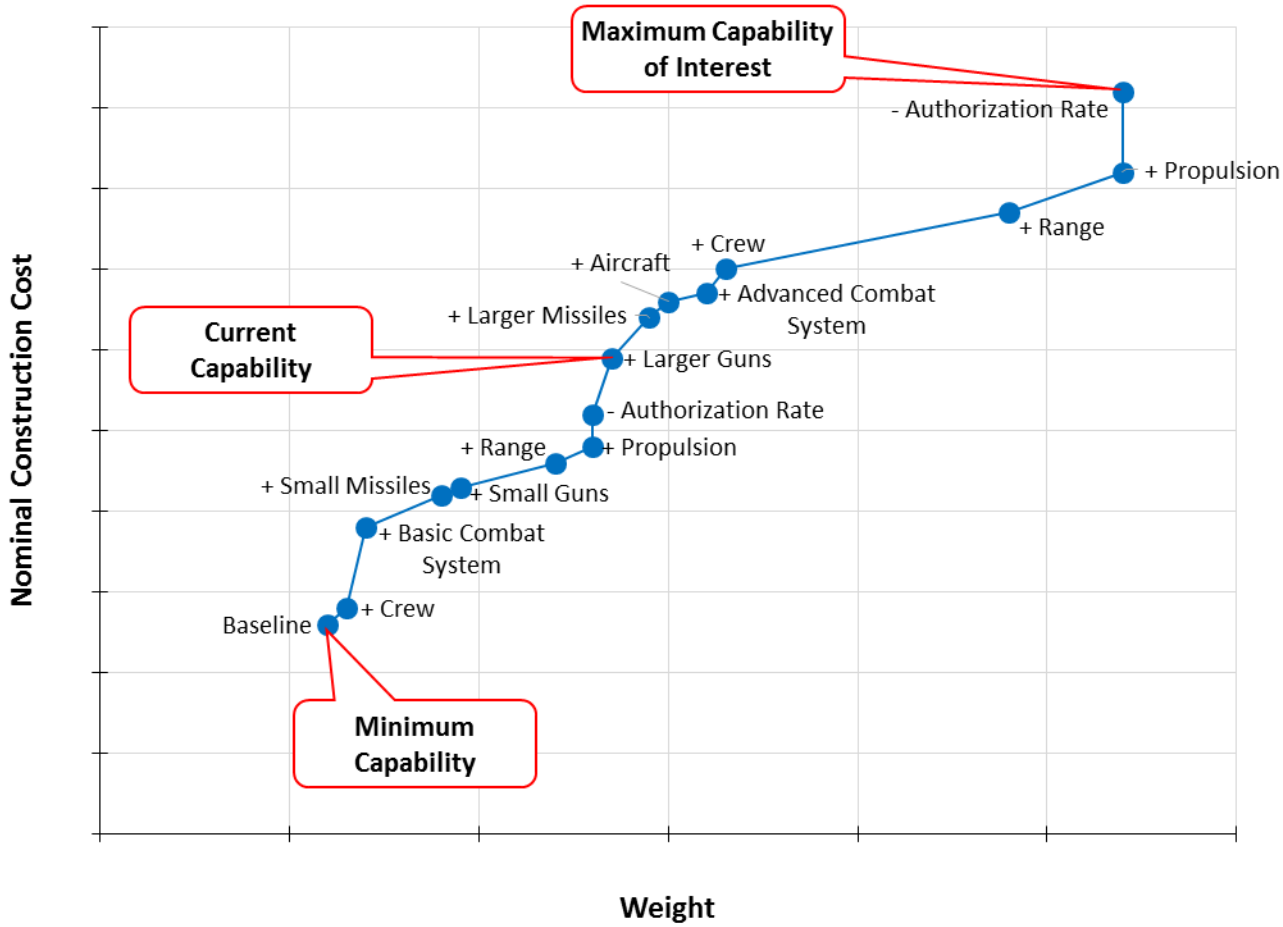
- Weapon Systems Acquisition Reform Act (WSARA) of 2009
  - Established Office of Performance Assessments and Root Cause Analyses (PARCA)
- Several RCA status briefs at DoDCAS 2012

	Programs											
Inception Issues	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**
Unrealistic cost or schedule estimates				X		X			X	X	X	
Immature technology, excessive manufacturing, integration risk												
Unrealistic performance expectations		X										
Other									X			
Execution Issues												
Change in procurement quantity				X	X			X				
Inadequate funding/funding instability												
Unanticipated design, engineering, manufacturing or technology issues	X											
Poor performance			X			X	X		X		X	X
Other												

"Observations from AT&L/PARCA's Root Cause Analyses," David Nicholls, DoDCAS, 2012

Walk-About Chart Example (PBCM)

- PBCM provides a forward-looking (design) walk-bout
- RCA provides a backward-looking walk-about



"Relating Cost to Performance: The Performance-Based Cost Model," Michael Jeffers, Anna Irvine, Robert Nehring, Robert Jones, Kelly Meyers, Jean-Ali Tavassoli, ICEAA, 2014

Key Drivers of Cost

Roughly descending order of importance/impact

1) Requirements
2) Capability
3) Decisions
4) Random Chance*
5) Incentives

The true impact of "Management"

Author's opinion!

*Includes both truly random factors and those which behave as random based on our (lack of) ability to model

The Restaurant Metaphor

- Simple case of meeting a known need at a known price…how hard can it be?

> "You can't stand outside a restaurant *with* a menu, *with* prices, *and* the people you'll be dining with, *and* a calculator and get within 10% of the final bill!"

Dick Coleman (attributed)

- What makes you think you can estimate a complex multi-billion-dollar acquisition program with that precision?

Key Components of RCA

- Requirements
  - Translated into Technical and Programmatic Inputs
- Ground Rules and Assumptions
- Cost Model (with Risk)
- Context/Narrative
  - The goal is to "tell a story" without spinning a tale!

All are needed over time, with changes tracked!

SAR Cost Growth Categories

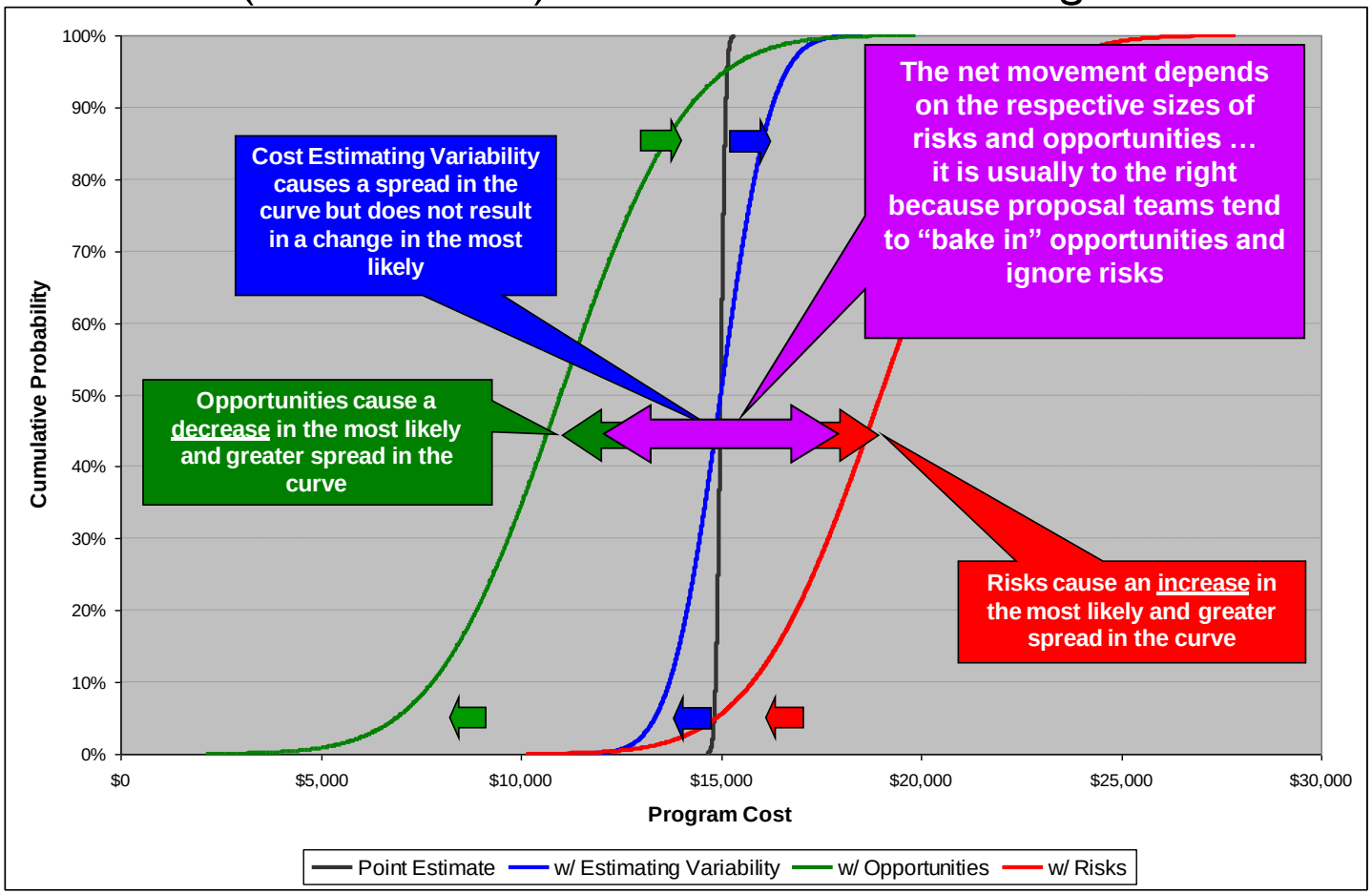
- Economic – change in OSD inflation indices
- Quantity – change in # of Dev/Prod units
- Schedule – change in time-phasing
- Engineering – change in functional characteristics
- Estimating – change in cost estimate
- Other – unusual risks
- Support – change in non-flyaway costs

Version 1.0 SAR Data Entry Instructions, Revision 1.4, 06/28/2011, pp. 153-156, Defense Acquisition Management Information Retrieval (DAMIR), http://www.acq.osd.mil/damir/documents/SAR_Data_Entry_Instructions.pdf

Estimating typically gets "blamed" for realization of random variation in sunk costs

S-Curves and Shaping Forces

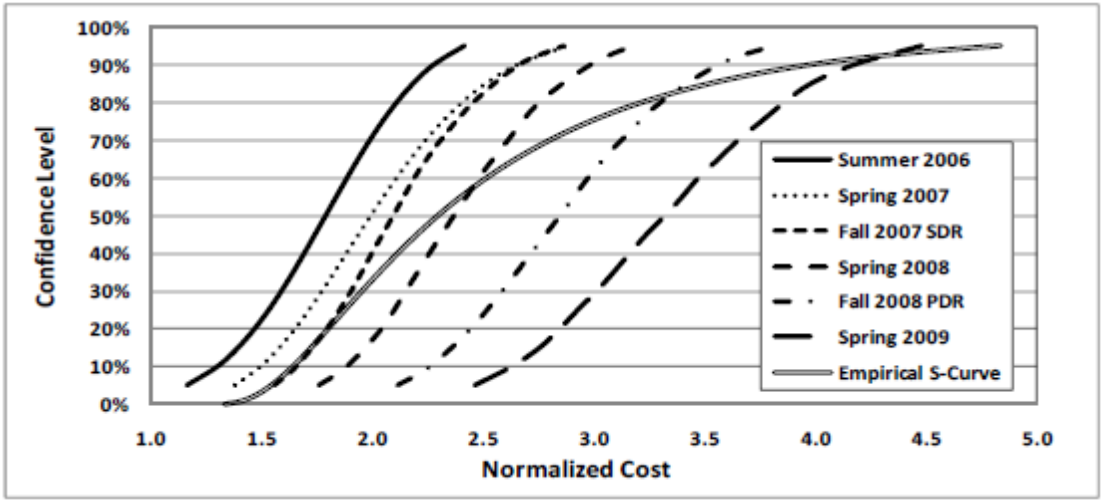
- All Risk is relative!
  - Whether risks and opportunities are "baked in" affects the point estimate, but the ideal (unconditional) S-curve should not change



"S-Curves and Risk," R.L. Coleman, P.J. Braxton, E.R. Druker, Northrop Grumman Contracts, Pricing, and Supply Chain Conference, 2008.

Conditional S-Curves

- Dr. Christian Smart introduced the idea of conditional S-curves to illustrate how markedly depictions of uncertainty can vary:
  - Based on assumptions
  - Over time



"Covered with Oil: Incorporating Realism in Cost Risk Analysis," Christian Smart, Missile Defense Agency (MDA), ISPA/SCEA, 2011.

Restaurant Cost Analysis Framework

- Historical data
  - Receipts
- Requirements
  - Purpose of meal, diners, type of restaurant
- Trade space
  - Menu
- Cost model
  - Conditional and unconditional uncertainty

Restaurant Analogies – Acquisition

- Key Decision Points
  - Milestone A = Going Out to Eat
  - Milestone B = Picking a Restaurant
  - Milestone C = Ordering
- Acquisition Strategy = a la carte vs. prix fixe
- Contract Incentives = tip
- Portfolio Management = sharing meals
- Diminishing Manufacturing Sources (DMS) = out of menu item

Restaurant Analogies – Technical

- Commodity = type of meal
  - Breakfast, brunch, lunch, happy hour, dinner
- Commodity sub-type = context
  - Family meal, date, group travel, solo travel
- Stringency of requirements = type of restaurant
  - Fast food, chain, local, high-end
- ECPs = customizing order
- Rework = sending food back to the kitchen

Restaurant Analogies – Programmatics

- Schedule = duration of meal
- Quantity = number of diners
- Schedule Risk = waiting for a table
- Schedule-driven cost = drinks

Restaurant Analogies – Cost/Risk

- WBS/CES = Courses
- Fee = Tax
- Learning Curve = wife and kids
- Self-fulfilling prophecy = cleaning your plate
- Cost avoidance = taking food home

The (Author's) Data

- 100's of receipts and 100's of credit card charges
  - Partial overlap
- For receipts, itemized costs by appetizer, entrée, side, drinks, dessert, and tax
  - In some cases, itemized receipt not available (e.g., family-owned sushi restaurant) or illegible
- Expert assessment
  - Meals attributed to self, wife, kids, guest(s)
  - Purpose of meal and type of restaurant

Examples and Results

- Solo dinner, rushing to evening program at son's school
  - Burger King near commuter train station; size of meal, ease of eating while driving, taste when cold
- Solo lunch, regular work day, failed to pack lunch
  - Quizno's; Choose Two (variety within budget), sides, forgot to charge for soda
- Family dinner, near the mall
  - Silver Diner; decide whether/which kids meals
- Fancy date with wife
  - 2941; tasting menu, split single wine pairing
- Spreadsheet demonstration (if time)

Application to RCA

- Unconditional Cost/Risk Model
- Vary Requirements over time to create walk-about chart and sequence of conditional S-curves
- Last step is realization of probabilistic outcome
  - "Lucky" or "unlucky"
  - Possible to isolate components, e.g., Inflation

Cost Model RCA

- Actual cost comes in at 99.9th percentile of S-Curve
- Natural conclusion is not that this is a Black Swan, but rather that the S-Curve was flawed
  - That being said, Black Swans do happen – just ask NNT!

The Black Swan, Nicholas Nassim Taleb.

Restaurant Analogy Imperfections

- Restaurants have a robust marketplace
  - Defense acquisition is typically closer to an oligopoly / monopsony
- Restaurants operate in a fixed-price environment
  - Multitude of meals and diners, invoke law of large numbers
  - Variations in cost "priced in" to offerings
  - Assumes profitability (hardly a guarantee!)
  - Defense acquisition is typically Cost Reimbursement
- Similarly, restaurants are essentially commercial off-the-shelf (COTS)
  - Defense acquisition is typically highly developmental

Even with these imperfections,
Restaurant Cost Analysis is vividly illustrative

The Goal of Root Cause Analysis

- Separate deterministic from probabilistic causes for variation in cost from estimates
- Identify "Lessons to be Learned" for:
  - Better acquisition outcomes
  - Better cost and schedule risk estimates
  - …is there a difference?!
- Program Manager's Serenity Prayer
  - Decisions they can make
  - External decisions they can lobby to influence
  - Factors simply beyond their, or perhaps anyone's, control

More than just a "post mortem"

Conclusion

- Get dirty with data
- Beware RCA on a point estimate
- Much easier to document and track as you go than to try to re-create after the fact

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Ideas for Future Research

- Develop a more robust database
- Decomposition of uncertainty