

Time is a Flat Circle



Hilbert's Problems III: The Post-Pandemic Cost Community

ICEAA, San Antonio
Tuesday, May 16th, 2023
Mr. Peter J. Braxton, Technomics, Inc.

Best Paper, Data Science and Timely Topics

The opinions and views expressed herein are my own, culled from observations made during my tenure as a proud member of the cost analysis community. Given the personal nature of the narrative, they are not necessarily shared by any government or industry organization, any employees therein, or any past or current client.

Abstract

The cost community stands at an inflection point. Revolutions in telework, data science, and artificial intelligence are opening doors to never-before collaboration and innovation. Indeed, businesses around the world are testing some of the new, exciting technologies to save time and money, such as automatic image generation, report synthesis, and even automatic composition of reports and e-mails. Rest assured reader that, I, Peter J. Braxton, am writing here, and not a bot – at least not yet!

A word of caution, however. The new tools might *not necessarily* inform us about things we don't know. They're better interpreted as useful in helping us do our jobs better (more efficiently and effectively). There is no short cut to achieving expertise in the discipline of cost analysis. Hard work, study, and hands-on experience will always be required.

At any rate, given the on-going revolution in technical capability, where do we stand now in the community? The time seems particularly propitious to revisit the “*Hilbert's Problems II*” ICEAA paper, after a decade, and reassess the topics of *Professional Identity*, *Cost Estimating Techniques*, *Cost Estimating Implementation*, *Cost and Schedule Risk Analysis*, and *Integration with Other Disciplines*.

This think piece summarizes recent progress in our discipline and presents challenges for future research, in the best tradition of Professor Hilbert, such as exploring the frontiers of digital engineering, Agile software development, AI, and machine learning – and, more specifically, their application to cost analysis.

*“If thou wert my fool, I’d have thee beaten/
Thou shouldst not have been old before thou wert wise.”*

-William Shakespeare, King Lear

Outline

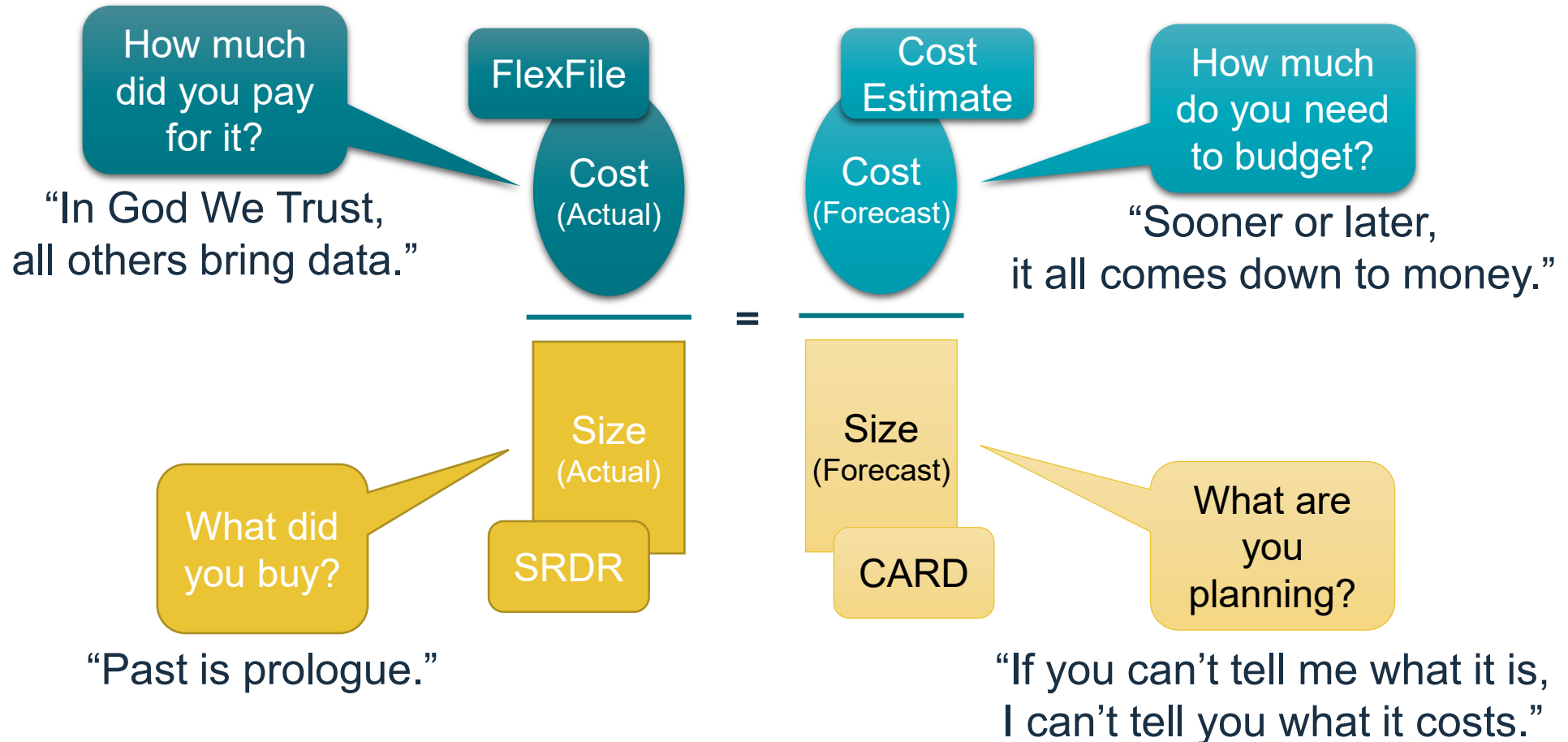
- *Prologue*
- **S**trengths
- **W**eaknesses
- **O**pportunities
- **T**hreats
- *Epilogue*

“Vanity ... Nothing new under the sun”

Ecclesiastes

Cost Analysis in One Picture

- There are three key ingredients to Cost Analysis



“The best laid plans o’ mice and men/ Gang aft agley.”

-Robert Burns, “To a Mouse”

SWOT Analysis for the Cost Community

■ Strengths

- Data
- Visualization
- Prophecy

■ Opportunities

- Digital Engineering and ERP
- Data Management and Data Analytics
- Feedback Loops

■ Weaknesses

- Parochialism
- Identity Crisis
- Conservatism

■ Threats

- “Working” from Home
- Agile and the Death of EVM
- The Next Generation

“Cost Estimating is a Science and an Art ... and a Religion”

-Anonymous

Strengths – A Foundation, a Vision, and a Calling

“In God we trust, all others bring data.”

-W. Edwards Deming,
as cited on the door of then-USD(A&S) Frank Kendall’s office

Data

- *We were “Data” before “Data Science”*
- Contractor Cost Data Reporting (CCDR) dates back to the 1960s
 - Visibility and Management of Operating and Support Costs (VAMOSOC) to the 1970s
- Industrial Engineering (IE) roots of Cost go back to the early days of the Aerospace industry (i.e., 20th century)
- “Never estimate outside the range of the data”
- “Cost is an unrepeatable experiment”
- Population = *all metaphysically possible...*

The Science = Data-Driven Estimating

The Role of Experts

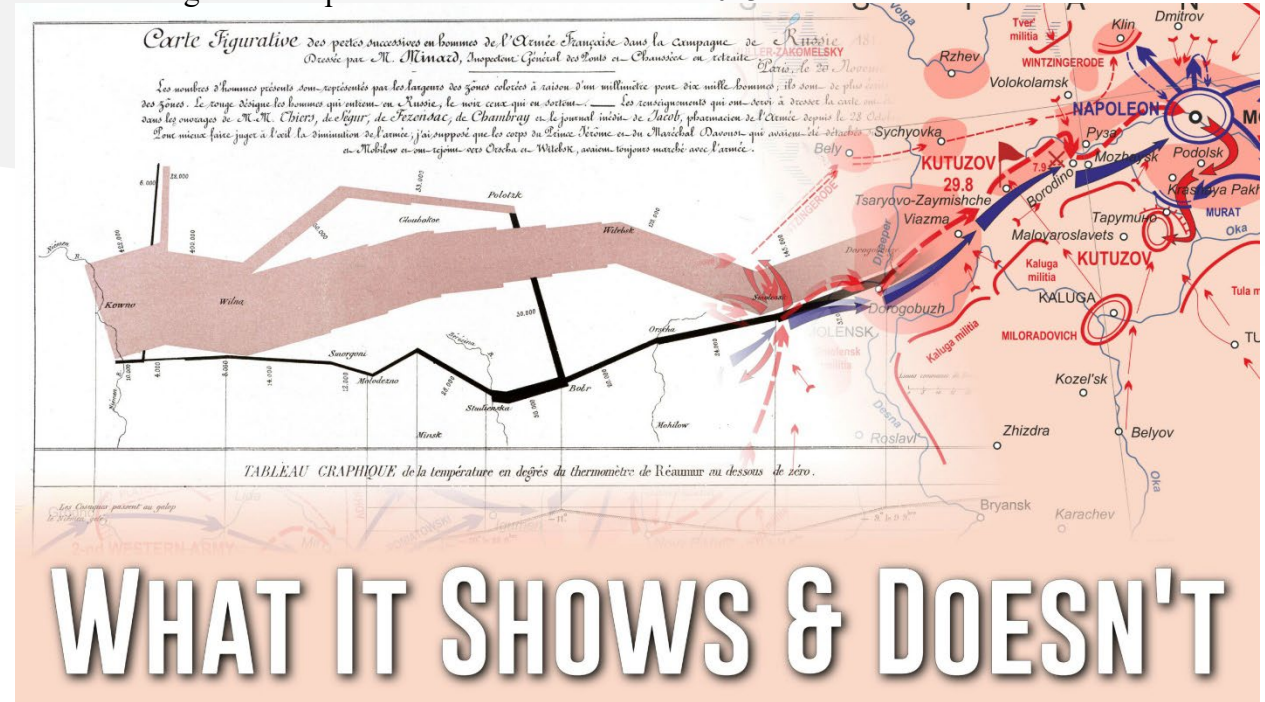
Expert Role	Definition	Mnemonic
Expert Opinion	The estimate springs fully formed from the head of the SME like Athena from the mind of Zeus; no evident basis	"I Reckon"
Expert Testimony	Where accounting and other data systems fail, those who worked historical programs can provide approximate LOE, cost, duration, etc.; aka Anecdotal Actuals	"I Recall"
Expert Judgment	The expert uses domain knowledge and insight into program context to artfully apply data-driven methods; beware cherry-picking!	"I Recommend"

“When we reason about quantitative evidence, certain methods for displaying and analyzing data are better than others. Superior methods are more likely to produce truthful, credible, and precise findings. The difference between an excellent analysis and a faulty one can sometimes have momentous consequences.”

*-Edward R. Tufte, *Visual and Statistical Thinking: Displays of Evidence for Making Decisions*, as cited in CEBoK® Module 6*

Visualization

- Graphs, infographics, tables
 - Conditional Formatting!
- Everybody's got a Dashboard
 - But GIGO still holds
- Convince yourself first...
 - Have a Vision
- ...then convince your stakeholders
 - Share the Vision



The Art = The Gift of Sight

“You can’t handle the truth, counsellor!”

*-Jack Nicholson as Colonel Nathan Jessup, *A Few Good Men**

Prophecy

- “[Cost Estimating] Dies in Darkness”
- In the era of “Fake News” and silver-tongued ChatGPT, whom can you trust?
- We speak for the Data ... with Provenance and Rationale
 - From Documentation to Data Pipelines
 - The Signal and the Noise
- Present *defensible* estimates ... they defend themselves!
- We are the “adversarial ally”
 - The synthesis of optimism (PM) and pessimism (Risk) is *realism*

The Religion = Speaking Truth to Power

Weaknesses – Narrow-Mindedness, Isolationism, and Fear of Change

“You can’t start a fire/ You can’t start a fire without a spark...”

-Bruce Springsteen, “Dancing in the Dark”

“A house divided against itself cannot stand.”

-Abraham Lincoln

Parochialism

- If Cost defines itself too narrowly, it will be balkanized into competing sects
 - We should strive to be more ecumenical
- Different specializations and emphases are inevitable
 - But we should cultivate mutually beneficial partnerships across organizations
 - Just like ISPA and SCEA pre-merger
- In some cases, aligning public and professional interests is way harder than it should be
 - OSD CAPE, DAU, MORS (Cost Analysis and Affordability)

Splinter Groups and Fora

*“I don’t want to blend in and be indistinguishable/
I want to be a part of the different crowd/
And assert my individuality along with the others/
Who are different like me”*

*-King Missile, “Saturday,” *Happy Hour* [1992]*

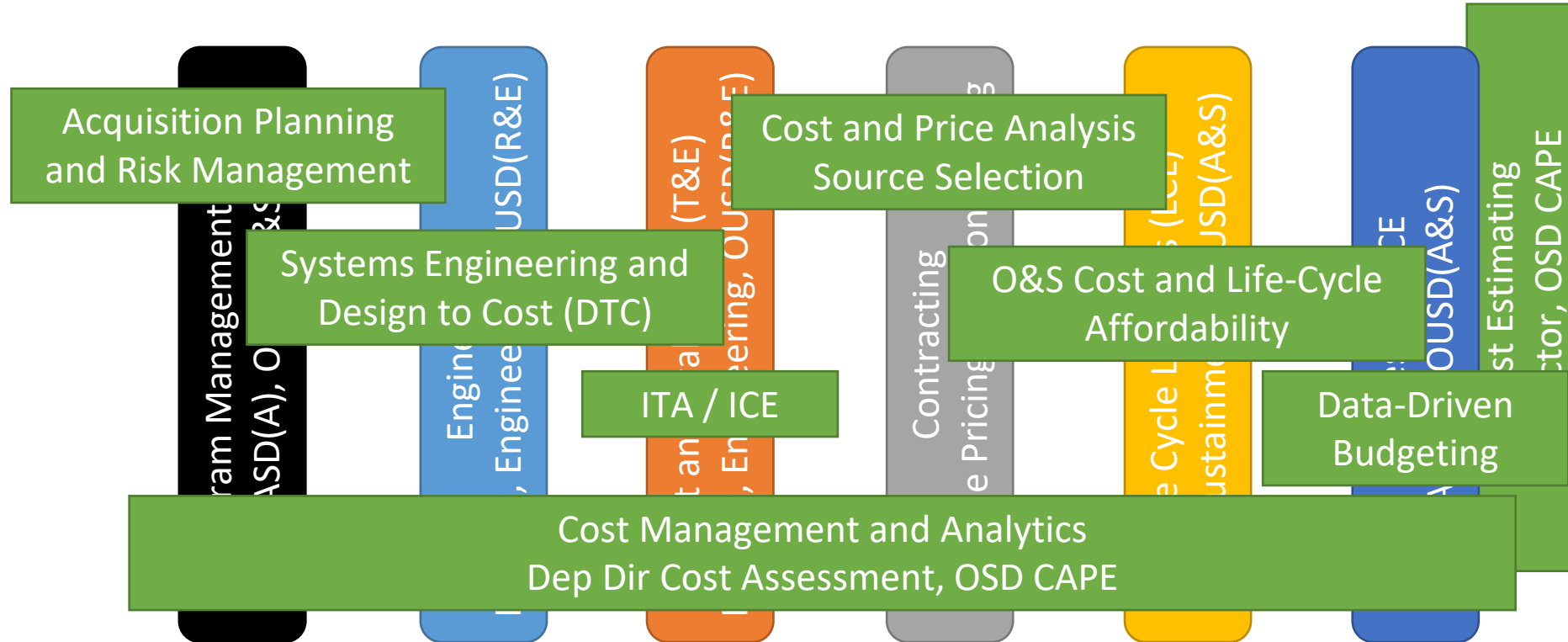
Identity Crisis

- Cost Analysis is unusual and unique ... but defined too narrowly, it loses economies of scale
- Cost Analysis is related to many other fields ... but defined too broadly, it loses its identity
 - Contract Pricing (NCMA), OR (INFORMS/MORS), Budgeting (ASMC)
- Cost Analysis is an interdisciplinary field
 - Defining roles and relationships supports specialization within Cost and healthy interchange of ideas

In Search of Goldilocks

Cost Contributions to Other Disciplines

- Cost can maintain its independence while making important contributions to other disciplines



Part of the problem ... and part of the solution!

*“See, what you’re really selling/ Is the way things oughta be/
So your pitch becomes compelling/ Selling more than just a tree/
It’s a symbol of your values/ It’s your ethics and your cause/
You can either be fake like the trees they make/
Or take a stand for Santa Claus”*

-“Bringin’ Back Christmas,” Spirited

Conservatism

Area	The Old	The New
Data	Legacy 1921-series CCDR CPRs	FlexFiles IPMDAR
Models	Excel / ACEIT	Data Pipelines and Scripts
Methods	Regression Analysis	Machine Learning (ML); Bayesian
Economic Effects	Inflation; 2% flat projections	Escalation; market-driven projections
Programs	Acquisition	Infrastructure; Portfolios
Estimates	Milestone	NACAs (Budget); Changes (Design)
Documentation	Stand-alone	In-line

Come back for next year's paper on "The Ontology of Cost Models"!

Clinging to Old Ways

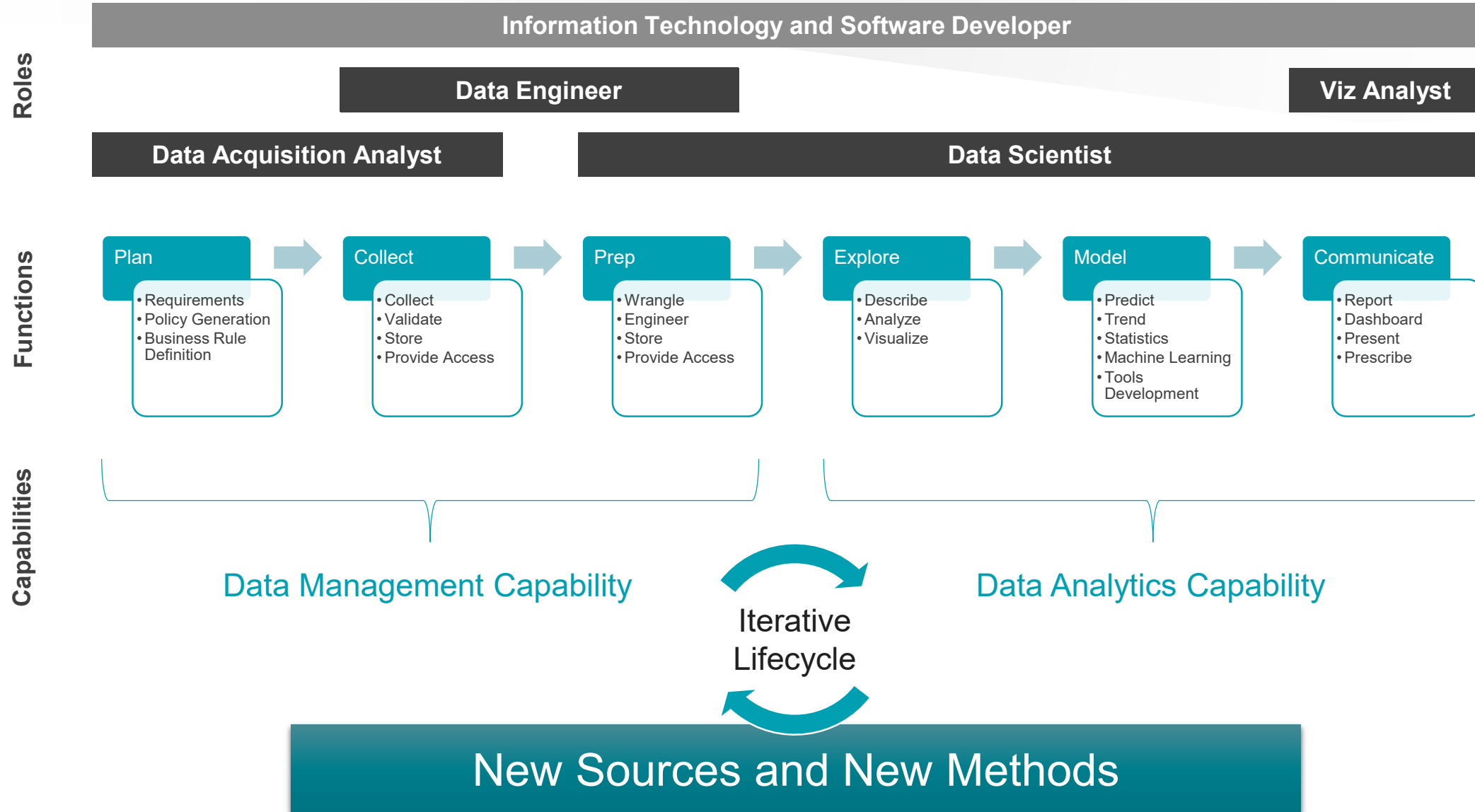
Opportunities – More Data, Better Data, More Often

Digital Engineering and ERP

- Traditionally, there have been “air gaps” between Data Accrual and Data Collection, and again between Data Collection and Estimate Data
- More and more, there are “live” systems of record from which cost-able information and even costs can be pulled in real time
 - Recall the two different “flavors” of data
- CAD/CAM (for Hardware) and Agile Management systems like Jira (for Software) can maintain an evolving description of what is being designed and built
 - Ideal is a “Digital Twin” supporting simulations, walk-throughs, and estimates
- ERP systems hold promise for better treatment of Government costs

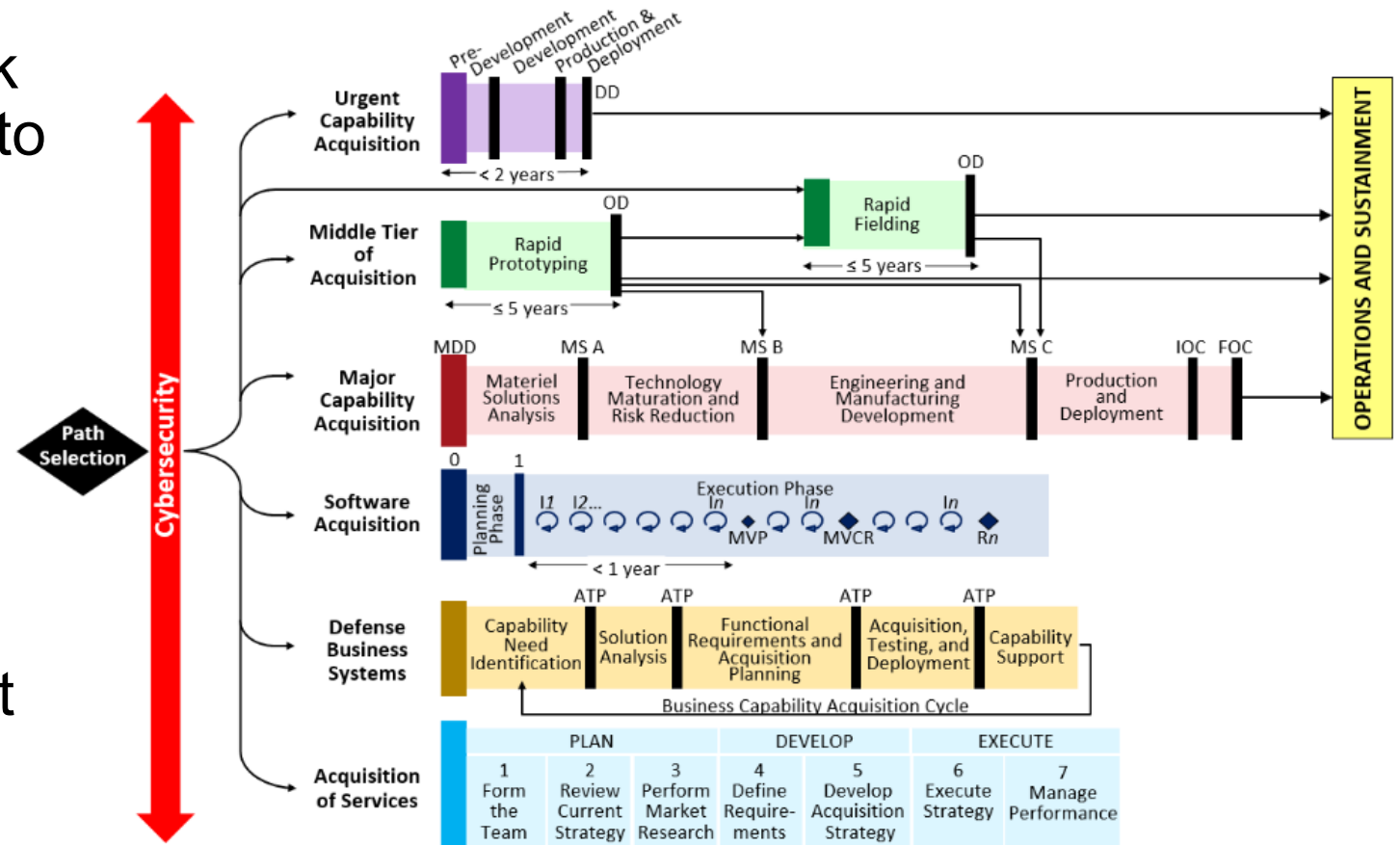
Native Data

Data Management and Data Analytics



Feedback Loops

- Adaptive Acquisition Framework (AAF) provides the opportunity to shorten Acquisition – and Data Collection – cycles, where appropriate
 - Especially the Software Pathway
- DevSecOps emphasis on Continuous Integration and Delivery (CI/CD) blurs the lines between Software Development and Maintenance
 - What about CA/CE?!



<https://aaf.dau.mil/>

Acquisition Pathways and DevSecOps

Threats – Telework, #NoEstimates, and Brain Drain

“There is no ‘there’ there.”

-Gertrude Stein (about Oakland!)

“Working” from Home

- Collaboration tools that helped us survive the pandemic (Zoom, Slack, etc.) are no substitute for direct human interaction
 - Official government term “telework” is telling: *tele-* = “distant”
- An entire generation used to difficult circumstances ... and lower expectations?!
- Need to delineate *transaction* from *interaction*
 - Improve the efficiency and effectiveness of both
- Conversations around the data and a common lore
- “The #1 weapon of the cost analyst is the telephone”

Mentoring and Collaboration in the New Normal

*“Some idiot just called me up on the phone. What!?
Don’t they know how to text? OMG”*

*-“Weird AI” Yankovic, “First World Problems,”
Mandatory Fun (2014)*

Agile and the Death of EVM

- Cost (and EVM) are both predicated on the inherent relationship between scope and resources
 - What requirements or capabilities are delivered and what they cost
 - Cost focuses on forecasting and analysis; EVM on planning and management
- Extreme #NoEstimates variety of Agile asserts the futility of kind of medium- to long-range planning
 - *Everything* is a prioritized backlog
- The more complex and difficult an undertaking, the greater the importance of planning and forecasting – especially when *spending other people's money*
 - Cost is most needed when it is (apparently) least effective
 - Underscores importance of risk and uncertainty

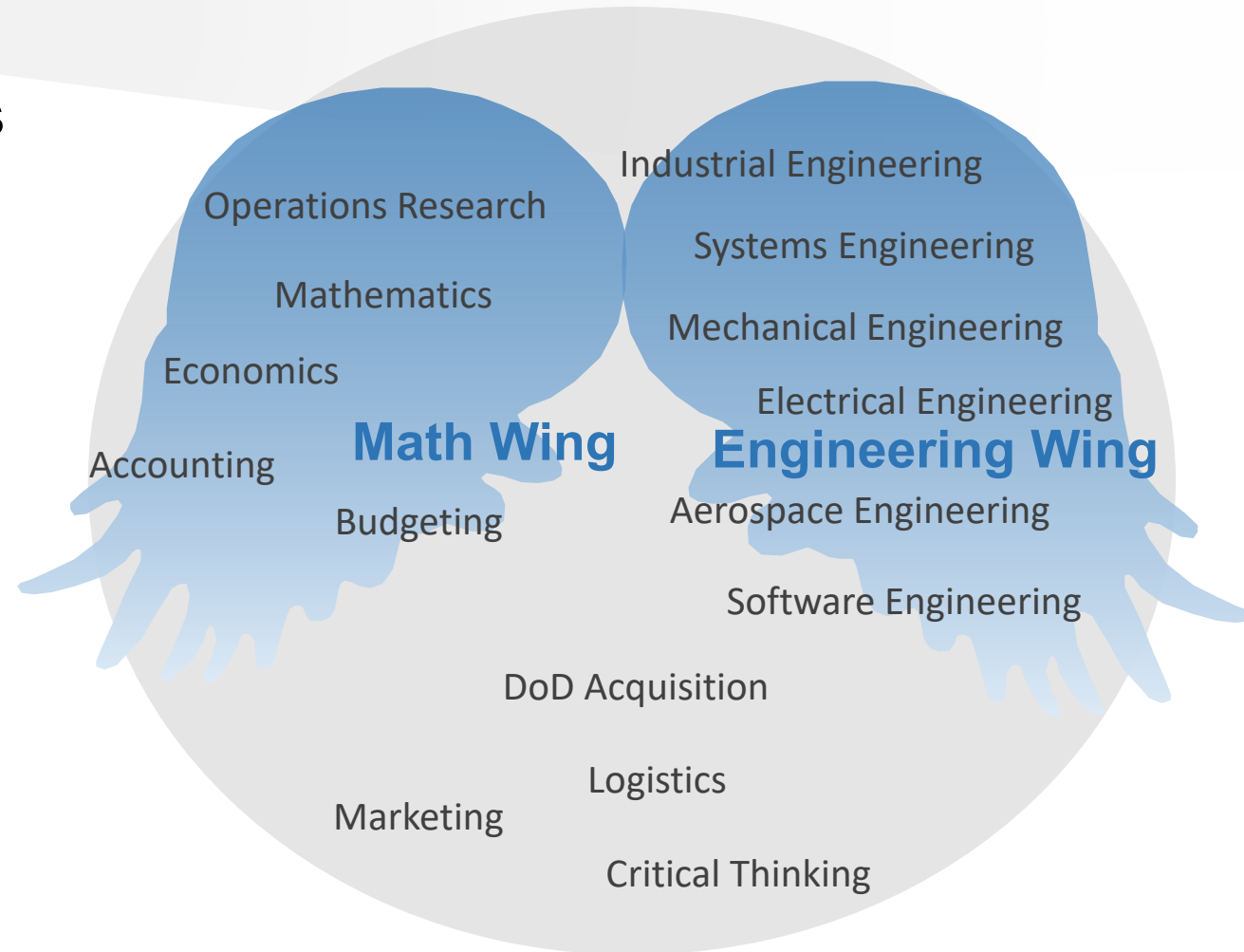
What Is Value?

*“Where is my Marlboro man?
Where is his shiny gun?
Where is my lonely ranger?
Where have all the cowboys gone?”*

-Paula Cole, “Where Have All the Cowboys Gone”

The Next Generation

- Need to appeal to Data Science grads
 - But Cost is not sitting *in a back room* doing Data Analytics
 - Need analysts who are comfortable sitting *at the table* as a trusted advisor
- Achieve the right balance of Specialization and Generalization
 - True polymaths are rare, but there is a proud tradition of generalists – teachers, farmers, cost analysts!
- Rare if not unique confluence of mission, meaningful work, and interesting colleagues



Where Have All the Farmers Gone?

“Il faut cultiver notre jardin.”

-Jean-Marie Arouet Le Jeune, aka Voltaire, “Candide”

Epilogue – Rise of the Machines

“Eventually, computers and robots will run things. Humans will manage those machines, but that doesn’t require courage or strength, or any characteristics like those. In fact, men are outliving their usefulness.”

*-Photographer-writer Robert Kincaid in
The Bridges of Madison County, Robert James Waller”*

Machine Learning

- Developing new and varied models on larger, more detailed, and more diverse data sets
 - Onus on the analyst to collect and normalize the data
 - Improved DM/DA practices can help
- New algorithms, same stuff
 - Analysts must have a solid understanding of how methods operate
 - Analysts must cope with modeling issues such as over- and underfitting
 - Analysts must present defensible approach to decision-makers to lend confidence to their results

“ML ... AI that actually works!”

*“John Henry was a steel-drivin’ man/...
And he died with a hammer in his hand, Lawd, Lawd”*

-“John Henry,” American folk song

Artificial Intelligence

- Even in the few months since this paper was submitted, there has been an explosion in accessibility to AI by the general public
 - OpenAI, Microsoft, Google,...
- Ironically, AI may automate the “interesting” analysis and leave the drudgery for humans
 - Donald Knuth: “AI has by now succeeded in doing essentially everything that requires ‘thinking’ but has failed to do most of what people and animals do ‘without thinking’ – that, somehow, is much harder!”
- Concerns with Automation
 - Gaming the system
 - Black Box syndrome

ChatGPT wrote my ICEAA paper...