

Anatomy of the Future DoD Cost Estimator

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Disclaimer: The view expressed in this briefing are those of the authors and do not necessarily reflect the official policy or position of the United States Air Force

Agenda

- Change
- Decision Context
- The Role of Analytics – past, present and future
- Anatomy of the Cost Estimator
- Posturing of the DoD Cost Estimator
- Projections for the future

Change: The act or process through which something becomes different....

“It is not the strongest of the species that survives, nor the most intelligent that survives. It is the one that is most adaptable to change.”
- Charles Darwin

“Change is inevitable.
Change is constant.”

Benjamin Disraeli

“CHANGE IS
INEVITABLE.
GROWTH IS
OPTIONAL.”
- John
Maxwell

*“Change is the only constant in
life. One’s ability to adapt to those
changes will determine your
success in life.”*

- Benjamin Franklin

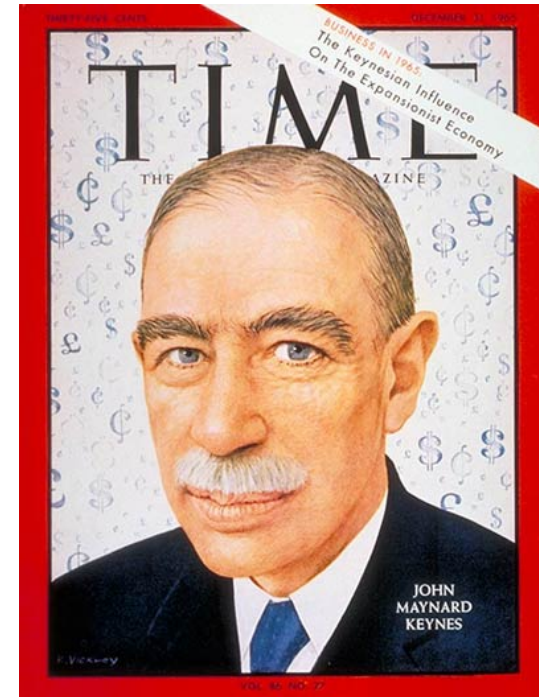
“Intelligence is the
ability to adapt to
change.”
- Stephen Hawking

**Flexibility is the
key to Air Power**

We are all Operations Research Analysts Now!

- National Defense Authorization Act – 2006-2007
- Acquisition Improvement Plan (AIP) – 2009
- RAND: Acquisition Cost-Estimating Workforce – 2009
- Weapon Systems Acquisition Reform Act (WSARA) – 2009
- SAF/FM

“We are all
Keynesians
now.”

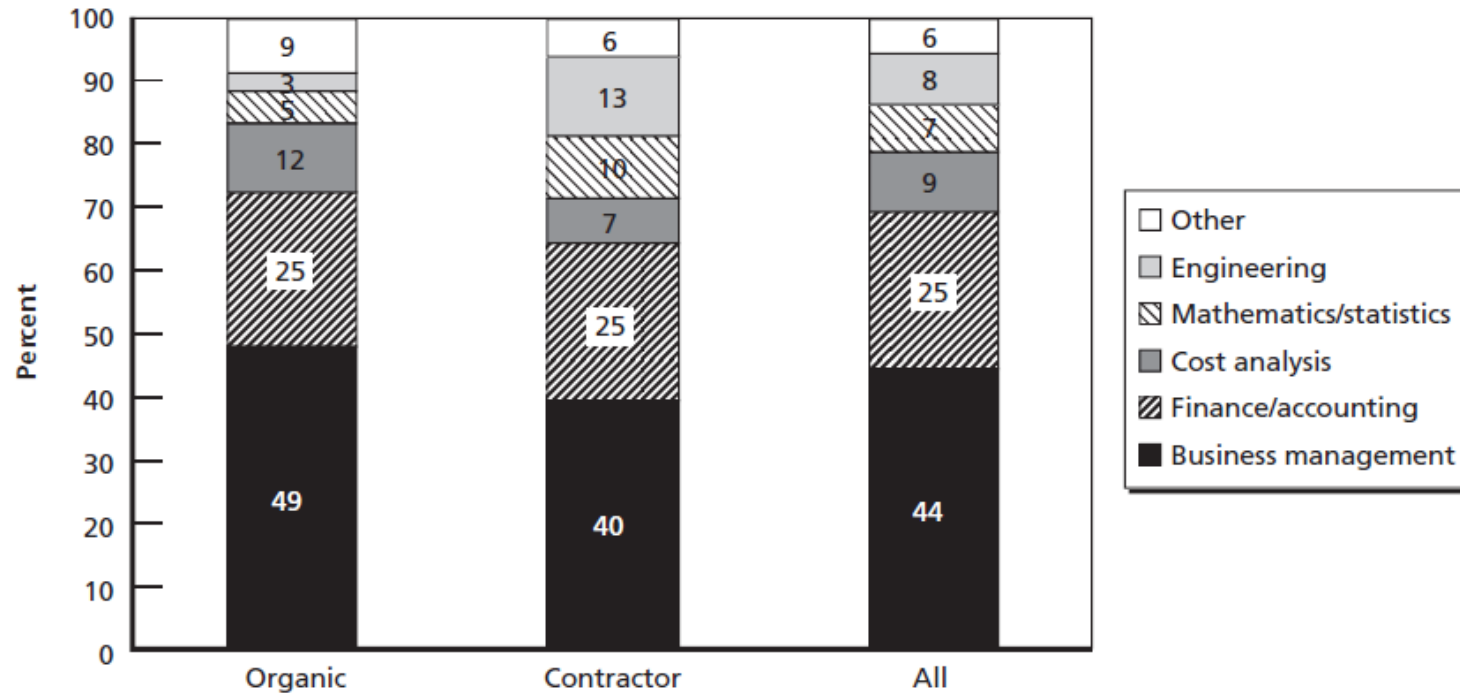


RAND: Acquisition Cost-Estimating Workforce (2009)

- Defense Acquisition University (DAU) training courses: too general, lack depth
- Two-thirds of the cost-estimating workforce, both organic and contracted, reported having no certification in cost-estimating
- Lack of advancement opportunities was cited as a major drawback in hiring and retaining cost estimators
 - ~10% of the civilian workforce was in GS-14 and GS-15 equivalent positions
 - ~10% of the military workforce were in the grade of LtCol or Colonel
- Consensus among respondents was that a technical degree (Engineering, Mathematics, Operations Research, etc.) would be beneficial in the cost estimating career field
- AFIT-trained cost estimators were highly valued but two problems remained:
 - Mainly military cost estimators, little opportunity for civilians or contractors
 - Military cost estimators tended to stay in a cost estimating job for only 1 assignment

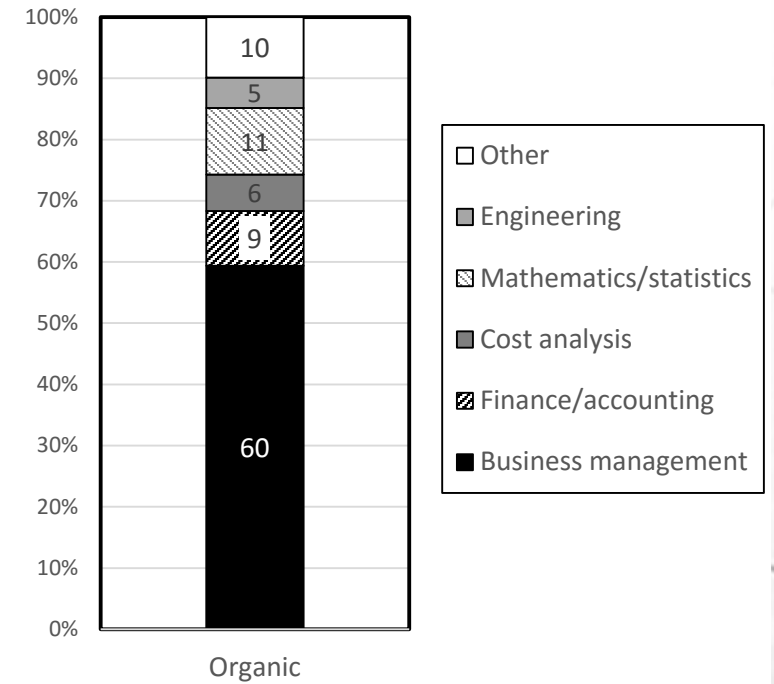
Snapshot of Air Force Cost Workforce Education

Backgrounds of Cost Estimators, 2008



Education Degrees of Air Force Cost Estimators (reprinted from RAND 2008)

AFMC Cost Estimators Degree Types, 2017



Cost Estimating Core Competencies

- 1 Identify how cost estimates support the PPBE process
- 2 Identify applicable cost OMB, DoD, and Air Force directives, policies and publications
- 3 Describe the statutory requirements that provide guidance for cost estimating
- 4 Describe how the requirements serve as the foundation for cost estimating
- 5 Describe how cost estimating supports the PPBE process
- 6 Identify the cost products that support a program in the PPBE process
- 7 Describe the component model
- 8 Describe the component acquisition decision model
- 9 Describe the component selection process
- 10 Discuss the relationship between estimates and budget decisions
- 11 Perform information gathering from various data collection systems
- 12 Apply cost modeling tools to develop cost estimates (Excel, ACE-IT, Crystal Ball, etc.)
- 13 Explain various estimating methods
- 14 Perform cost, risk, and sensitivity analysis in a cost estimate
- 15 Document and describe the relationships and the results of the cost estimating analysis
- 16 Perform cost analysis for relationships
- 17 Apply mathematical and statistical methods to develop cost relationships
- 18 Describe how the schedule affects a cost estimate
- 19 Prepare a work breakdown MILSTD 881B for a specific product to capture all program elements
- 20 Apply appropriate inflation factors to develop a cost estimate
- 21 Apply appropriate discount factors to develop a cost estimate
- 22 Discuss life cycle resource requirements for program feasibility and program management
- 23 Explain activity based cost estimating and cost to benefit techniques
- 24 Describe Cost Estimating (EA, BCA, Lease vs Buy)
- 25 Discuss the acquisition process life cycle of a program and its impact on budget formulation and execution
- 26 Describe mission, purpose, and function of System Program Office (SPO)
- 27 Apply a variety of analytical methods/processes (learning curve, regression analysis, parametric analysis, etc) in a cost estimate
- 28 Prepare cost instructions and evaluation criteria for a request for proposal

11 Perform information gathering from various data collection systems (ie. AFTOC)

12 Apply cost modeling tools to develop cost estimates (Excel, ACE-IT, Crystal Ball, etc.)

13 Explain various estimating methods

14 Perform cost, risk, and sensitivity analysis in a cost estimate

17 Apply mathematical and statistical methods to develop cost estimating relationships

24 Describe Cost Estimating techniques (EA, BCA, Lease vs Buy)

27 Apply a variety of analytical methods/processes (learning curve, regression analysis, parametric analysis, etc) in a cost estimate

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OR Methods

Applied Probability & Stats

- Markov Chains
- Regression
- Statistical Process Control
- Design of Experiments
- Data Mining
- Forecasting

Modeling & Simulation

- Monte Carlo Methods
- Discrete Event Simulation
- Queuing Theory
- Campaign Modeling
- C++, Visual Basic

Optimization

- Linear Programming
- Nonlinear Programming
- Network Flows
- Scheduling

Decision Analysis

- Decision Trees
- Value-Focused Thinking
- Analytical Hierarchy Process
- Game Theory

The Analytics Big Bang

Predictive analytics reaches critical mass as Big Data and new technologies collide

Key Innovations

New Users

- + Monte Carlo simulations
- + Computational models for neural networks
- + Linear programming



Government Agencies

- + Non-linear programming
- + Computer-based heuristic problem solving



Corporations & Research Institutions

- + Real-time analytics
- + Prescriptive analytics



Mid-size Businesses & Tech Startups

- + R version 1.0
- + Standardization of natural language processing
- + Apache Hadoop



Small Businesses & Analytic Experts

- + Analytic exchanges that enable global collaboration
- + Anticipatory analytics



Anyone

Analytic Innovation Accelerates
2000–2009: Production version of R language for analytic software grows from 0 to 1,000,000 users¹

Buy! Buy! Buy!
2000–2012: Analytic software market grows from \$11 billion to \$35 billion²

21st Century's Sexiest Job³
2011–2012: Data scientist job posts jump 15,000%⁴

Hyper-connectivity
2012: 1.7 billion mobile devices sold and 2+ billion people on social networks add to data explosion

Collaboration
leads to massive innovation

Personalization
of every event, experience, offer

Solving the Unsolvable
in medicine, energy, agriculture and more

Analytic Talent Gap
grows as demand skyrockets

Affordable and Accessible
analytics as tools become broadly adopted

1930s–40s

1950s–1960s

1970s–1990s

2000–Present

Next

An Example of Analysis in Action

- Major League Baseball (MLB)
 - Baseball was entrenched in old paradigms:
 - MLB stats were outdated and often a poor representation of a player's worth
 - Very experienced baseball scouts making the calls – assessments based more on gut feel than data
 - Valued a certain set of physical characteristics
 - Billy Beane of the Oakland A's was one of the first to discard old baseball practices and embrace analytics in evaluating players
 - Impetus: player salary budget was very limited for the A's
 - Billy Beane along with his analyst, Paul DePodesta, began to look at which player stats produced the greatest results
 - Result: Oakland A's were wildly successful, 20 game winning streak and a 103-59 record in 2002 on budget 1/3 the size of the NY Yankees
 - Take Away Questions:
 - How is ****insert your organization here**** entrenched in old paradigms?
 - How can you use your analytical and creative thinking to break down old paradigms and evaluate the what truly matters?



Other Analytical Trends

- Ever increasing collection of data
- Increasing computer processing power
- Analytics in ever major sector:
 - Business
 - Healthcare
 - Sports
 - Politics

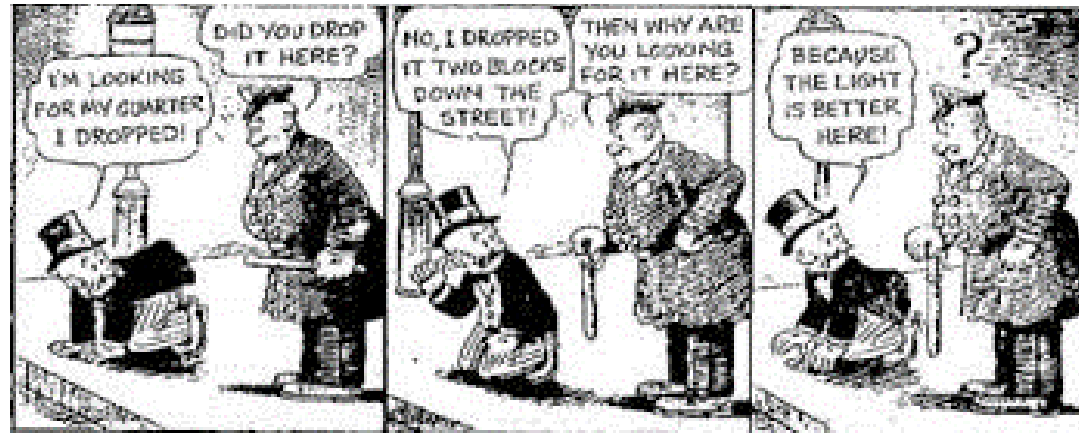
Bottom Line: There is an increasing need for qualified people to process and analyze data and communicate the results

INFORMs

- Definition of Operations Research: “The secret of better decision making in a complex world. Executives in every kind of organization – large and small, private and public, for-profit and not-for-profit – are using analytics to unlock the value in their data, model complex systems, and make better decisions with less risk. Whether analytics is used to inform high-level strategy or improve day-to-day operations, the results speak for themselves.”
 - Insight into difficult problems
 - Higher Quality
 - Accurate predictions, plans
 - Improved processes & productivity
 - Better asset utilizations
 - More and better options
 - Millions in cost savings
 - Superior ROI
 - Breakthrough efficiencies

Air Force ORA Challenges

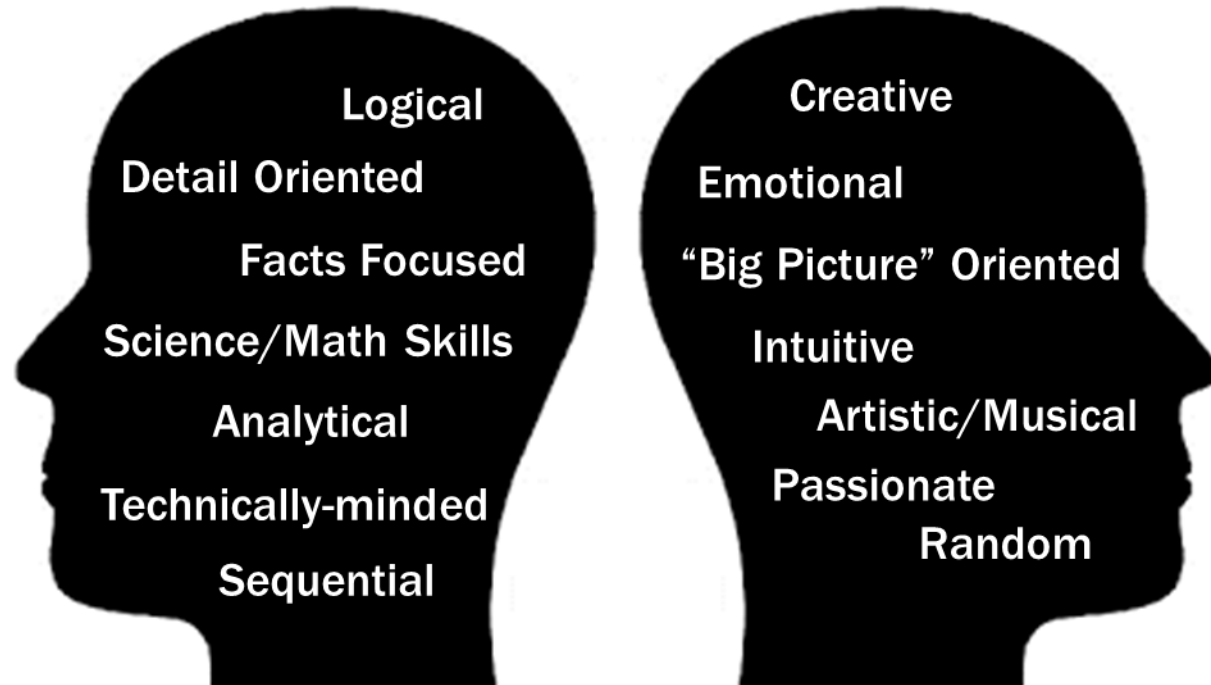
- Marketing
- Decision Context
- Autonomous Agencies Resist a Whole Government Approach to Missions**



**Locher, James R. III, "Leadership, National Security, and Whole of Government Reforms: The Project on National Security Reform (PNSR) Perspective." Extracted from Rethinking Leadership and "Whole of Government" National Security Reform: Problems, Progress, and Prospects, editors Joseph R. Cerami and Jeffrey A. Engel (Carlisle Barracks, PA: U.S. Army War College, 2010), 29-48.

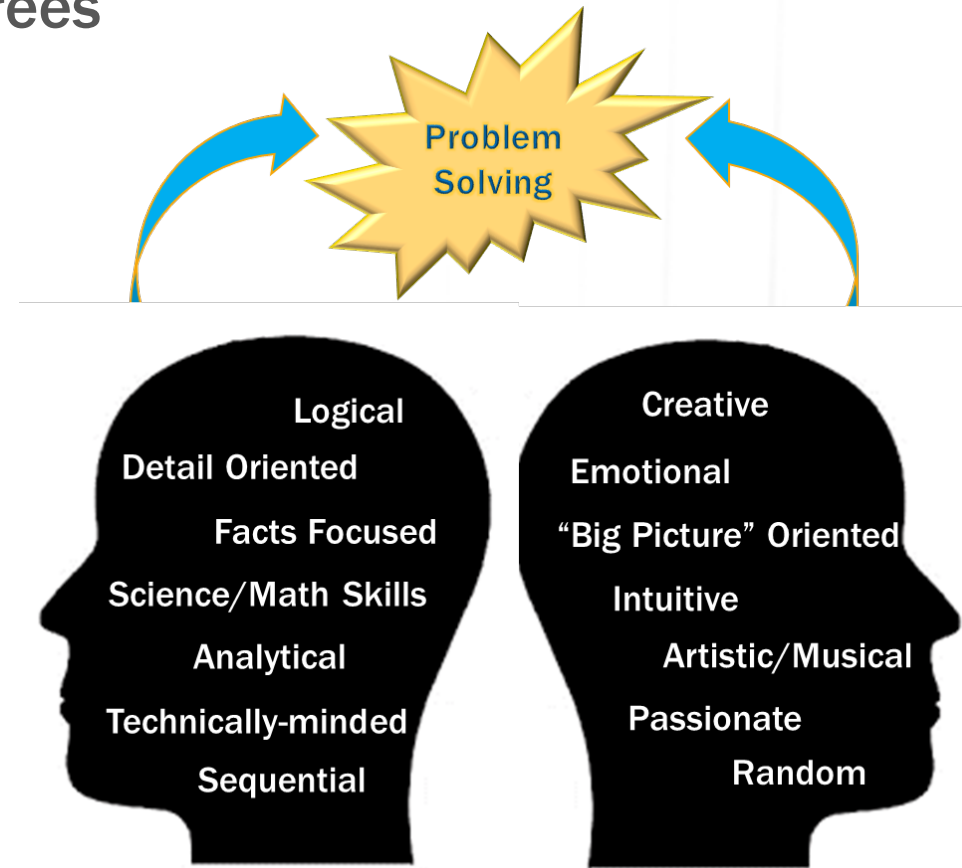
Right Brain and Left Brain..... Parallels to the Art and Science

- Why Left-Brain?
 - Technical applications
 - Stats/Regression
 - Data manipulation
- Why Right-Brain?
 - “Thinking outside the box”
 - Analyzing costs of new technologies
 - Creative problem solving



Anatomy of a Cost Estimator

- Quantitative Skills/Technical Degrees
- Experience
- Creativity
- Communication



Peering into the Future: the Anatomy

- Educational Background
 - Shift away from accounting/finance/management
 - Shift towards a technical background (e.g. math, stats, engineering)
- Emphasis on growing an experience base
- Enhancing opportunity and growth to entice an eager workforce

Posturing of DoD Cost Graduate Education

- Air Force Institute of Technology – Master of Science

- Cost degree dating back to 1982
- Admission Standards
- Forward leaning: Operations Research classes part of curriculum since 2001
- Quantitatively focused degree requirements: statistics, operations research, math econ, risk analysis, quantitative cost classes, thesis
- SAF/FM sponsors up to 3 full-time civilian students/year



- Naval Postgraduate School

- Distance Learning Master of Cost Analysis (began 2010)
- Admission Standards
- Quantitatively focused degree requirements: statistics, operations research, risk analysis, quantitative cost classes



Delivering the Academic Pedigree Required for Future Cost Analysts

Conclusion

- Change.... the only constant
- Enhancing tomorrow's cost estimator with greater analytic skills while retaining the basic skill-set necessary to fulfil the “art” aspects of cost estimating
- Result:
 - Better cost estimates
 - Better analyses
 - Better Decisions