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

“Flexibility is the key to Air Power”

“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

“CHANGE IS INEVITABLE. GROWTH IS OPTIONAL.”
- John Maxwell
We are all Operations Research Analysts Now!

- Acquisition Improvement Plan (AIP) – 2009
- Weapon Systems Acquisition Reform Act (WSARA) – 2009
- SAF/FM

“We are all Keynesians now.”

- 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

AFMC Cost Estimators Degree Types, 2017

Education Degrees of Air Force Cost Estimators (reprinted from RAND 2008)
Education Requirements – shifting to a technical background

- 1515 Operations Research Job Series
  - OPM: degree in operations research or at least
    24 hours in a combination of OR, math, probability
    statistics, science, or subject-matter courses requiring
    substantial competence in college-level math or statistics
  - 3 credit hours must be in calculus
Cost Estimating Core Competencies

1. Identify how cost estimates support the PPES process
2. Identify applicable cost OMB, DoD, and Air Force directives, policies, and publications
3. Describe how the budget serves as the foundation
4. Describe how the PPES process
5. Describe how cost estimates
6. Identify the cost estimate support a program in the
7. Describe the component model
8. Describe the component acquisition decision model
9. Describe the component selection process
10. Discus the relationship of cost, cost estimates
11. Perform information gathering
12. Collect data collection systems
13. Explain various estimating methods
14. Explain various estimating methods
15. Analyze and cost analysis
16. Develop and cost analysis
17. Explain cost analysis
18. Explain how the objective affects cost estimate
19. Prepare a work breakdown
20. Apply appropriate models to calculate cost
21. Apply appropriate estimating to develop a cost estimate
22. Discuss life cycle model for program cost and program management
23. Explain activity based costing and cost to benefit
24. Describe Cost Estimating
25. Describe the Acquisition
26. Describe the budget formulation and execution
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

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
- Queueing 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:
- Monte Carlo simulations
- Computational models for neural networks
- Linear programming
- Non-linear programming
- Computer-based heuristic problem solving
- Real-time analytics
- Prescriptive analytics
- R version 1.0
- Standardization of natural language processing
- Apache Hadoop
- Analytic exchanges that enable global collaboration
- Anticipatory analytics

New Users:
- Government Agencies
- Corporations & Research Institutions
- Mid-size Businesses & Tech Startups
- Small Businesses & Analytic Experts

Analytic Innovation Accelerates:
- 2000–2009: Production version of R language for analytic software grows from 0 to 1,000,000 users.
- 21st Century’s Sexiest Job: data scientist job posts jump 15,000%.

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

Hyper-connectivity:
- 2012: 1.7 billion mobile devices sold and 2.4 billion people on social networks add to data explosion.

Next:
- Affordable and Accessible
- Analytics as tools become broadly adopted
- Analytic Talent Gap
- Solving the Unsolvable
- Personalization
- Collaboration
- Add to massive innovation
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**

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