Image via Jakub Jirsak/Fotolia.

Acquisition Data Governance, Management, and Analytics in the Department of Defense

Briefing for The National Academies of Sciences, Engineering, and Medicine Committee on

Improving Defense Acquisition Workforce Capability in Data Use

October 28, 2019

RAND CORPORATION

RAND has analyzed DoD acquisition data governance, management, and analytics

2015

- Issues with Access to Acquisition Data and Information in the Department of Defense: Policy and Practice

2016

- A Closer Look at the Origins & Implementation of Controlled Unclassified Information Labels & Security Policy

2017

- Doing Data Right in Weapon System Acquisition

2018

- Considerations for Implementing the Controlled Unclassified Information Reform Program
- Streamlining and Improving the Defense Acquisition Executive Summary (DAES) Process
- Identification and Characterization of Program Data for ACAT II and III, Pre-MDAPs, and Business Systems

2019

- Considerations for Managing Program Data in the Emerging Acquisition Environment
- Assessing DoD Use of Data Analytics and Enabling Data Management to Improve Acquisition Outcomes

Acquisition Data Management and Analytics

Study results can be found at *https://www.rand.org/*

In 2015, OUSD(AT&L) and OSD CAPE asked RAND to define acquisition data management challenges

Research Questions:

- What are the problems and challenges associated with sharing unclassified information within DoD?
- How do DoD security policies, processes, and procedures affect the ability of OUSD(AT&L) to provide efficient access to acquisition data?

Methods:

- Evaluated how labeling Controlled Unclassified Information (CUI) procedures, practices, and security policy affect needed access to acquisition oversight data
- Conducted structured discussions with subject matter experts (67 acquisition professionals from 18 separate offices); analyzed origins of commonly-used acquisition data markings

Key Findings:

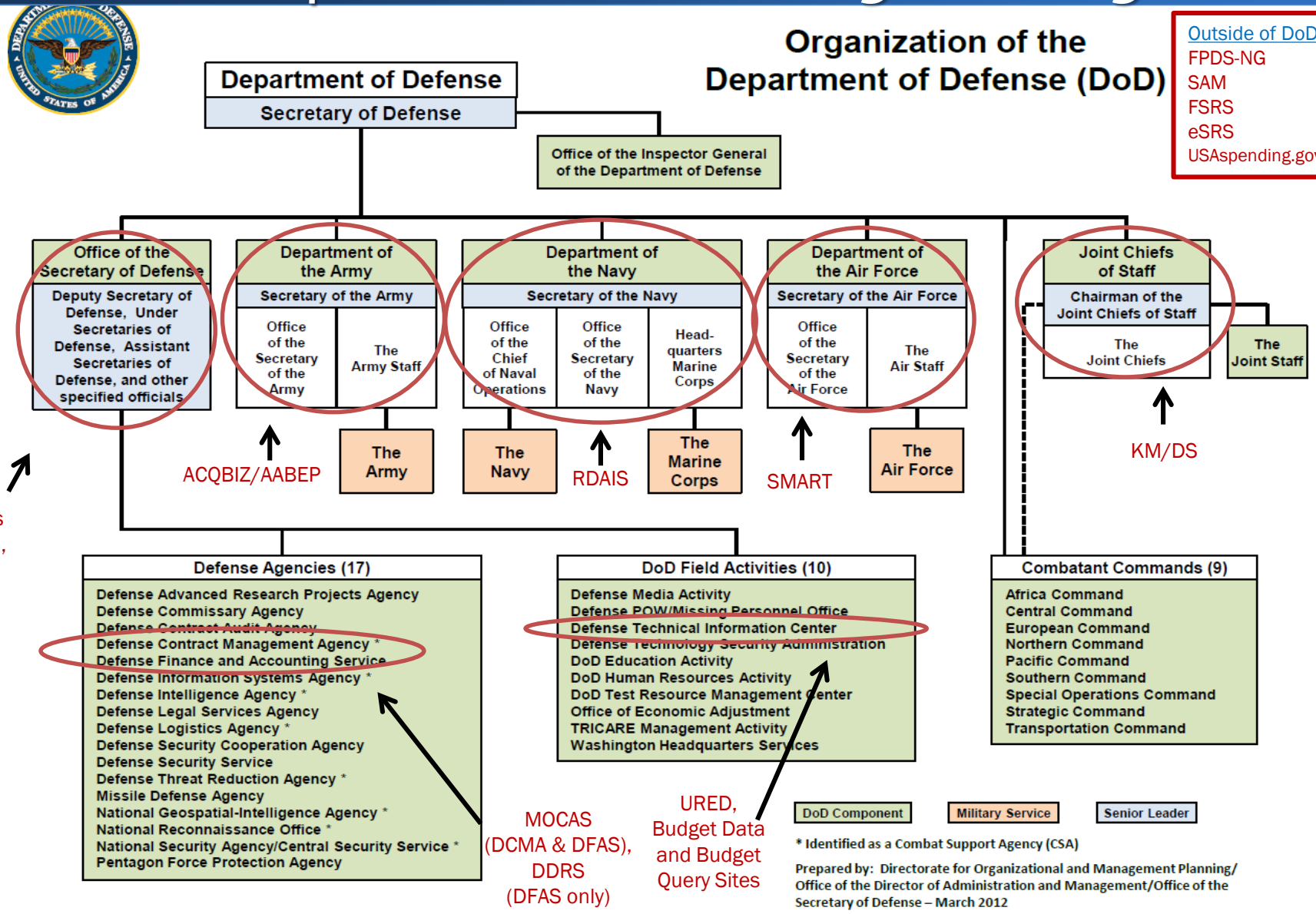
- Data access policy is highly decentralized, not well known, and subject to a wide range of interpretation
- Marking criteria are not always clear or consistent
- Third parties (e.g., FFRDCs) must establish costly and time-consuming agreements to view some data
- Institutional and cultural barriers exacerbate data sharing issues—even within the government

Options:

- Establish a more robust, central authoritative source for CUI data labeling, access, and management
- In areas where guidance interpretations conflict (e.g., FOUO and proprietary information), provide additional guidance upfront on identifying/labeling
- Establish general access for all direct support contractors; this would require legislative or contractual changes

Federal CUI Reform is likely to further complicate CUI practices when USD(I) releases revised DoD manual 5200.1 Vol. IV in response to NARA's CUI Reform (Federal Registry, 2016)

RAND also identified and analyzed DoD and federal sources of acquisition data in *Doing Data Right*…



…With the goal of improving acquisition data visibility

Research Questions:

- What kinds of acquisition data does DoD have?
- What information systems does DoD use to manage acquisition data?
- Given that DoD is not alone in having to manage large amounts of data, what can it learn from the practices in the commercial sector?

Methods:

- Reviewed 21 key acquisition-related data information systems and their origins and uses
- Identified key questions that could be answered from the data in these systems along with strengths and challenges of the data and systems
- Summarized commercial practices in data management; and offered findings and recommendations to further improve acquisition data quality, access, and use

Key Findings:

- DoD collects a wide variety of acquisition data and information in different information systems and formats
- Acquisition information resides in multiple systems at the federal level and at different levels of DoD
- The private sector struggles with similar problems

Options:

- Formalize a DoD data governance function to assist with planning, monitoring, and managing acquisition data
- Improve the quality and analytic value of DoD data further (e.g., require all systems to have data dictionaries)
- Prioritize collection of structured over unstructured DoD data
- Continue to develop internal capabilities to use and improve acquisition data among the acquisition workforce

RAND looked more closely at the alignment of ACAT I-IV acquisition program data between OSD/Services

Research Questions:
- How aligned are OSD and Service data models across ACAT levels and program types?
- What is the potential for use of a common data framework across ACAT levels and program types?

Methods:
- Review, assess, and compare extant OSD and Service policy and guidance on data requirements, governance, and management practice discussion
- Discussions with OSD and Service SMEs
- Data element comparisons

Key Findings:

- OSD and the Services have
  - Established formal data governance and standardized data management practices through the AVSG and AVWG
  - Consolidated acquisition program lists in DAVE
  - Adopted common data framework across ACAT levels, including many data element definitions
- ACAT II-IV cost, schedule, performance data not shared with OSD
- DBS sufficiently different that only select aspects of ACAT framework apply

Options:

- Continue AVSG/AVWG to facilitate data governance
- Promulgate an acquisition data strategy for DoD
- Focus initial efforts on identifying a core set of acquisition program data
- Leverage existing data infrastructure
- Establish common definition of “program” and “program start”

RAND highlighted data governance and management challenges and opportunities in the *Emerging Acquisition Environment*

Research Questions:

- Identify and analyze data-related issues associated with recent changes in roles, responsibilities, authorities, and organizational structure

Methods:

- Focus was on challenges associated with four topics:
  - General data governance and management practices
  - Middle Tier of Acquisition (MTA)
  - Selected Acquisition Report (SAR)
  - Defense Acquisition Executive Summary (DAES) process and data

Key Findings:

- Data governance and management requires continued senior leadership attention
- Existing ACAT data framework enabled rapid implementation of MTA
- Legacy SAR and DAES underlie existing program data framework and should continue until suitable alternatives are developed and implemented

Options:

- Let decision-making drive data requirements
- Minimize reporting requirements and costs more generally
- Align and standardize where possible through use of a common acquisition data framework
- Capitalize on existing structures to minimize costs and burdens (including ad hoc data calls) by leveraging existing data frameworks, information systems, and organizations

RAND recently assisted on a Congressional tasking on Data Analytics in Defense Acquisition

The briefing from the Secretary of Defense shall address:

Status Quo

Extent

"The **extent to which data analytics capabilities have been implemented** within the military services, DoD laboratories, test centers, and [FFRDCs] to provide technical support for acquisition program management"

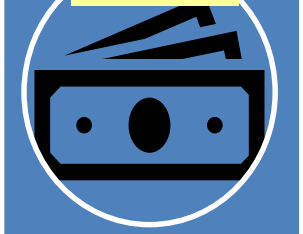
Opportunities

Increase Use

"The **potential to increase the use of analytical capabilities** for acquisition programs and offices to improve acquisition outcomes"

Status Quo

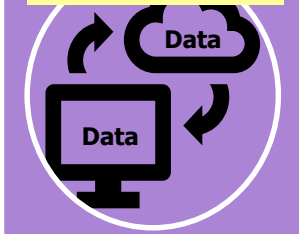
R&D



"The **amount of funding** for intramural and extramural **research and development activities to develop and implement data analytics capabilities** in support of improved acquisition outcomes"

Opportunities

Efficient Data



"Any **potential improvements,** based on **private-sector best practices**, in the **efficiency** of current data collection and analysis processes that could **minimize collection and delivery of data** by, from, and to government organizations"

Status Quo

Expose Data

"**Steps** being taken to appropriately **expose acquisition data** in an anonymized fashion to **researchers and analysts**"

Status Quo

Train

"Whether the **curriculum** at the National Defense University, the Defense Acquisition University, and appropriate private-sector academic institutions includes appropriate **courses on data analytics and other evaluation-related methods** and their application to defense acquisitions"

SOURCE: H.R. 114-840, 2016, pp. 1125–1126.
NOTE: FFRDC = federally funded research and development center; R&D = research and development.

These primary government functions enable the acquisition of goods and services

Primary Acquisition Functions

1. Program Management/Manager
   - 1.1 Business case and economic analysis
   - 1.2 Affordability analysis
   - 1.3 Acquisition strategy
   - 1.4 Risk management
   - 1.5 Technical maturity
   - 1.6 Personnel and team management
   - 1.7 Business and marketing practices
   - 1.8 configuration management
2. Research and Development (R&D)
3. Engineering
   - 3.1 Systems engineering
   - 3.2 Facilities engineering
   - 3.3 Software/IT
4. Intelligence & Security
   - 4.1 Cybersecurity
   - 4.2 Program Protection
5. Test and Evaluation (T&E)
   - 5.1 Developmental T&E
   - 5.2 Operational T&E
6. Production, Quality, and Manufacturing (PQM)
7. System and Operational Issues
   - 7.1 Spectrum (frequency allocation, emissions, etc.)
   - 7.2 Environmental
   - 7.3 Energy
8. Product Support, Logistics, and Sustainment
9. Financial Management
10. Cost Estimating
11. Auditing
12. Contract Administration
    - 12.1 Contracting actions
    - 12.2 Contracting strategy
    - 12.3 Contract peer review
    - 12.4 Acceptance of deliverables
13. Purchasing
14. Industrial Base and Supply-Chain Management
15. Infrastructure and Property Management
16. Manpower Planning and Human Systems Integration
17. Training and education
    - 17.1 Training and education for government execution
    - 17.2 Training and education for acquired systems
18. Disposal

Acquisition Interface Functions

19. Requirements: receive, inform, and fulfill
20. Acquisition Intelligence: request, receive, and respond
21. Legal Counsel: request and act upon

SOURCES: Anton et. al (forthcoming), DAU (2002, 2004), Parker (2011), MCSC (2017), NAVAIR (2015), OPM (2009), USD(AT&L) (2016b)

RAND found some progress but improvements are needed, especially in data access

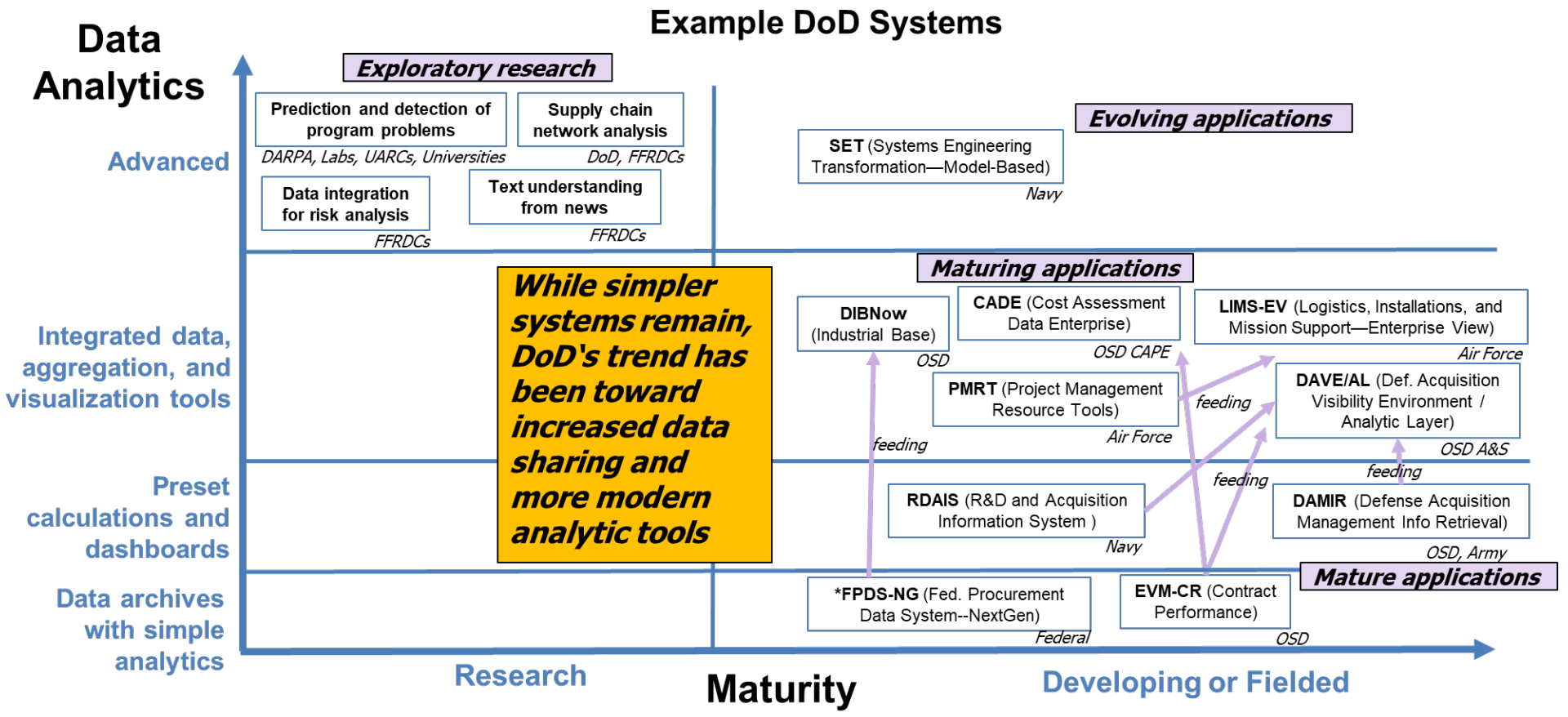
Acquisition data analytics are extensive

- DoD data & analytics support decisionmaking across a wide range of acquisition functions
  - functions include fields used for decades: e.g., engineering, test and evaluation, cost estimating, and auditing
  - techniques range from simple empirical methods to more advanced engineering & estimating approaches
- The magnitude of annual DoD investment in data analytics are in the billions of dollars
- Adverse outcomes decisions in some major acquisition programs were driven by strategic factors or other drivers—not for lack of data analytics

Still, there is room for improvement

- Barriers to expanded data and analytics include:
  - Some cases of inefficient collection and lack of sharing data because of ***cultural, security, and investment issues***
  - Limited analytic desktop software for general staff
  - Workforce trained on job-specific data analytics rather than broader analytic skills
- Progress has been made
  - Applying commercial best practices to efficient data management and sharing
  - Adding commercial business intelligence tools (e.g., Tableau, QlikSense) to information systems to facilitate data processing, analysis, and visualization
  - Offering new courses in data analytics at acquisition training institutions
- Continued investments & progress are needed
  - DoD appears to recognize this based on continued (albeit constrained) investments
- Applying advanced data analytics to DoD acquisition program data is limited and mostly in the exploratory phase

DoD systems are evolving from isolated data to shared data with analytic layers; More advanced analytics are exploratory



Q6. Do training institutions include appropriate courses on data analytics and other methods and their application to defense acquisitions?

Findings:

- Yes, DAU, NPS, NDU, AFIT, and partner universities and institutions* offer:
  - Applied methods and tools courses
  - Applied data analytics courses
  - Generic data analytics courses and electives
  - Advanced analytics courses are predominantly at NPS and partner institutions
- Enrollments at DAU in FY 2018 indicates a reasonable stratification:
  - *~150,000: Applied methods and tools courses*
  - *~ 60,000: Applied data analytics courses*
  - *~ 3,300: Generic data analytics courses*
- These courses should help staff understand how to request analysis and understand the results

* Georgia Tech, American University, George Mason University, Georgetown University, George Washington University, Johns Hopkins University, Stanford, University of Michigan, Google, IBM, and DoD Cyber Crime Center (DC3) Cyber Training Academy

Perspectives:

- Not everyone in acquisition can or should become a data scientist
- On-the-job training is also important
- Analytic layers on information systems are fairly intuitive and come with online help and training sessions
- As in industry, few people understand both data science and the application area
- Did not assess quality of courses

Opportunities:

- Implement rotations in analytic-based offices
- Better inform personnel of available analytics-based courses
- Encourage analytics-based training

Summary: Acquisition data governance and management require continued senior leadership attention

DoD acquisition data environment is complex and faces many challenges

- DoD collects a lot of data in many information systems, formats, and for multiple purposes
- Data access policy is highly decentralized, not well known, and subject to a wide range of interpretation
- Marking criteria are not always clear or consistent
- Third parties (e.g., FFRDCs) must establish costly and time-consuming agreements to view some data
- The private sector struggles with similar problems

However, program data management shows signs of collaboration and maturity

- OSD/Services established formal data governance and standardized data management practices
- Adopted common data framework across ACAT levels, including many data element definitions
- Consolidated acquisition program lists in DAVE
- Legacy SAR and DAES underlie existing program data framework and should continue until suitable alternatives are developed and implemented
- Existing ACAT data framework enabled rapid implementation of MTA

Institutional and cultural barriers in the DoD exacerbate data sharing issues—even among DoD officials

We recommend…

- Let decision-making drive data requirements
- Minimize reporting requirements and costs more generally
- Leverage data that PMs/PEOs use to manage programs
- Align and standardize where possible through use of a common acquisition data framework
- Capitalize on existing structures to minimize costs and burdens (including ad hoc data calls) by leveraging existing data frameworks, information systems, and organizations
- Guidance on data requirements needs to be built in to policy

Back-up

DoD's internal institutions have many applied data analytics and a few purely data science courses

- Defense Acquisition University (DAU)
  - Many applied data-analysis classes and a few general-purpose data-analytic courses
  - Other courses include methods directly tied to applications (e.g., PQM, testing, contracting)
  - Provides analytic "tools" (simpler calculation) in courses and online
- Naval Postgraduate School (NPS)
  - Offers a variety of data science classes teaching data methods, tools, and a variety of analysis
- Air Force Institute of Technology (AFIT)
  - Classes which use data are mostly applied data science courses teaching a variety of analysis. Some classes offered teaching methods and tools only
- National Defense University (NDU)
  - Most NDU courses are policy and strategy related rather than acquisition
  - Courses which incorporate data are mostly methods and tools, with some systems analysis
  - One "Big Data" course has been designed in response to the FY2017 NDAA

We categorized courses related to data and analysis at DoD Institutions

- Overall, the defense universities teach many acquisition-applied data analytics courses along with their concentrations in acquisition theory, processes, methods, and tools
  - More than 50 percent of the courses for NPS contain acquisition-applied data analytics
  - DAU concentrates on acquisition theory (including processes, methods and tools), with some emphasis on acquisition-applied data analytics
  - AFIT School of Engineering & Management (E&M) offers programs that teach data science and have relevance to acquisition-applied data analytics
  - AFIT School of Systems & Logistics (S&L) offers acquisition courses with less emphasis on data analytics
  - NDU has mostly courses on strategy that require little or no quantitative data

	Acquisition Theory and Processes Only	Acquisition Theory, Processes and Methods	Acquisition Processes & Methods w/ Tools	Acquisition-Applied Data Analytics	General Data Analytics	Other (not acquisition or data related)	Total Number of Courses
DAU	56	68	41	49	9	0	223
NDU	0	12	15	9	6	109	151
NPS	3	12	5	31	6	2	59
AFIT (S&L)	38	2	4	23	3	25	95
AFIT (E&M)	2	9	5	27	1	6	50
TOTAL	**99**	**103**	**70**	**139**	**25**	**142**	**578**

Increasing analytical acquisition courses

Examples of applied and general-purpose courses at DAU

Examples Out of 223 DAU Courses Analyzed and Categorized

Category	Example Courses	Description
Applied		
Acquisition Theory and Processes Only	Export Controls (CMQ 216)	Provides an overview of export control regulations, with a specific emphasis on how these regulations pertain to U.S. Government personnel when delegating contract surveillance to foreign persons.
Acquisition Theory, Processes and Methods	Engineering Support to Technical Reviews (CME 203)	Provides DCMA Engineers with a firm understanding of their roles and responsibilities in executing a three-phase, six-step methodology for providing effective program support to acquisition program technical reviews, using DCMA guidelines.
Acquisition Processes & Methods w/ Tools	Fraud Awareness (AUD 1283)	Overview of the auditor's responsibility for the consideration of fraud in DCAA's audits and to heighten auditor awareness of the possibility of fraudulent activities.
Acquisition-Applied Data Analytics	Mission-Focused Services Acquisition (ACQ 265)	This course is designed to improve our tradecraft in the acquisition of services. It uses a multifunctional approach that provides acquisition team members with the tools and techniques necessary to analyze and apply performance-based principles when developing requirements documents and effective business strategies for contractor-provided services.
	Cost Risk Analysis (BCF 206)	Cost analysts taking this course are given an overview of how to model the cost/risk associated with a defense acquisition program. Topics covered include basic cost risk concepts, subjective probability assessment, goodness-of-fit testing, basic simulation concepts, and spreadsheet-based simulation.
General		
Data Analytics	Introduction to Probability and Statistics (CLE 035)	This continuous learning module provides participants with a basic introduction and understanding of probability and statistics, a crucial foundation for the Test and Evaluation (T&E) career field.

About a quarter of DAU's courses provide data analytics tools

Examples of Applied Analytic Tools in DAU Courses

Tool Name	Application
Ishikawa	Root Cause Analysis
Microsoft Project, Oracle Primavera	Integrated Master Schedule (IMS) analysis
Acquisition Requirements Roadmap Tool Cost Estimating Module	Services Acquisition contract cost estimating
ARRT Risk Management Module	Risk Analysis
ARRT Performance Management Module	Enables alignment between requirements, standards & government surveillance of contract
Empower	Earned-Value Management (EVM) Data Analysis
SteelRay	IMS Metrics
@Risk	Schedule Risk Analysis
5 Why's	Problem solving and root cause analysis
Affinity Diagram, Deployment Flowchart, Force Field Analysis, Histogram, Nominal Group Technique (NGT), Pareto Charts, Scatter Diagram, Risk Management Cube	Problem Solving, Root Cause and Risk Analysis
Prioritization Matrix	Risk prioritization analysis
Dragonfly Simulation	Analysis of manufacturing, budget, test and evaluation, and sustainment cost/benefit and risk
Oracle Crystal Ball	Schedule and cost risk analysis using Monte Carlo simulation

NDU data analytics courses focus on management training and leadership decision-making

- NDU courses relate to Data Analytics and analysis in general
  - CIC 6004: Big Data to Decisions (EIT/DAV)
    - Developed in response to the FY2017 NDAA
    - Course includes relevant Big Data readings
  - CIC 6037: Data Analytics for Decision Makers (DAV)
  - BCP (6606): White House, Congress, and the Budget
  - DMS (6414): Data Management Strategies and Technologies: A Managerial Perspective
  - DAL (6420): Data Analytics for Leaders
  - DMS (6414): Data Management Strategies and Technologies: A Managerial Perspective
  - FFR (6607): The Future of Federal Financial Information Sharing
- The emerging Data Analytics and Visualization (DAV) program examines the need for information superiority and decision making through data and big data concepts, and data analytics
- NDU publications illustrate application to informing decision-making
  - e.g., Kimminau (2015) and Lester et al. (2018)

NPS is a traditional university with general data science courses plus applied training embedded in acquisition courses

- Data science courses are available to students as electives
- Some acquisition fields (e.g., cost analysis) include extensive data science courses
- Not reasonable to expect all acquisition students would become data science specialist
  - Same goes for other domains
    - e.g., quality management, systems engineering, test and evaluation, contracting
  - Acquisition management courses include overviews of analytically related disciplines
    - e.g., systems analysis methods and functional area concerns…requirements analysis…test and evaluation

General data science courses are available to students but not mandatory in general acquisition curricula

Example: NPS has an extensive curriculum on data analytics and other evaluation-related methods

- Heavily analytic degrees and programs
  - Masters of Cost Estimating and Analysis
    - Operations Research for Cost Analysis
    - Probability and Statistics I
    - Probability and Statistics II
    - Advanced Concepts in Cost Estimating
    - Risk and Uncertainty Analysis
    - Decision Analysis
    - Applied Cost Analysis
    - Cost Economics
  - Data Science Certificate Program
    - Basic computation; Basic statistics and data analysis; Large data; Machine learning; Assessment; Supervised Learning; Unsupervised learning

- Analytic Courses (*partial list*)
  - OS4106 Advanced Data Analysis
  - OS4118 Statistical and Machine Learning
  - CC4920 Multi-Criteria Analysis
  - CS3315 Introduction to Machine Learning and Big Data
  - CS3636 Data Fusion with Online Information Systems
  - CS3640 Analysis of DoD Critical Infrastructure Protection
  - CS3695 Network Vulnerability Assessment and Risk Mitigation
  - CS3802 Computational Methods for Data Analytics
  - CS4312 Advanced Database Systems
  - CS4315 Introduction to Machine Learning and Data Mining
  - CS4678 Advanced Cyber Vulnerability Assessment
  - CS4680 Introduction to Risk Management Framework
  - CY3650 Cyber Data Management and Analytics
  - DA3450 Open Source Data Analysis
  - DA3610 Visual Analytics
  - DA4610 Dynamic Network Analysis
  - EC2100 Circuit Analysis
  - EC2110 Circuit Analysis II
  - EC2410 Analysis of Signals and Systems
  - EC3310 Optimal Estimation: Sensor and Data Association
  - EC3460 Introduction to Machine Learning for Signal Analytics
  - EC3500 Analysis of Random Signals
  - EC4747 Data Mining in Cyber Applications
  - GB1000 Quantitative Skills for Graduate Management Studies
  - GB3040 Managerial Statistics
  - GB3042 Process Analytics
  - GB3050 Financial Reporting and Analysis
  - GE3040 Statistics for Executive Management
  - GE3040 Statistics for Executive Management
  - GE3042 Process Analytics
  - GE3050 Financial Reporting and Analysis
  - IS3200 Enterprise Systems Analysis and Design
  - Etc.

http://nps.smartcatalogiq.com/en/Current/Academic-Catalog/Courses

AFIT is a traditional university that offers acquisition courses and data science courses

- AFIT School of Systems and Logistics offers a series of acquisition courses and workshops
  - Most are management-related
  - Relatively few have data science training
- AFIT School of Engineering and Management offers several acquisition-relevant programs, all of which include data science courses:
  - Cost Capability Analysis Certificate Program & M.S. Cost Analysis
  - M.S. Systems Engineering and M.E. Applied Systems Engineering
  - M.S. Logistics, M.S. Logistics and Supply Chain Management, & Supply Chain Management Certificate program
  - M.S. Operations

Example: AFIT School of Systems & Logistics Acquisition Courses Relevant to Data Analytics

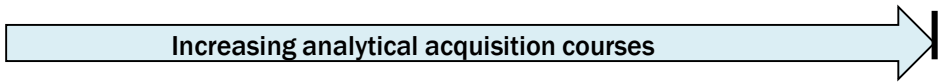
Course Name	Course Type	Course Length
21X 312 Programming and Budgeting for Staff Logisticians	Instructor Led, Live Internet Course	15 days
21X 324 Deployment Planning	e-Learning Course	45 days
MRC 102 Mission Ready Contracting Officer Course	In-Residence or On-site Course	23 days
QMT 290 Integrated Cost Analysis	In-Residence or On-site Course	4 days
REL 210 Reliability Basics for Acquisition Professionals	In-Residence or On-site Course	
REL 310 Reliability and Reliability Growth Foundations I	In-Residence or On-site Course	5 days
REL 410 Reliability and Reliability Growth Foundations II	In-Residence or On-site Course	4 days
SOT 210 Science of Test Fundamentals for Managers	In-Residence or On-site Course	2 days
SOT 310 Science of Test: Experimental Design and Analysis I	In-Residence or On-site Course	4.5 days
SOT 410 Science of Test: Experimental Design and Analysis II	In-Residence or On-site Course	4.5 days
SYS 031 Intelligence in Acquisition Life Cycle Management	e-Learning Course	9 hours
SYS 110 Fundamentals of Data Management	e-Learning Course	10 hours
SYS 114 Acquisition Incident Review Process	e-Learning Course	45 days
SYS 150 Engineering Data Management	In-Residence or On-site Course	4 days
SYS 153 Early Tester Involvement	e-Learning Course	
SYS 182 Introduction to Systems Engineering	e-Learning Course	4 hours
SYS 208 Life Cycle Risk Management Course	In-Residence or On-site Course	3 days
SYS 213 Management of the Manufacturing Readiness Process	In-Residence or On-site Course	3 days
SYS 240 Avionics Cyber Vulnerability Assessment, Mitigation, and Protection	Instructor Led, Live Internet Course	2 days
SYS 252 Developmental Test & Evaluation (DT&E) High Performance Team Member Course	In-Residence or On-site Course	2 days/14 hours (Resident)
SYS 253 Early Test and Evaluation Influence in Acquisition	In-Residence or On-site Course	3 days
SYS 279 Logistics Assessment (LA) Assessor's Course	In-Residence or On-site Course	1.5 days
SYS 281 AF Acquisition and Sustainment Course	In-Residence or On-site Course	3 days
SYS 282 Management of the Systems Engineering Process	In-Residence or On-site Course	3 days
SYS 316 Advanced Air Worthiness Certification Course	In-Residence or On-site Course	8 days
SYS 383 Architecting in the Air Force	In-Residence or On-site Course	3 days
WKS 0657 Better Business Deals	In-Residence or On-site Course	3.5 days
WKS 0658 Data Analytics for the Rest of Us	In-Residence or On-site Course	2 days
WKS 0668 Applied Concepts of Data Analytics	In-Residence or On-site Course	24 hours
WKS 0669 Data Analytics for Senior Leaders	In-Residence or On-site Course	8 hours
WKS 0670 Professional Services Acquisition	Workshop	2 days
WKSP QMT 490 Current Topics in Cost Estimating	Workshop	2.5 days

DAU attendance shows large numbers of acquisition-applied data analytics training and some general data-analytic training

- As expected, most of DAU's students take applied acquisition courses
  - A significant number include tools (simpler calculations) as well as deeper acquisition-applied data analytics
- Attendance in general data-analytic courses is in the thousands per year

FY2017	Acquisition Theory and Processes Only	Acquisition Theory, Processes and Methods	Acquisition Processes & Methods w/ Tools	Acquisition-Applied Data Analytics	General Data Analytics	Other (not acquisition or data related)
AWF Civilian	23,611	48,188	35,320	40,200	3,125	0
AWF Military	4,145	6,972	6,555	7,790	104	0
Civilian	12,551	25,815	5,226	8,211	325	0
Military	6,534	12,351	1,805	4,213	120	0
Contractor	1,909	6,802	1,342	3,174	97	0
TOTAL	**48,750**	**100,128**	**50,248**	**63,588**	**3,771**	**0**

FY2018	Acquisition Theory and Processes Only	Acquisition Theory, Processes and Methods	Acquisition Processes & Methods w/ Tools	Acquisition-Applied Data Analytics	General Data Analytics	Other (not acquisition or data related)
AWF Civilian	22,253	49,927	36,640	37,381	2,640	0
AWF Military	4,038	7,661	7,007	7,444	142	0
Civilian	15,640	29,005	6,096	8,856	310	0
Military	9,032	13,203	1,784	3,813	141	0
Contractor	1,111	4,653	953	1,931	51	0
TOTAL	**52,074**	**104,449**	**52,480**	**59,425**	**3,284**	**0**



CAUTION: There are about 10 times as many civilians in the AWF as military, so straight attendance comparisons are problematic. Also, we do not have attendance by individual to understand the extent of analytic training across the entire AWF.

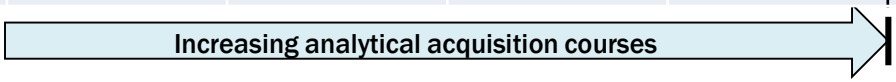
Through external institutions and established partnerships, DoD's workforce has access to additional data-analytics training

- Some specific examples of commercial institutions' programs in both data analytics and acquisition include:
  - *Georgia Tech* offers DAU-approved continuing education to government and acquisition professionals
    - Most courses are acquisition theory, process, methods, and tools related
  - *American University* offers the Key Executive Leadership Program in partnership with the DAU. Students in this program can attain an AU Master of Public Administration degree
    - Offers some courses involving data analysis, primarily analysis methods
  - *George Mason University* offers certificate programs for government contractors and acquisition professionals as well as an MPA in Public Administration. They also offer a MS, Data Analytics Engineering
    - Relatively few data analysis courses are present in the certificate programs; those present are primarily related to the cost discipline and are part of the Government Contracts Accounting Certificate
    - MPA Public Administration involves the highest number data analytics-specific courses relevant to acquisition out of all of the universities
  - *Georgetown University* offers a Master of Public Policy
    - Core classes are relevant to data science and various types of analysis
  - *George Washington University* offers an MS in Government Contracts
    - Has a few courses dealing with applied data analysis; however, most are acquisition theory and process related

External partnership institutions provide additional applied data analytics in acquisition

- GMU's MPA program has the highest number of courses in acquisition-applied data analytics
  - A few additional general data analytics courses are also available

	Acquisition Theory and Processes Only	Acquisition Theory, Processes and Methods	Acquisition Processes & Methods w/ Tools	Acquisition-Applied Data Analytics	General Data Analytics	Other (not acquisition or data related)	Total Number of Courses
GMU (CF&A)	5	0	0	1	0	0	6
GMU (CGA)	2	0	0	4	0	0	6
GMU (MPA)	0	1	0	8	2	7	18
Georgetown (MPP)	0	1	1	5	0	11	18
GA Tech	7	3	1	1	0	0	12
AU	2	2	0	4	0	7	15
GW (GC)	10	3	0	4	0	0	17
TOTAL	26	10	2	27	2	25	92



DAU also leverages strategic educational partnerships to provide opportunities to the workforce that DAU cannot support in-house

Course	Provider
Data Scientists Toolbox	Johns Hopkins University
Developing Data Products	Johns Hopkins University
R Programming	Johns Hopkins University
Machine Learning Foundations	Stanford
Applied Text Mining in Python	University of Michigan
Serverless Data Analysis with Google BigQuery	Google
Data Bases and SQL for Data Science	IBM
Cyber Training	DC3 Cyber Training Academy

Most are general data analytics courses

Thus, the Department of Defense acquisition workforce has access to data analytics training through multiple avenues

- DoD's acquisition training institutions have expanded their data analytics offerings
  - Data governance, database operations, data management, and data security are largely present in the curriculums of the universities
  - Some areas (e.g., data collection, data development, data transformation, data quality management, data architecture management) appear to be lacking in these institutions
- Understanding that DoD should be moving toward the use of advanced analytics in decision-making, DoD's institutions have taken multiple steps to improve offerings, including:
  - Additional partnerships with organizations at the forefront of advanced analytics (e.g., Google)
  - In 2018, NPS stood up a new interdisciplinary working group to streamline the way data science is developed, taught, and shared
- However, we did not assess the quality of the curriculum

Abbreviations

AABEP	Army Acquisition Business Enterprise Portal
ACAT	Acquisition Category
AFIT	Air Force Institute of Technology
AIR	Acquisition Information Repository
AL	analytic layer
AT&L	Acquisition, Technology, and Logistics
AU	American University
AVSG	Acquisition Visibility Steering Group
AVWG	Acquisition Visibility Working Group
AWF	acquisition workforce
CADE	Cost Assessment Data Enterprise
CAPE	Cost Assessment and Program Evaluation
CF&A	(George Mason University) Contract Formation and Administration
CGA	(George Mason University) Certificate in Government Accounting
CUI	Controlled Unclassified Information
DACIMS	Defense Acquisition Cost Information Management System
DAES	Defense Acquisition Executive Summary
DAMIR	Defense Acquisition Management Information Retrieval
DARPA	Defense Advanced Research Projects Agency
DAU	Defense Acquisition University
DAV	Data Analytics and Visualization
DAVE	Defense Acquisition Visibility Environment
DBS	Defense Business System
DCAA	Defense Contract Audit Agency
DCMA	Defense Contract Management Agency
DC3	Department of Defense Cyber Crime Center
DDRS	Defense Department Reporting System
DFAS	Defense Finance and Accounting Services
DIBNow	Defense Industrial Base Now
DoD	Department of Defense
DRDW	DoD Resources Data Warehouse
E&M	(AFIT School of) Engineering & Management
eSRS	Electronic Subcontracting Reporting System
EVM	Earned Value Management
EVM-CR	Earned-Value Management—Central Repository
FFRDC	Federally Funded Research and Development Center
FPDS-NG	Federal Procurement Data System—Next Generation
FOUO	For Official Use Only
FSRS	Federal Funding Accountability and Transparency Act Subaward Reporting System
FY	fiscal year
GC	George Washington University (GC)
GA Tech	Georgia Tech

Abbreviations (continued)

H.R.	House Report
IBM	International Business Machines (Corporation)
KM/DS	Knowledge Management/Decision Support
LIMS-EV	Logistics Installation Mission Support—Enterprise View
MCSC	Marine Corps Systems Command
ME	Masters in Engineering
MOCAS	Mechanization of Contract Administration Services
MPA	Masters of Public Administration
MPP	Masters of Public Policy
MS	Masters of Science
MTA	Middle Tier of Acquisition
NARA	National Archives
NAVAIR	Naval Air Systems Command
NDAA	National Defense Authorization Act
NDU	National Defense University
NPS	Naval Postgraduate School
OPM	Office of Personnel Management
OSD	Office of the Secretary of Defense
OUSD(AT&L)	Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics
PEO	Program Executive Officer
PM	program management
PMRT	Project Management Resource Tools
PQM	production, quality, and manufacturing
PRCP	Program Resources Collection Process
R&D	research and development
RDAIS	(Assistant Secretary of the Navy) Research, Development, and Acquisition Information System
S&L	(AFIT School of) Systems & Logistics
SAM	System for Award Management
SAR	Selected Acquisition Report
SET	Systems Engineering Transformation—Model-Based
SMART	System Metric and Reporting Tool
SME	subject matter expert
T&E	test and evaluation
UARC	University-Affiliated Research Center
URED	Unified Research and Engineering Database
US	United States
USD(AT&L)	Under Secretary of Defense for Acquisition, Technology, and Logistics
USD(I)	Under Secretary of Defense for Intelligence
Vol	Volume

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