



Proceedings of the **Fourteenth Annual Acquisition Research Symposium**

Thursday Sessions Volume II

**Acquisition Research:
Creating Synergy for Informed Change**

April 26–27, 2017

Published March 31, 2017

Approved for public release; distribution is unlimited.

Prepared for the Naval Postgraduate School, Monterey, CA 93943.



**Acquisition Research Program
Graduate School of Business & Public Policy
Naval Postgraduate School**

On Data Capabilities for Acquisition Management

Richard Wang—is Director of the MIT Chief Data Officer and Information Quality Program. He is also the Executive Director of the Institute for Chief Data Officers (iCDO) and Professor at the University of Arkansas at Little Rock. From 2009–2011, Wang served as the Deputy Chief Data Officer and Chief Data Quality Officer of the U.S. Army. He received his PhD in information Technology from the MIT Sloan School of Management in 1985. [rwang@mit.edu]

Ningning Wu—is Professor of Information Science at the University of Arkansas at Little Rock. She received a BS and an MS degree in Electrical Engineering from the University of Science and Technology of China and a PhD in Information Technology from George Mason University. Dr. Wu's research interests are data mining, network and information security, and information quality. She holds certificates of the IAIDQ Information Quality Certified Professional (IQCP) and the SANS GIAC Security Essentials Certified Professional. [nxwu@ualr.edu]

Abstract

Military logistics are responsible for sourcing and providing nearly every consumable item used by military forces worldwide. The process is highly complex; any misplaced decisions have serious cost and security consequences. Central to the entire process is the quality of the data used to make these acquisition decisions. We explore an enterprise approach to improving data capabilities for acquisition management, building upon a cumulative body of knowledge from Chief Data Officer (CDO) and information quality research and practice.

Overview

The success of the U.S. military acquisition process depends in large part on the ability to make data-driven decisions across the entirety of the organization in an efficient and effective manner. By connecting internal management from all branches of the Armed Forces to the Office of the Secretary of Defense (OSD) through improving data capabilities for acquisition management, the Under Secretary of Defense for Acquisition, Technology, and Logistics (USD[AT&L]) provides data stewardship, data access, and data analysis to help improve acquisition insight, management, policies, and processes for trillions of dollars in budgetary assets. These processes are then more accurately measured in reports delivered to the OSD and Congress. Department-wide acquisition includes aspects of performance improvement, budget planning, industry reviews, program milestone decisions, program portfolio reviews, program insight, and portfolio oversight. These deliverables make up the bulk of reporting information and are the responsibility of the USD(AT&L). The mission of improving data capabilities for acquisition management, supported by the Acquisition Resources and Analysis branch of Enterprise Information at the Department of Defense (DoD; see Appendix A), is to provide leadership with timely access to accurate, authoritative, and reliable data supporting acquisition oversight, analysis, and decision-making.

A closer look at the evolution of acquisition policy (Appendix B) at a successful defense acquisition program, as defined by the Office of the Secretary of Defense, shows the definition to be “a program that satisfies national security objectives, provides a balanced force structure, and does not attract undue congressional scrutiny” (Brown, 2010). For the program manager, success also means overseeing a system that is delivered on time, within cost, and meets requirements of their staff. The Quadrennial Defense Report identified four major problems in the DoD's ability to acquire military capabilities in a timely and affordable manner (Brown, 2010):



- Requirements for new systems too often reflect the far limits of current technology, and requirements that continue to increase throughout a program's life cycle.
- The acquisition workforce lacks the trained personnel in the areas of cost estimators, systems engineers, and acquisition managers. This causes problems in the conduct of effective oversight.
- The acquisition process too often encourages overly optimistic cost estimates. Underestimating cost is likely to result in too many programs chasing too few dollars, and cost threshold breaches requiring program terminations and increased reporting to Congress.
- Improvements are needed in the effective and efficient delivery of logistical support to the fighting forces in the field.

These problems outline the heart of Augustine's Laws as they relate to acquisition in the U.S. military. Simply put, there is a cyclical relationship between the acquisition community and contractors that seemingly cannot be broken in the status quo, as the free market pressures that typically would step in and self-regulate supply and demand fluctuations do not exist in the same manner in this closed environment. The budgetary and acquisition problems faced are in desperate need of resolution. The emerging "big data" solutions seem to begin to address pitfalls of military acquisition theory and practice identified by Augustine (Appendix C).

In order to more fully understand the problems facing the growth and realization of improving data capabilities for acquisition management, we must look at the difficult task facing individual program managers, as they try to create the maximum amount of value for their individual program, while consistently facing scrutiny from a variety of sources regarding their respective cost and output levels. Figure 1 shows us the complicated environment of the program manager (Brown, 2010).

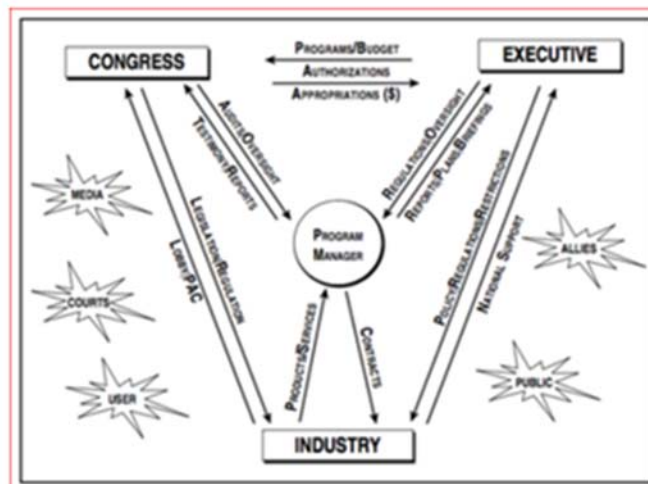


Figure 1. The Program Manager's Environment

By acknowledging the various types of interference involved in the program manager's execution of duties, we recognize why resistance to modifications of protocol can be so difficult to overcome. Once program managers discover how to navigate the difficult waters of program implementation, it seems understandable that they might resist modification of their proven methods of solving complex management issues. Additionally,

by utilizing Augustine's Laws of military acquisition theory (Augustine, 1997), we can begin to understand the difficulty surrounding program managers and the frequently shifting environments in which they are expected to perform their duties. In addition to having a budgetary status that is uncertain and often-changing, many program managers will never see the completion of their own projects, as the life cycle of program managers is shorter than the average lifespan of a program, often even with the narrowest of perspectives.

Defense Acquisition Management Systems

Conducting a shortened analysis of the Defense Acquisition Management System is a difficult task, in part due to the sheer volume of steps, and in part due to the degree of acronyms utilized in conducting programs. DoD Instruction (DoDI) 5000.02 provides an outline of the in-depth protocols for conducting these processes, and it would also be useful to have *Introduction to Defense Acquisitions Management* (10th ed.) as a primer for understanding the colloquialisms and protocols involved in each step. However, it is important to acknowledge a few certain prime movers and processes in this process to begin any understanding:

- Defense Acquisition Executive (DAE)—The DAE is the Under Secretary of Defense for Acquisition, Technology, and Logistics (USD[AT&L]). The DAE acts as the Milestone Decision Authority (MDA) for Major Defense Acquisition Programs (MDAPs) and Major Automated Information System (MAIS) programs.
- Milestone Decision Authority—The MDA establishes procedures for assigned programs using DoDI 5000.02, and tailors program strategies and oversight, including program information, acquisition phase content, timing, and scope of decision reviews and decision levels, based on the specifics of the product being acquired, including complexity, risk factors, and required timelines to satisfy validated capability requirements. The MDA is the sole and final decision authority.
- Program Acquisition Categories (ACATs)—All defense acquisition programs are designated by an ACAT (i.e., ACAT I through III) and type (e.g., MDAP, MAIS, or Major System)
- The Defense Acquisition Board (DAB)—The DAB advises the DAE on critical acquisition decisions when the DAE is the MDA. The DAE or designee will chair the DAB. An Acquisition Decision Memorandum (ADM) will document decisions resulting from reviews. Similar procedures will be established at the Component level for use by other MDAs.
- Program Managers—Under the supervision of Program Executive Officers (PEOs) and CAEs, program managers are expected to design acquisition programs, prepare programs for decisions, and execute approved program plans.

Figure 2 from DoDI 2010 gives an idea of what the acquisition phases and decision points might look like, so that readers might have an idea of processes involved in development of technology.



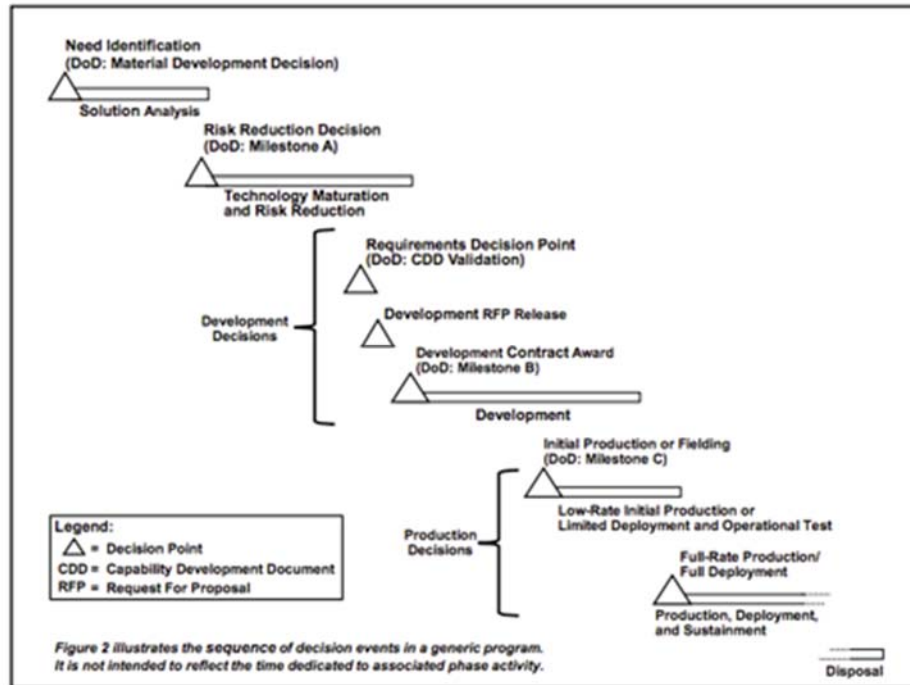


Figure 2. Generic Acquisition Phases and Decision Points

Opportunities for Advancement

It has long been proposed that, among other government practices, reporting data for federal acquisitions should be standardized to help make that data more accessible and useful. Recent research findings have shed significant light to support the importance of data quality. Accompanying such research progress includes advances in data analytics, data integration, data wrangling, and data visualization. Here *data wrangling* refers to any data transformation required to prepare a dataset for downstream analyses. Striding the entire process is the subject of data governance, which provides the centralized, and enterprise level oversight of corporate and enterprise data as an asset.

Many important acquisition management research issues have arisen from the emerging chief data officer practices. Additionally, acquisition planning, resource allocation, and other kinds of decisions depend critically on the data used in supporting these decision-making processes. Too often the question arises: How much do poor-quality data cost? How do untimely data, incomplete data, inconsistent data, untrusted data, and inaccurate data impact the eventual decision, and the subsequent operations and strategic making? Answering these questions will provide an acquisition guideline concerning how much it is worth investing to identify various root causes of poor-quality data, and continuously improve them throughout the acquisition decision cycle and their underlying data life cycle.

Research Approach

We propose a holistic enterprise approach to improving data capabilities for acquisition management, encompassing many interrelated research components:

1. A data platform with data technologies to handle a variety of data in high volume and velocity
2. Innovative data quality and data integration solutions, as well as state-of-the-art big data tools for improved data capabilities.

3. Data analytics ranging from simple business analytics to machine learning algorithms, to large scale math programming methods to improve acquisition management
4. Improved data capabilities in this data platform through emerging chief data officer and information quality research results and industry practices
5. Application of this holistic approach in various organizational settings to identify issues critical for future acquisitions research

Research issues will be addressed and research findings written for senior acquisition leaders and academic researchers. We expect three areas of research results:

- An assessment of the state-of-the-art, data-centric acquisition management practice
- Characterization of the salient features of successful outcomes
- A requirement analysis of tools, methods, and techniques that should be developed to improve acquisition management

We have used datasets from USASpending.gov to perform preliminary tasks. To begin with, we have downloaded 40 GB of DoD spending data, then loaded it into four tables that are categorized as PrimeAwardContracts, PrimeAwardsOFA, SubAwardContracts, and SubAwardGrants. The following are some preliminary findings:

- For some of the key fields, we have seen a number of data quality issues, such as misinterpretation, missing values, columns with no data, inconsistent representation, and fitness for use.
- There are chances of information dissemination when sensitive data is shared in public. It could potentially expose the information to users for exploitation purposes or hampering the business. This could be a possible weak link that is exposed here.

For instance, following is a sample use case that describes this scenario. For a company with prime_awardee_parent_duns : 217304393, we can easily retrieve the key information. The statistics of the company and the work that it does are exposed, which could be a possible risk. We can get information such as the following:

- We can see top products or services this company does for the DoD.
- We can also infer more information based on sub-awards by spending type or received ones.
- We can see more information on total funds awarded as prime and as sub-awardee.

(See

<https://www.usaspending.gov/transparency/Pages/RecipientProfile.aspx?DUNSNumber=217304393&FiscalYear=2017>.)

In addition, when this information is combined with other information available on the Internet, more information might be inferred. To find information related to acquisition from the available data sources, we need to take a big dive into the datasets and see if we can design a model or logic to answer these big questions. We have begun to perform analysis to see how we can cross compare data from different units by applying Extract, Transform, and Load (ETL) and data analytics processes.

Specifically, we are replicating the same for other units to see how to operate in terms of resourcing, executing, deciding, and reporting the data well. Since this is big data



problem, we plan to do a migration of all the data to Amazon Web Services to conduct further research analysis that traditional military acquisition theory and practice failed. Moreover, we are exploring opportunities on collecting more data for big data analysis for cross comparing the datasets from different units to see if we can infer relationships and conduct possible analysis to increase the business value.

Concluding Remarks

The mission of improving data capabilities for acquisition management is to provide leadership with timely access to accurate, authoritative, and reliable data supporting acquisition oversight, analysis, and decision-making. In this paper, we have reviewed the Defense Acquisition Visibility Environment, the evolution of acquisition policy, Augustine's Laws, related literature, and the defense acquisition management systems.

We explored opportunities for advancement in acquisition management and proposed a holistic enterprise approach to improving data capabilities for acquisition management, encompassing many interrelated research components. Next, we applied USASpending.gov datasets, unraveling data quality issues like misinterpretation, missing values, columns with no data, inconsistent representation, and fitness for use. We are poised to demonstrate that when sensitive data is shared in public, it could potentially expose the information to users for exploitation purposes or to hamper the U.S. acquisition management practice. Our research findings could strengthen U.S. acquisition decision-making processes while preventing adversaries from exploiting public data to hamper defense acquisition management practice.

References

- Augustine, N. R. (1997). *Augustine's laws*. AIAA.
- Brown, B. (2010). *Introduction to defense acquisitions management* (10th ed.). Defense Acquisition University.
- Cilli, M. et al. (2015). A systems engineering perspective on the revised defense acquisition system. *Systems Engineering*, 18(6), 584–603. doi:10.1002/sys.21329
- Defense Acquisition University. *DAU Center for Defense Acquisition Research agenda 2016–2017*. Retrieved from http://dau.dodlive.mil/files/2016/01/ARJ-76_ONLINE-FULL.pdf
- Gaither, C. C. (2014). Incorporating market based decision making processes in defense acquisitions. *International Journal of Defense Acquisition Management*, 6, 38–50.
- Hagan, G. (1998). *Glossary: Defense acquisition acronyms and terms*. Fort Belvoir, VA: DoD, Defense Systems Management College.
- Krzysko, M. (2012, February). The need for acquisition visibility. *Journal of Software Technology*, 4–9.
- Krzysko, M. (2016). Acquisition decision making through information and data management. Retrieved from http://www.digitalgovernment.com/media/Downloads/asset_upload_file917_5737.pdf
- Miller, A., & Ray, J. (2015, January). Moving from standard practices to best practices in defense acquisition. *Defense ARJ*, 22(1), 64–83.
- Pennock, M. J. (2008). *Defense acquisition: A tragedy of the commons*. ProQuest.
- Under Secretary of Defense for Acquisition, Technology, and Logistics (USD[AT&L]). (2007, November). *Operation of the Defense Acquisition System* (DoDI 5000.01). Washington, DC: Author.



Under Secretary of Defense for Acquisition, Technology, and Logistics (USD[AT&L]). (2015). *Operation of the Defense Acquisition System* (DoDI 5000.02). Washington, DC: Author.

Zhao, Y., MacKinnon, D. J., & Gallup, S. P. (2015, May). *Lexical Link Analysis (LLA) application: Improving web service to defense acquisition visibility environment*. Monterey, CA: Naval Postgraduate School, Acquisition Research Program.

Acknowledgments

Work reported herein has been contributed, in part, by Kiran Kumar Bandeli, Yupo Chan, Eva Lee, William Parsley, John Talburt, and many colleagues in the Department of Defense.

Appendix A: Defense Acquisition Visibility Environment (DAVE)

The Improving Data Capabilities for Acquisition Management Model, when fully realized, will feature three parts: the **DAVE portal**, **DAVE Platform**, and AV Data Framework.

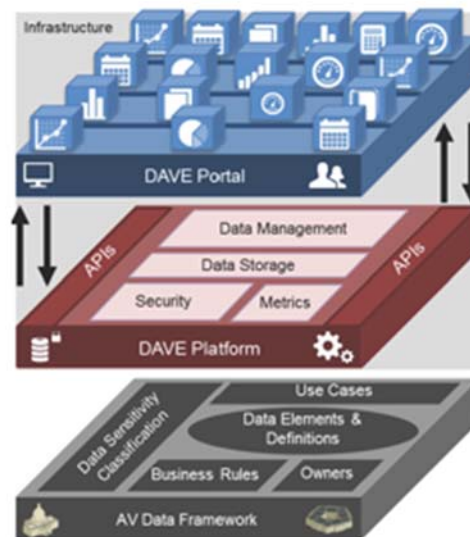


Figure 3. Improving Data Capabilities for Acquisition Management Model

DAVE Portal: The **DAVE portal** is a synthesis of interactive infrastructure including data visualizations, calendars, and project management tools that are set to continue to grow in scope and capability as DAVE expands. These diverse tools with analysis capabilities will help users answer such questions as, “Are we solving a business problem by assessing the efficiency and effectiveness of the project?” and “What value does the project add to acquisitions in the Department of Defense?”

DAVE Platform: The **DAVE platform** includes the Application Programming Interfaces (APIs) for data management, data storage, metrics, and security. The **DAVE** platform determines the APIs for facilitating data access, and determines to which party the information can be shared. This platform is made up of a single intuitive interface for all data, and supports the implementation of a data exposure strategy of acquisition of data, promotion data sharing, and also provides for flexibility. The APIs are the building blocks that allow for the integration of features or data, and the platform itself processes the data to get it to the state users require, as well as coordinating internal processes. These APIs also allow for a greater flexibility with analytics and faster development of new capabilities. The

platform also facilitates data management, allowing a flexible yet technical approach for understanding, sharing, and protecting data. Throughout the entire process, APIs provide support for all the **DAVE** functions, ensuring security and proper access. At this time there are 350 structured item types and 84 unstructured document types, including data sets.

AV Data Framework: The AV Data Framework is the foundation on which the portal and platform are built and provides a number of essential elements including use cases, data elements and definitions, business rules, guidelines and markers regarding ownership of data, and data sensitivity classifications. The AV Data Matrix (AVDM) includes the definitions, definition owner, laws, regulations, data governance policies, data providers, and functions as the authoritative source for all data. It also includes data stewardship, representing the agreement and accountability for definitions and authoritative data. Currently, under **DAVE** governance, there are 582 acquisition data elements.

By providing department-wide access to DAVE to all branches of the armed forces, essential federal government agencies, Aerospace, Institute for Defense Analyses (IDA), the RAND Corporation, and the MITRE Corporation, among others, USD(AT&L) hopes to bring together all aspects of the acquisition process into one large data resource and to standardize that resource using entrenched data quality benchmarks and techniques. This data resource would then be made available to the appropriate recipients who could then take advantage of the value of timely and quality data. Governance would also be provided through the involvement of governmental agencies in the oversight and management of the data in DAVE. These agencies include the Assistant Secretary of the Navy (ASN), Information Systems (RDAIS), System Metric and Reporting Tool (SMART), Defense Acquisition Management Information Retrieval (System) (DAMIR), Defense Data Repository System (DORS), Defense Technical Information Center (DTIC/AIR), Earned Value Central Repository (EVCR), OUSD Budget Materials, Cost Assessment Data Enterprise (CADE), and other authorized entities. The input, oversight, and expertise of these groups would add their own aspects of value to the DAVE system and in return would be able to reap benefits of information on potential projects of their own.

The goals of this updated model of **DAVE** are clearly outlined in *Acquisition Decision Making Through Information and Data Management*: “streamline reporting, improve[d] availability of data for analytics, enabling decisions based on analytics through faster development of new capabilities, [and] incorporate[d] evolving security requirements” (Krzysko, 2016). The updated model of **DAVE** establishes a framework for improved and expanded support for the USD(AT&L), and does so by using data and the inherent value produced through increasing information quality to improve upon the current practices of programs managed by USD(AT&L). By continuing to develop and implement **DAVE**, the USD(AT&L) will create a platform for big data, enable new acquisition capabilities, coordinate operational alignment, and support analysts to enable decision-making (Zhao, MacKinnon, & Gallup, 2015).

Analyzing Programs for Insight

Actions and projects undertaken in the U.S. Armed Forces are conducted in what is referred to as programs and are led by program managers. However, the exact definition of *program* varies among services. At the base level, we have programs, led by program managers, who are in turn led by Program Executive Officers, who are led by service level executives (Air Force, Navy), who are then led by the DoD-level leadership. What is missing from the following organizational chart are the five main goals of program managers, which tie together DoDI 5000.02 and **DAVE** goals: solve the business problem, solve the data problem, solve the organizational problem, drive efficiency, and drive effectiveness.





Figure 4. Program Organizational Chart

Appendix B: Evolution of Acquisition Policy

With the Better Buying Power initiative introduced in 2010 by then USD(AT&L) Ashton Carter, a new focus was directed to reworking how the DoD managed its complex acquisition practices. This model directly challenged the department to improve its methods of acquisition management, oversight, and process. This move was in part due to a budget that had risen to \$1.7 trillion dollars, a 60% increase in under 10 years. USD(AT&L) was faced with a need to find a way to use the data at their disposal to change their practices as they came to expenditures and outcomes in order to develop more data-driven analytics and guidelines (Pennock, 2008).

The message was clear: data and information were key to managing, overseeing and streamlining processes within the acquisition portfolio, but DoD would require diligence to obtain it. Data offered innovative perspectives on acquisition processes, delivering the necessary insight into acquisition cost, performance, affordability and other critical elements. Empowered with data, DoD leadership could report, analyze, and make informed decisions on the Department's complex acquisition portfolio.

This mandate then directed a team to focus on using structured data for insight into areas for improvement within the DoD, with areas of focus being data governance and using data as a service. The team could “identify authoritative sources of major acquisition information; have consistent, semantic definitions across the Department; measure data for accuracy, reliability and availability; and provide it to acquisition leadership for use in any visual tool giving them data-driven insight into the major acquisition portfolio.” The pilot program proved that the DoD could manage and govern acquisition information and could provide data and information as a service in an efficient and effective way.

This was truly a game-changer for the USD(AT&L). Acquisition data was now understood as essential to effectiveness, and structured data was seen as the new way forward. This prompted the creation of “an on-demand environment that could provide data across the enterprise seamlessly and efficiently” (DAU, 2016). This became known as Acquisition Visibility (AV), which was made formally effective as of July 2009. AV is officially defined as “having timely access to accurate authoritative, and reliable information supporting acquisition oversight, accountability, and decision making throughout the Department for effective and efficient delivery of warfighter capabilities” (USD[AT&L], 2007). AV quickly grew into an essential source of information across the Department, with teams providing functional, technical, and data expertise. AV now includes all major defense acquisition programs and shares operating costs as well as earned value management data.



AV increases transparency, which aids reporting, helps reduce costs, and is responsive to users (USD[AT&L], 2015).

In July 2015, the DoD revised its defense acquisition system policy, moving from DoDI 5000.01, *Operation of the Defense Acquisition System*, to DoDI 5000.02. DoDI 5000.01 provided a basic set of definitions and three overarching policies that governed the defense acquisition system: flexibility, responsiveness, and innovation. Part of the cause for this shift in policy was a need to address suspected root causes hindering higher success rates. DoDI 5000.02 established a management framework for translating mission needs and technological opportunities into “stable, affordable, and well-managed acquisition programs” (Brown, 2010). DoDI 5000.02 established a general approach for managing all defense acquisition programs while authorizing program managers and the Milestone Decision Authorities (MDAs) discretion to exercise prudent business judgment in structuring tailored, responsive, and innovative programs (Brown, 2010). DoDI 5000.02 placed increased emphasis on the use of systems engineering activities applied early in the project life cycle, so that meaningful tradeoffs between capability requirements and life-cycle costs could be explored and to ensure that realistic program baselines were established such that associated life-cycle costs would fit within future budgets (Cilli et al., 2015).

This effort to move away from the open-loop capability requirements writing approach toward a closed-loop capability requirements writing process informed by rigorous assessments of a broad range of system level alternatives across a thorough set of stakeholder value criteria to include life-cycle costs, schedule, and performance. (Cilli et al., 2015)

As of 2016, the OSD is fed reports from a variety of unaffiliated data sources. Individual program offices are responsible for managing and streamlining their own programs, and are given the authority to make modifications to their programs in ways that they best see fit. Unfortunately, this practice creates a multitude of largely unstructured, loosely-governed data that are difficult to manage, report on, or standardize, which are then fed to the OSD without first having data quality best practices applied (Gaither, 2014). Acquisition decisions are primarily made at the service level, which is understandable considering they are the parties who will be responsible for said items in the field, but this division between program managers, MDAs, and the OSD has created communication gaps which need to be overcome in order to adequately manage and translate data from one entrenched group to another. In the past, the USD(AT&L) has expressed that the following are areas where improvement is essential to the continued success of Improving Data Capabilities for Acquisition Management, and acquisitions in general (Hagan, 1998):

- Initial operational test ratings
- Incorrect testing and management of program expectations and deliverables
- MDAP Research Development Test & Evaluation (RDT&E) funding growth from original baselines
- Falling competition rates
- Subcontracting roadblocks
- Overly optimistic program baselines
- Lower development schedule growth compared to development cost growth

Users also need to retire legacy reporting systems, but still must report their data consistently before, during, and after system retirement takes place. This conflicts in principal with the DoD goal of encouraging deeper data analytics by confusing data types and targets (Miller, 2016). Currently, acquisition data management functions by combining



data and information access, federated data stores, and a variety of older data resources (DAMIR, KScope, AIR, Data Matrix, etc.) into one large data repository. Improving data capabilities for acquisition management seeks to provide the DoD with data and analysis support capabilities to better inform the acquisition community. At its fully-realized potential, improving data capabilities for acquisition management would function as the location, platform, and framework for the DoD to access and utilize this data more fully than ever before. This newly revised model of Improving Data Capabilities for Acquisition Management would represent a shift from the collection of capabilities into one fully integrated and mature analytics system, where an integrated data processing background would support an agile environment and efficient data and information access.

Appendix C: Augustine's Laws and Major System Development Programs

In 1979, Norman Augustine, the then assistant director of Defense Research and Engineering in the Office of the Secretary of Defense, penned a tongue-in-cheek piece on the pitfalls of military acquisition theory and practice, and to this day, it is touted as a highly accurate, if comical, display of the discouraging practices involved with acquisitions in the U.S. military. All jokes aside, and there are many jokes, his analysis was accurate in that even in 1979, Augustine could accurately predict the degree to which military spending, employment of civilian population, time management decline, and program failures would continue to the modern military procedures post 9-11. His insights were so striking because, first, he was in the position to make them, and second, unlike so many of his predecessors and even successors, he was frank about these problems and their sources. To attempt to construct a better model for the acquisition programs would be impossible without incorporating many of Augustine's "Laws." Some of the more appropriate ones reduced to theories for incorporation include the following:

- The bottom half of the production produces less than 20% of the output.
- Delivery of items will take on average one-third more time than initially estimated.
- The "doing" time has not increased, but instead the "planning time" has.
- Systems are now obsolete almost before they enter the field.
- In non-competitive processes, time expands to fit the work prescribed.
- "Lightning" in the form of unforeseen circumstances, usually negative (or unknown unknowns, as compared to known unknowns) will strike every project, but the cost-cutting bidding measures that prevail in cost-reimbursing contract work doesn't allow for controlling or budgeting for said factors.
- More complex systems are always more expensive, but don't always translate into contributing that much more success of military actions in the field, and especially not to the degree to which they are more costly.
- Most programs get a one-year honeymoon period, and from there the chances of being cancelled increase every year by a linear factor.
- Price-reduction bidding incurs the problem of rewarding a contract to a new business who does not understand the difficult lessons learned by the original producer of the item, who set the original price that began the bidding process.
- Congress will approve the defense budget for the given year as: the budget of the prior year, plus 3/4ths of what is requested, and minus a 4% tax.
- Regulations as a management surrogate will grow at an exponential pace.



- Program managers responsible for long-term projects often are not in their position long enough to see most of their project completed.
 - “By the time the people at the top are ready for the answer, the people at the bottom have forgotten the question.”
 - There is no incentive system to assist in rewarding good managers, and vice versa.
 - It would be pertinent to reduce the number of acronyms used to clear up understanding.
 - Software is always expanding and increasing in complexity.
 - If you send money to the management of a project that is in trouble, they will remember you the next time they need money.
- (Augustine, 1979, 2015)

Appendix D: A Preliminary Literature Review

The following are theories that offer critiques of the current system and opportunities for constructive modifications.

Lexical Link Analysis

In 2015, researchers from the Naval Postgraduate School utilized Lexical Link Analysis (LLA) as a way of improving web services for Improving Data Capabilities for Acquisition Management and found there were significant opportunities for further research (Zhao et al., 2015). LLA, a hash-like process, was used to find a “fit” between budgets, final products, and requirements using reports, visualization, and linguistic analysis. Collaborative learning agents for pattern recognition were also tested, and may allow for scaling up to big data. Topics mentioned as opportunities for further study were system self-awareness, big data architecture and analytics, and deep learning. By examining acquisition data sources, we might be able to perform big data analytics and gain business insights from contractor relationships, budget analysis, time series analysis, and so forth. Additionally, system self-awareness might be utilized to compare behavior among nodes, and compare these relationships to business processes.

“Push, Practicality, and Pull” Theory of Standardization of Practices

In *Moving From Standard Practices to Best Practices in Defense Acquisition*, Alex Miller and Joshua L. Ray (2015), economics professors from University of Tennessee, Knoxville, and members of the Defense Acquisition University (DAU), looked at utilizing “Big Checks” as a method to help illustrate cost-saving and value-production to communicate value in data-driven investments. They found that personal-best-interest was the primary motivating factor in defense contractor work, and suggest extending this model to defense logistics and acquisition. Their prime theme, “What’s in It for Me?” (WIIFM), found that the following six forces work collectively to influence the extent to which organizations are able to turn isolated best practices into widespread standard practices:

- Inherent Stakes
- Making Advantages Visible
- Replicability of Work
- Implementing Standard Work
- Organizational Alignment
- Driving Compliance



Producing a single communication system could help break through the negative cycles of acquisition times, budgetary oversights, and data governance issues, if only the ideas were shared appropriately. This stands as a model for the prime mover of Improving Data Capabilities for Acquisition Management as well as with WIIFM. In both instances, the stakes need to be visible and clear. For example, efforts to reduce acquisition cycle times produced impressive breakthroughs, often with cycle times reduced 40–60%. And yet, there is little evidence that the efforts producing these performance gains are encouraged as standard practices:

Consider the perspective of members of a defense acquisition program team who had greatly reduced their source-selection time, allowing a badly needed system to be put under contract months earlier than expected. No one on the team could identify a single request to share ideas with other source-selection teams. Furthermore, members of the successful team were not confident that members of this team would apply lessons learned from their effort, even to their own future source selection work! (Miller & Ray, 2015)

Defense acquisition suffers from what can only be described as an abundance of, and yet a severe drought of, communication in policy execution. Often, the process that is undertaken to accomplish a program takes so long that by the time the higher brass have decided about an appropriate solution, there is no longer a problem at the lower ranks. And yet, it is in these same situations that DAVE could function as a model to increase communication in the acquisition process through data management strategies. It seems that the current model of defense communication does not make a large enough effort to systematically share best practices, even though the work performed across departments is very similar and often utilizes the very same contractors.

The most common answer in response to questions about this lack of standardization was very revealing in that it highlighted the importance of perceived high stakes as a driver: “Standardization across organizational boundaries is hard. Why do it if we can get satisfactory performance working on our own?” ... The perceived stakes inherent in defense acquisition are not sufficiently high to be an important driver of efforts to standardize and replicate processes. Note the emphasis on perceived stakes; the actual stakes are really quite high, suggesting the need for managers to make the stakes more visible. (Miller & Ray, 2015)

Tragedy of the Commons

In his research paper, *Defense Acquisition: A Tragedy of the Commons*, Michael Pennock (2008) argued that the DoD should recognize the Tragedy of the Commons as it relates to the development and implementation of new military contractor work and pursue mature technologies as project and programs expand in scope. Pennock presents the reader with a model with mathematical analysis for the conundrum and consequences of increased project requirements burdening the system by adding increasingly expanding scope and subsequently immature technologies to meet uncharted project scope areas. This process unnecessarily burdens the system and eventually causes failure, budgeting crisis, and cost-overages.

To understand this situation, a mathematical model of a series of acquisition programs is developed and analyzed. It reveals that when differing stakeholder interests come into play, the program suffers from a classic tragedy of the commons. The program serves as a common resource for these stakeholders, and they are incentivized to pursue aggressive



performance requirements that necessitate immature technology. The critical aspect of this result is that this behavior is rational. In other words, the behavior we see is exactly what we should expect to see. This suggests that the recent trend in defense acquisition to reduce costs by aggregating the requirements of multiple groups of users into a single program may actually be counterproductive. This result has implications for the policy makers, managers, and engineers that are responsible for developing and deploying defense systems. (Pennock, 2008)

Big Data

When we think about big data, we typically think of the “Big 3 Vs”: velocity, volume, and variety, and with the “4 Big Questions” (Hagen, 2015)

- Where will big data and analytics create advantage?
- How should we organize to capture the benefits of big data and analytics?
- What technology investments can enable the analytics capabilities?
- How do we get started on the big data journey?

When considering the value of these questions in terms of the acquisition process defined thus far, it is essential to consider the purpose and value of supply chain data structures. If Big Data can get a handle on the vast amount of resources at the behest of the USD(AT&L), the ability to move and sort not only data, but actual goods and services to areas of need could be monumental. If every good, service, and data point was given a stock keeping unit (SKUs), and these SKUs were consistently measured and accountable using our Big Data resources, in the event of a need in one area, the SKUs could automatically be routed to that area as a sort of economic triage immune system response. Instead of being bombarded with white blood cells or antibodies, however, a program manager in need of lumber might get a notification that three program managers have excess or unused lumber at the moment, and these could be selected by geographic distance to find the best logistical match. And unlike typical supply chain structures, the U.S. military is in a unique position to control the goods, services, supply chain, and communication devices relative to its operations. By incorporating already in owned transportation techniques to ease transport and arrival, USD(AT&L) could reap the rewards of a supply chain windfall, not unlike how Wal-Mart based much of its low-price strategy on its ability to ship the predetermined number of goods to designated stores by using single palettes for multiple good types. This could also help to build a predictive model so that the next time the program manager is almost out of lumber, the model will already be working on the best possible solution before the need becomes a reality.

Map/Reduce & Scan/Hash

Two final non-mutually exclusive suggestions stem from reading thus far. First, a Map/Reduce algorithm could be applied to create associations with terms, groups, and contractors in an attempt to learn from previous work orders, experiences, reports, and so forth. This would allow us to create a working and searchable knowledgebase that is responsive in real-time to inputs in Improving Data Capabilities for Acquisition Management, and generates a report of potential helpful pieces of past reporting (which is sensitive to security needs, of course). If a program manager were entering in his cost reporting data for his program for XYZ Manufacturing Company, Improving Data Capabilities for Acquisition Management could point the program manager to alternative contracts with XYZ Mfg. This could help not only expedite work order forms and billing information, but might also allow the program manager to get into touch with individuals in other departments who have experience working with XYZ Mfg. This manager could utilize **DAVE** to then quickly



message the other party to ask questions, to ask for tips, or to request insight into their experience with XYZ.

A Scan/Hash function that searched for acronyms and replaced them with complete and readable terms for use in Improving Data Capabilities for Acquisition Management might save many users headaches and help to encourage simplification, if only at the linguistic level. This could create ease of use solutions for users, and a general increase in understanding of complex acquisition processes.





**Acquisition Research Program
Graduate School of Business & Public Policy
Naval Postgraduate School
555 Dyer Road, Ingersoll Hall
Monterey, CA 93943**

www.acquisitionresearch.net