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A Historical  
Perspective

**“Better, Faster,  
Cheaper”—  
Possible but  
Unlikely**

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# Simulation and Scenario-Based Training

*James N. Phillips, Jr., DBA, PMP, CFCM*

**A**N UNNAMED ACQUISITION SAGE ONCE SAID, “WE WOULDN’T PUT A NEW PILOT INTO A \$100 million aircraft without first having him put in some time in a flight simulator; so why does it make sense to put a new acquisition team on to a \$100 million Source Selection without the same degree of attentiveness?” As we look to create meaningful real-time training, the need to add simulation to the mix is important. For many, it is easy to visualize a training simulator, but it is less easy to see simulation or scenario-based acquisition training. Simulation, as differentiated from an exercise or a workshop, seeks to train on a specific subject and infuse meaningful experience to those participating in the simulation. Using scenario-based acquisition models focuses on team building, gaining a process familiarity through use, and creating a common core of experience shared by the intact team. The result provides for greater team confidence by building team competence.

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(Editor's Note: Also see "Acquisition—Practice Like You Play; Simulated Learning as the Key," by Chad Millette, *Defense Acquisition* magazine, September-October 2018, pp. 28-32.)

### **Some Terminology Explained**

It is not uncommon to hear the phrase "attention to detail" bandied about an acquisition office. What does attention to detail mean? It generally means you must focus or pay attention or you will miss something important. So what does something important mean? In order for acquisition professionals to know if something is important, they need to know something about something. For instance, in creating requirements, there may be parts of the requirement that are so critical that failing to include them will exclude a contractor from the competition. A common term for these critical parts is "salient characteristics." But how are you to know if the characteristic is salient? The answer is by paying attention, learning from experience, and knowing the goods or service and the requirement.

Members of the acquisition team, particularly contracting professionals, are not ordained experts in their discipline merely because they took the course and received a certificate. Highly functioning teams work together on common projects to achieve positive results. Simulation is used to achieve that end.

### **History**

In 1990, the passage of the Defense Acquisition Workforce Improvement Act (DAWIA) ushered in an aggregated and consolidated understanding of how to manage and train the Defense Acquisition Workforce. Prior to 1990, each Service component had its own acquisition training system with each following the Federal Acquisition Regulation (FAR) through agency supplements. As a result, this consolidation was seen as necessary to support the jointness as identified in the 1980s' Packard Commission on defense management.

Training was consolidated and standardized for the workforce under DAWIA through the establishment of the Defense Acquisition University (DAU) system. DAU was set up to provide not only standardization, but rigor, to the acquisition system, and serve as a think tank to support senior decision makers.

It is important to note that action taken by the Department of Defense (DoD) has reverberated across the entire federal government, as in training for nonmilitary agencies' acquisition professionals. This affected the training industry and had allowed development of uniformity in essential basic training in the field.

As the goods and services change, so too must the training of the acquisition workforce. It is no longer acceptable

to suggest that delays are just part of the system. The acquisition workforce now is expected to work smarter and find solutions using creative and critical thinking. Concepts such as other transaction authority (OTA) and agile were essentially unheard of 10 to 20 years ago and now are part of today's acquisition vernacular. The integration and cross-pollination from other allied disciplines (lean, project management, supply chain, etc.) have become more important as the system seeks a more vibrant and robust performance from its acquisition workforce.

Customer engagement becomes a meaningful component of assessing a systems performance. The system that cannot deliver the goods or services to the location where needed is not satisfying the customer's requirements. Accordingly, the acquisition system must not only teach what the tools are and how to use them; it must also teach when it is appropriate to use the tools and when alternative tools would be a better choice.

### **DAU Learning Types**

DAU is the premier corporate learning center for DoD. DAU is charged with teaching and researching in support of the defense acquisition system and uses three main learning methodologies to support its charter: Foundational, Workflow, and Performance Learning.

Foundational Learning occurs as a result of initial training by an employer. This type of training creates the foundation on which all other training will be built. Foundational Learning is classroom or computer-driven and content focused, and aims to deliver content. Foundational learning is highly structured. Yet Foundation Learning is necessary because it allows for more challenging and difficult concepts to be introduced later.

Workflow Learning is designed to improve what is—i.e., how we operate now. Workflow Learning is unstructured and is different than Foundational Learning. Workflow Learning engages the natural inclination of the workforce to improve and standardize. Common training might be lean, six sigma or project management to expand the workforce's thinking as related to its environment. Here the creation of work aids such as check lists and flow charts help the acquisition professionals better tackle their work using more refined tools and techniques. A good tool for this is the Instruction, Direction and Correction model.

(Editor's Note: Also see "Instruction, Direction and Correction: Improving the Acquisition Culture" by James N. Phillips Jr., *Defense AT&L* magazine, March-April 2018, pp. 26-28.)

Performance Learning, for the purpose of this article, will focus on what is commonly referred to as Mission Assistance (MA), which is not training but, rather, facilitated

learning. Performance Learning has an eye on a future result or outcome. While Foundational and Workflow Learning both focus on the current status, Performance Learning aggregates and synthesizes learning toward what ought to be. This forward-leaning learning is consistent with consulting so that MA facilitators are considered consultants.

Performance Learning focuses the higher levels of Benjamin Bloom’s Taxonomy, the DIKW Model, and Donald Kirkpatrick’s Four Levels of Training Evaluation.

**Bloom’s Taxonomy:** This hierarchical model classifies particular types of learning into categories, each of which has a graduated and increased degree of complexity. For instance, the learning required for remembering is different and less complex compared to what is required for application.

The model, in descending order of importance include six activities:

- Create
- Evaluate
- Analyze
- Apply
- Understand
- Remember

When Bloom’s categories are compared with the three learning types (Table 1), it becomes clear that certain learning types are reflected in specific Bloom’s categories. For instance, Bloom’s remember and understand are consistent with the Foundational Learning, while analyze and evaluate are aligned with Performance Learning.

For simulation, the use of the higher ordered Bloom’s categories are required.

**DIKW Model:** Data, Information, Knowledge and Wisdom or DIKW is a useful model as it applies to Performance Learning and particularly to simulation. The DIKW model, like Bloom’s, is a hierarchical model, not of learning objective categorization but of knowledge management (KM) categorization. The four objectives here (again, from highest to lowest) are:

- Wisdom
- Knowledge
- Information
- Data

It is particularly beneficial to draw from this model its inference toward the future; while data relate

to past or historic events, wisdom focuses on the future—or, said differently, wisdom is applied knowledge.

When compared to the three learning types, it becomes evident that, similar to Bloom’s, the higher-ordered DIKW is consistent with Performance Learning (Table 2).

**Kirkpatrick’s Four Levels of Training Evaluation:** This model does not focus on content like Bloom’s, or KM categories like DIKW, but it addresses the effectiveness of training through training evaluation.

In the Kirkpatrick model, training is measured by its output. Foundational Training is designed to initiate and invite (Levels 1 and 2) the new contracting professional into the environment. Later, when the professional learns “the ropes,” they start into Level 3, Behavior, and then on to Level 4, Results and contribute to the team (Table 3).

Following the Kirkpatrick Table 4, the higher level of performance is attributed to Performance Learning. This measure is particularly important as it reflects the return on investment (ROI) or return on expectations (ROE). In Foundational Learning—i.e., a classroom—do you expect the student to change, or make a difference, in the profession? No, not really. However, in Performance Learning, the student is empowered to take what is learned, apply it in the future and make a difference. Simulation is an ideal method to use in Performance Learning, as simulation suggests applied knowledge for a beneficial outcome, such as participating in a Source Selection Simulation (or a Service Acquisition Workshop) for future opportunities.

**Table 1. Bloom’s Taxonomy, Revised 2001**

	Remember	Understand	Apply	Analyze	Evaluate	Create
Foundational Learning	✓	✓				
Workflow Learning		✓	✓			
Performance Learning			✓	✓	✓	✓

Source: The author.

**Table 2. DIKW Model**

	Data	Information	Knowledge	Wisdom
Foundational Learning	✓	✓		
Workflow Learning		✓	✓	
Performance Learning			✓	✓

Source: The author.

**Summary of models:** Each model had something to offer as related to the three learning types. Foundational Learning focuses on the simple acquisition of information needed to enter the profession of ideas; whereas Performance Learning is elevated to the point of reflective and anticipatory planning (critical thinking) with an eye on results.

### What Is a Simulation and What Are Its Benefits?

A simulation is an attempt to model a real-life or a hypothetical situation. Simulation is not, however, a workshop. A simulation uses real-life or hypothetical situations and builds upon them with an intact team; a workshop teaches a particular outcome or outcomes and may or may not use an actual requirement or include an intact team.

Perhaps the most important benefit of simulation as a means of Performance Learning is the development of “muscle memory,” i.e., experience—or as some would say, developing scars or calluses that represent learning tough lessons. It is no mystery why pilots, tank commanders, surgeons and many others are trained using simulations. Tough lessons are costly when someone is experiencing a real-life quandary or problem. Simulation allows the student to take chances and explore alternatives. For instance, in the movie “Space Cowboys,” Tommy Lee Jones plays an older space shuttle commander who is recalled for a special mission. He and his three fellow older shuttle crew members are mocked by the younger crew members. Jones’ character is in the space shuttle simulator where he encounters a glitch in the shuttle’s aviation system. Rather than follow the prescribed response, he uses his experience and critical thinking to land the shuttle, thereby saving the mission and showing the younger crew the value of experience. Some of the other benefits of simulation are that:

- It is relatively inexpensive when compared to what could have been.
- It improves individual and team critical thinking by allowing a safe environment to openly discuss alternatives.
- It enhances team performance by building team cohesion.
- It uses reasonable analogs to convey the learning points of the simulation.
- It is performed in a non-attribution environment.
- There are no schoolhouse answers.

Simulations allow us the freedom to pay attention not just to detail, but through understanding one’s situation. The German term is *sitz im Leben*, which means situation in life. So paying attention is not just merely focusing but understanding the surroundings, the context, the *sitz im Leben*! No procurement action comes without context! Performance Learning through simulations helps to develop attentiveness to the situation and to its context—because context matters.

### Table 3. Learning and Output

The Kirkpatrick Model

Level 4: Results	The degree to which targeted program outcomes occur and contribute to the organization’s highest-level results
Level 3: Behavior	The degree to which participants apply what they learned during training when they are back on the job
Level 2: Learning	The degree to which participants acquire the intended knowledge, skills, attitude, confidence and commitment based on their participation in the training
Level 1: Reaction	The degree to which participants find the training favorable, engaging and relevant to their jobs

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### Table 4. Kirkpatrick Four Levels of Learning

	Reaction	Learning	Behavior	Results
Foundational Learning	✓	✓		
Workflow Learning		✓	✓	
Performance Learning			✓	✓

Source: The author, based on the Kirkpatrick model.

### Conclusion

Every learning type has its venue, method and desired outcomes. Foundational Learning involves classroom learning and Workflow Learning involves task aids and flow charts. Performance Learning is the mode that best focuses on sustained positive performance over time, as defined by Kirkpatrick’s Levels 3 and 4. Also as demonstrated above, Performance Learning is the only learning type that uses both the higher-order Bloom’s and DIKW categories. This also suggests a higher level of critical thinking and team cohesion.

Simulation is in the Performance Learning tool kit that helps an intact team effectively conduct its mission. Using a reality based scenario in training prepares the workforce member so that, when the real thing occurs, there will be less of a learning curve on process knowledge and less team strife during the forming, storming, norming and performing stages of team building. The result will be, from the get-go, a more highly functioning team supporting the organization’s mission.

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1969



1988



2005



20

# The DAES Process

## A Historical Perspective

Lawrence T. Gwozdz ■ Paul M. Kodzwa

**T**HE UNDER SECRETARY OF DEFENSE FOR ACQUISITION AND SUSTAINMENT (USD[A&S]) SERVES as the chief Department of Defense (DoD) official responsible for obtaining, delivering and sustaining timely, cost-effective capabilities for the armed forces.

The USD(A&S) also is responsible for supervising all elements of the DoD relating to acquisition and oversight of specific major defense acquisition programs (MDAPs) as the Defense Acquisition Executive (DAE). The latest Selected Acquisition Reports (SARs) for December 2017 indicate that the current total estimate MDAP portfolio is \$1.9 trillion. The DAE Summary (DAES) process has been a core process supporting the DAE's management of the MDAP portfolio since 1988.

At its initiation, the DAES process' primary purpose was to obtain early warning of potential program execution problems—largely technical or engineering related—that could adversely affect cost, schedule and performance. The DAES process is intended to allow a transparent understanding of program execution status by key component and Office of Secretary of Defense (OSD) stakeholders in between the major acquisition milestones that are traditionally years apart. This process has historically augmented existing acquisition decision-making events, such as Defense Acquisition Board (DAB) and in-process reviews. However, the DAES process is not itself a decision-making process.

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2010

2017

Key elements of the DAES process have changed over time, nevertheless, it remains one of the principal means of communicating acquisition program status to the DAE. Specifically, the purpose of the DAES process is "... to provide a venue to identify and address, as early as possible, potential and actual program issues which may impact the Department of Defense's (DoD's) on-time and on-schedule delivery of promised capabilities to the warfighter." In addition to the above purpose, the DAES process helps the DoD perform statutorily required periodic program assessments.

DAES data include cost, schedule, performance, contracting, budget data, risks and issues charts, briefing templates, program nomination, Program Executive Officer (PEO) and Overarching Integrated Product Team (OIPT) briefings, reliability growth curve and any other data or information generated by programs or used by an OSD office in carrying out its responsibilities.

### **The Long History of Program Execution Reporting**

The implementation independent program execution reporting in OSD as the DAES process truly began in the late 1980s; however, variants have existed since the start of modern defense acquisition in the Services. Independent progress reporting on major acquisition programs traces back to the Polaris missile. The Navy employed an independent performance

**“Always rely on the chain of command to transmit and implement your instructions, but if you rely on the chain of command for your information about what’s going on, you’re dead. Why? Because when questioned, the chain of command will respond, in polite bureaucratic prose, that everything is fine and please leave it alone.”**

**—Adm. H.G. Rickover to Former Under Secretary of the Navy R. James Woolsey**

measurement system to ensure timely delivery of intended capabilities at planned cost. This measurement system had the following general features:

- Every subsystem was reported in one of three categories with intermediate “Advisory” comments to capture positive or negative trends:
  - Green: On or ahead of schedule. Technical requirements being met. Costs at or below plan. No top-level attention needed.
  - Yellow: Problems in sight with adequate solutions. No top-level help needed.
  - Red: Problems beyond our control and will hurt overall program. Top-level help needed.
- Independent evaluators on the project manager’s top staff performed the first assessment and then by each subsystem manager in turn. The independent evaluators had free access to all subsystem data.
- The project manager received weekly progress reports from evaluators and subsystem managers. The managers knew the independent evaluations in advance and for yellow or red ratings were expected to: (1) explain why if they disagreed with a yellow or red rating; (2) their “get well” plan and when recovery was expected if they agreed with a yellow rating; or (3) explain what kind of help they needed from the project manager to address a red rating.

Although execution measurement approaches have a long history in the military Services, transition of these tools to OSD oversight and management of the defense acquisition enterprise has been less than seamless.

### **First Implementation Attempt—1969**

In 1969, Secretary of Defense Melvin R. Laird directed the production of a new series of weapon systems status reports called the SARs. These reports were viewed as “one facet of improved and strengthened procedures ... to closely monitor and control cost and technical progress of major weapon systems and to keep the House and Senate Armed Services and Appropriations Committees currently informed.”

A widely held concern was that the SARs could not inherently ensure early identification of incipient program execution issues. To rectify this limitation, the Management Systems Development division in the Comptroller’s office recommended: (1) the assignment of a three-person independent evaluation team for each reporting program; and (2) a monthly progress review chaired by the Deputy Secretary of Defense. These measures were intended to (a) ensure faster and more complete communication than the SARs could allow; and (b) encourage prompt, decisive corrective actions while problems could be readily addressed. Deputy Secretary of Defense David Packard had just established the Defense Systems Acquisition

Review Council (DSARC) to conduct detailed reviews at milestones. Packard’s perspective was that well-managed programs with senior leadership reviews at discrete points could limit the potential for costly failures. As a result, Packard wanted the Services to develop tailored management information for both the SAR and DSARC. In essence, Packard encouraged the Services to accept responsibility for improving the management of their programs by restraining OSD offices from becoming involved in program management except at specific milestones. Packard allowed program managers to limit status communications to OSD staff to quarterly reports and informal communications. Consequently, Comptroller Robert Moot rejected the independent evaluation recommendation.

### **Second Implementation Attempt—1984**

In 1984, in response to several high-profile acquisition failures, Secretary of Defense Caspar Weinberger directed the comptroller to create and implement the DAES process. During its nascent stages, the process aimed at establishing a procedure to oversee the progress of programs during the lengthy intervals between DSARC Milestone reviews. Initially, the focus of the DAES process was predominately on earned value (EV) assessments, during which reports would be generated with numerous EV charts. A few years later, however, the process was on the brink of termination, due to the lack of perceived value by the Services and OSD.

### **Maturation—1988**

With the creation of the new Under Secretary of Defense for Acquisition (USD[A]), the DoD also established a new Acquisition Program Integration (API) office. This organizational change included many new activities including a proficient method to internally identify failing acquisition programs prior to them becoming public news. In 1988, ownership of the DAES process was transferred from comptroller to the API office.

The priority was to regularly provide advance indications of salient emergent execution issues that could result in deviations from the program baseline. The new leadership recognized that a program manager’s DAES assessment could be optimistic. Consequently, the API office created an analytical process leveraging independent assessments from the several specialty functional offices—e.g., engineering, funding, test and production. API ensured that program managers saw all of the independent assessments. The assessments were presented at a monthly meeting held with required attendance by the USD(A) and other acquisition principals to discuss the significance of the identified risk. This meeting and subsequent executive interest, would serve as a forcing function to improve the quality of reports and create more transparent discussion with the program offices. The objective was to raise concerns as soon as possible,

resolve issues at the lowest level possible and consequently save time. This process would sufficiently oversee the status of programs in between DSARC (eventually DAB), milestone reviews and serve as an early warning system for the department.

API included review of the OSD assessments for potential key risk areas, including but not limited to Acquisition Program Baseline cost and schedule thresholds. API also added operational requirements and funding or budget issues. API would summarize these assessments and OSD staff and Components provided feedback. The DAES lead and the director of API would review these inputs and subsequently select programs for the next quarterly DAES meeting based on available data.

The National Defense Authorization Act for Fiscal Year 2000 established the Office of the Under Secretary

Finley directed program managers to perform DAES presentations instead of the OIPT leaders—who direct MDAP oversight and review activities. This increased the DAES process program selection cycle time by several weeks because of coordination delays within the Components. In addition, Finley did not see great value in the independent assessments being performed by the OSD staff. He also decided to have senior department political leaders select programs with well-reported issues that were germane for USD(AT&L) review rather than analyze DAES data for incipient risks. Over a year, the selection committee always selected nine high-visibility programs with uncontested execution concerns, three per service.

Instead of focused discussions on specific issues, Finley also created a standardized three-chart format to capture a broad overview of the program in each major category such as budget pressure, sustainment status

## **In 1984, in response to several high-profile acquisition failures, Secretary of Defense Caspar Weinberger directed the comptroller to create and implement the DAES process.**

of Defense for Acquisition, Technology, and Logistics (OUSD[AT&L]). Within OUSD(AT&L), the newly formed Acquisition Resources and Analysis (ARA) Directorate replaced and obtained all API functions, including DAES process operation. This transition began the transformation of the DAES process from an early-warning risk mitigation process toward a program overview.

### **Re-Engineering—2005**

In 2005, Kenneth Krieg, the new USD(AT&L), reassigned ownership of the process to Dr. James Finley, the Deputy Under Secretary of Defense for Acquisition and Technology. Finley expressed concerns about the process, stating that it was ineffective for oversight, insufficient for accountability in program management, and not treated as a decision forum. His philosophy was to orient the DAES process toward ensuring the components could help the individual program offices. For this reason, Finley changed the focus of the process from risks highlighted by the OSD staff to a broader program overview presentation led by the responsible Service.

and operational performance. In addition, several data requirements were eliminated from the process and this reduced the amount of available DAES data. As a result, the DAES process was centered more on broad program reviews rather than data-driven, advanced identification of incipient execution issues. This, among other internal matters, reduced OSD and component interest in the DAES process.

### **Revitalization and Expansion—2010**

In 2010, Frank Kendall, the then newly appointed Principal Deputy USD(AT&L) wanted to revitalize the DAES process as part of his initiatives to reduce the number of programs with excessive cost growth. From his experience as the Director of Tactical Warfare Systems from 1986 to 1989, he was familiar with the DAES process and viewed it as a valuable tool for management of the MDAP portfolio. Kendall tasked ARA with reviving the DAES process. He directed reinstatement and expansion of quarterly OSD staff assessments to ensure that all programs were assessed periodically across all AT&L oversight functions.

ARA changed program selection meeting participation from senior political leaders to Service and OSD Office staff. By broadening participation, coordination on the list of selected programs became more complex, increasing the DAES process cycle from 4 to 6 weeks. The selection team—led by ARA—used DAES data to select a maximum of three programs to brief the DAE with apparent incipient execution issues. Service program managers, using Finley's standardized charts, would still present the three programs to the DAE at a monthly meeting that then approved or suggested programmatic changes. The meeting, which included the DAE and senior acquisition leadership from

the DAES briefing was described as being too broad and unfocused. Furthermore, some had observed a stovepiping effect on assessments, owing to a lack of communication across functional areas. MacStravic directed OIPT leads, ARA and PARCA serve as integration agents across all functional areas—in other words, to provide a holistic view of program status from OSD and component DAES assessments, similar to API staff in the 1988–2000 period. Instead of a briefing, he also directed OIPTs, ARA and PARCA to produce a set of one-page assessments for selected programs that were coordinated with Component acquisition leadership. These single pages summarized key

## **Many view the DAES process ... as a data-driven, value-added enabling function for acquisition program success and timely delivery of warfighter capability.**

both the relevant Components and OSD, generally was scheduled to be conducted about 60 days after the initial submission of data from the program manager.

This direction coincided with the creation of the Office of Performance Assessments and Root Cause Analyses (PARCA), established by the 2009 Weapons System Acquisition Reform Act. The newly formed office attained several statutory responsibilities, including the issuance of policies, procedures and guidance regarding the conduct of periodic performance assessments. As a result, the USD(AT&L) directed ARA and PARCA to update the DAES policy guidance, which culminated in a memorandum issued by the Assistant Secretary of Defense (Acquisition) in December 2012. This guidance is supplemented by the *DAES Assessment Deskbook*, a living document in which periodic updates are included to reflect the most current status of the DAES process. This guidance introduced new assessment categories, including the decisive change of separating contract performance from overall program performance. In addition, the document assigns various OSD organizations as assessors for each indicator.

### **Streamlining and Refinement—2017**

In 2017, James MacStravic, while performing the duties of the USD(AT&L), expressed concern that the purpose and execution of the DAES process had become obscure over the intervening years. There was considerable concern within OSD and Components that the DAES process had become too bureaucratic and burdensome. In particular,

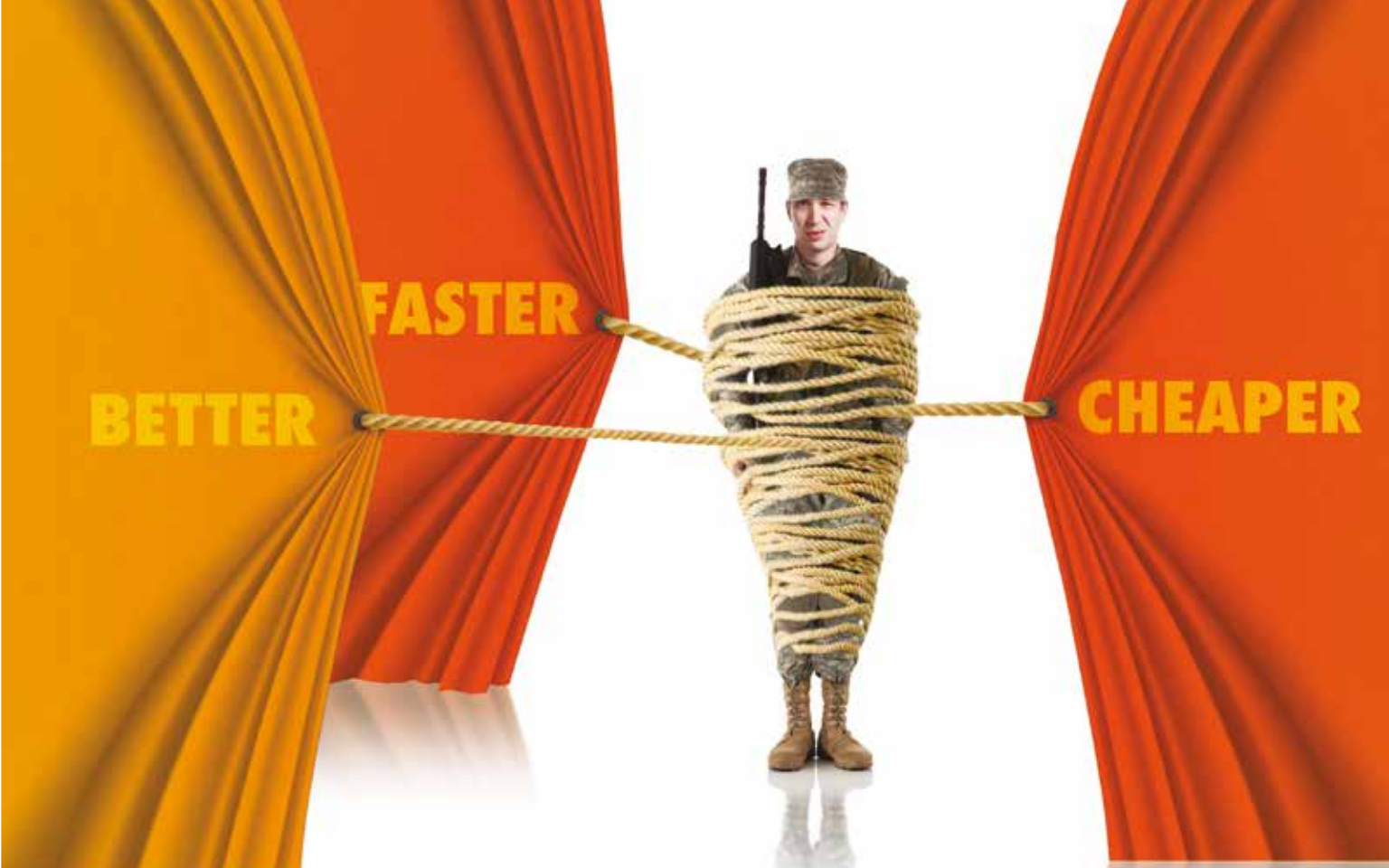
issues, their consequences and tailored recommendations. Based on collected data and the nature of identified issues, recommendations ranged from no action to a small-group discussion involving the program manager, the Component Acquisition Executive (CAE) and the DAE.

### **Summary and Emerging Concerns**

Many view the DAES process—when efficiently operated and leveraged—as a data-driven, value-added enabling function for acquisition program success and timely delivery of warfighter capability. DAES process outputs, although intended for the DAE, also can provide insight for CAE portfolio management. However, this process relies on objective assessments from program managers and across OSD, including Research and Engineering (R&E), A&S and the offices of the Director of Operational Test and Evaluation and the Director of Cost Assessment and Program Evaluation. The role of DAES process and its underlying data analysis activities must evolve as the DoD reforms its business practices to meet the challenges of the new National Defense Strategy, completes the reorganization of USD(AT&L) into USD(A&S) and USD(R&E) and delegates MDAPs from the DAE to CAEs. Nevertheless, history shows that the viability and relevance of this depends upon continued emphasis by the leadership of both program managers and OSD staff offices to provide data-rich, high-quality assessments.

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# “Better, Faster, Cheaper”— Possible but Unlikely

## Nash Equilibrium Theory and Defense Contracting

Robert T. McCann

**L**ATE, OVER BUDGET, DIFFICULT INTEGRATION, LOADS OF REWORK, AND PROJECT “DEATH MARCH” (OR a sense of inevitable failure)—those terms have provided often-used headlines in defense contracting for decades.

Why is that so often the case? How do we get high quality, on time and within budget (better, faster, cheaper)? Is there something wrong with the contracting methodology—e.g., Cost Plus Incentive Fee, Firm Fixed Price, Portfolio Management, Performance Based Logistics, etc.? There are many known acquisition methods documented in the *Defense Acquisition Guidebook*, but they all seem to have these outcomes—late, over budget, not the best quality.

There is a great deal of detail available in which to get lost. If one begins by examining leaves with a microscope, one might not develop a clear understanding of the forest. Perhaps the issue is structural and can be understood by looking at the overall context. This article applies Nash Equilibrium Theory to provide such insight. (The late John Forbes Nash won

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the 1994 Nobel Prize in Economics for what was essentially his Ph.D. thesis from 1950.)

I once took an introductory course in business finance from a retired U.S. Navy finance officer who had spent 30 years investigating contract failures. On the first day of class, the instructor prominently displayed a few items on the table at the front of class: a double-brimmed hat, a magnifying glass, a Meerschaum pipe and a thick valise full of case studies. He challenged the class to say why those items were present.

Several students correctly identified them as having something to do with Sherlock Holmes. The instructor then asked what they had to do with his class. Only one student knew why, because he had read the same collection of Arthur Conan Doyle stories as the instructor. When Sherlock had graduated from school, he spent serious time looking for a way to distinguish himself, given that he was the second-born son of an aristocrat.

Sherlock spent 3 years studying 1,000 criminal cases from the Scotland Yard archives. He came up with a very efficient investigative method. Both he and Inspector Lestrade used the MOM approach: method, opportunity and motive. The inspector had to use them in that order to create properly documented court cases. Holmes discovered that they were in inverted order and that looking at motive first was the best choice because it provided the best filter. Using motive first left him with far less work to do to eliminate all but a few suspects, and then he only needed to collect a small set of evidence to identify the perpetrator of the crime. Holmes always got to the answer before Lestrade, for he had far less work to do because he was solving crimes, not building court cases.

The business finance instructor let the class know that he had spent 3 decades investigating contract failure and had used the Holmes method to great success. His charge to the class was to look always for motivation first, then arrange the rest of the data collection in descending order by filter effectiveness. Per the instructor, looking at a balance sheet first will nearly always lead an investigator down too many rabbit holes and exhaust both his time and budget before the investigation is concluded. Looking first for motivation and then opportunity to shape policy opens the investigation to the few policy decisions that craft the necessary conditions for contract failure. Looking at the balance sheet last then results in a clear case of what happened with a firm basis in causality.

Since those days, I have had an opportunity to think about an event at Princeton University during the early 1980s in which some graduate students and I were debating how to divvy up proceeds of a Dungeons and Dragons campaign

in which we were about to compete. In the middle of the discussion, an elderly gentleman appearing very much like a faculty member walked in, looked at us, then quietly and simply wrote a few equations on a whiteboard, smiled at us and left.

The economics students immediately became very excited. They explained to the rest of us that these were the equations for a Nash Equilibrium and showed the rest of us how to apply them to our game. The model worked very well! We had a great evening and a successful campaign. (In a personal communication with me in November 2006, the late Professor Nash disavowed any memory of the event, but I thanked him for the insight he had created anyway. The identity of our consulting angel remains uncertain.)

The Nash theorem demonstrates that, in many situations, there is always a stable equilibrium for non-cooperative games with two or more players. At the time of Nash's thesis (1950), there were many fixed-point theorems in systems dynamics, but this one guaranteed that there was at least one *stable* fixed point.

A fixed-point is an equilibrium in system dynamics. If a system is in that configuration, it will stay there. If there is a small deviation from that point, the system will evolve. If the fixed point is stable, the system will return to the fixed point. Otherwise, the system will evolve away from the fixed point.

What does that have to do with defense contracting and the introductory finance course? As with the usual Nash Equilibrium examples such as the Prisoners Dilemma (given two individuals, each is individually better off confessing and, as a result, both are unwilling to cooperate with each other) and Tragedy of the Commons (the failure of individual users of a common resource to take care of that resource), it is useful first to identify the players (stakeholders) and what decisions they can make. Then list the ramifications of those decisions.

For purposes of simplification consider five stakeholders:

- Elected representatives in Congress
- Department of Defense (DoD) policy makers
- Defense contractor executives of publicly traded companies
- Taxpayers
- Uniformed military Service personnel who use contracted deliverables

One should note that neither the taxpayer nor the end user directly participates in important policy decisions but that the elected representatives, DoD policy makers, and defense contractor executives do. We will focus on those three below to reduce the complexity of the reasoning.

Why would we expect the system to deliver products “better, faster and cheaper”? That or a similar outcome is always the publicly advertised goal. Project management exhorts the engineering staff to make it so. Engineers are trained to do so in their college and other training.

That goal is certain to be mentioned when large Acquisition Category (ACAT)-I and ACAT-IA contracts get into the “late and over budget” regime and get excoriated as “troubled programs.” The press often seems to use a well-developed script in its reporting. Given the frequency of that outcome, the press doesn’t have to look far for well-practiced stock phrases. There always is significant discussion about the details of what goes wrong and what might be done to fix it—but few, if any, articles mention the motives of stakeholders. Instead, they highlight a virtual forest of project trials and tribulations. Please recall Inspector Lestrade’s usual outcome.

It is my thesis that this late and over budget (usually with poor quality) outcome is a Nash Equilibrium. The basis for the analogy is as follows:

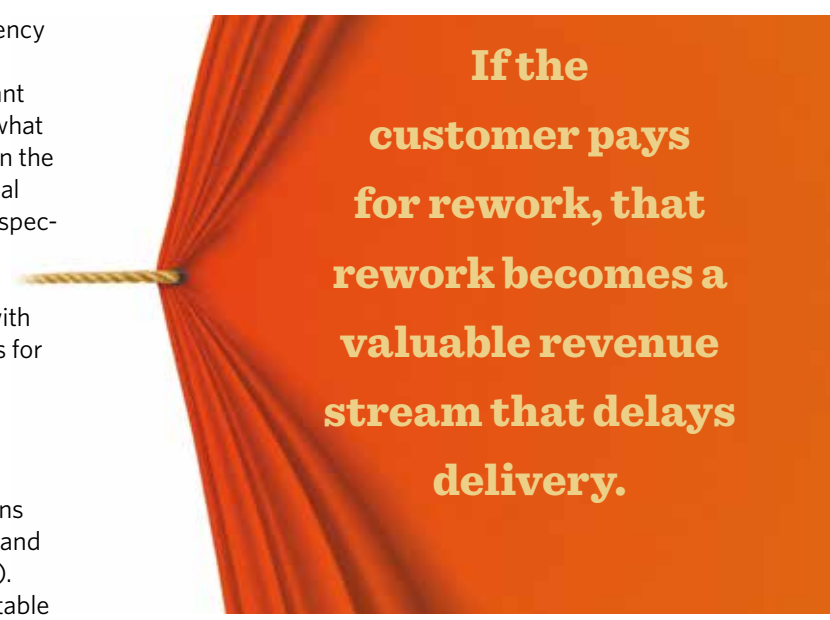
- There are two or more participants.
- There is an interaction between the participants.
- Each applies a strategy for self-benefit.
- The game is played in a way that the reward functions and the domain of the game are continuous, closed and bounded (i.e., easily understood by the participants).
- If these propositions are true, a Nash Equilibrium (stable optimum) is guaranteed under most circumstances.

To build on the analogy, a behavioral motivation is like a force in physics, and the response curve is like a potential function. The force is proportional to the slope of the potential and determines the dynamics. At a peak of a potential function, every step away from that point is downhill. At the bottom (minimum) of a potential function surface, every step away from that point is uphill. The forces that govern the dynamics are proportional to the slope. To interchange maximum and minimum, it is necessary to flip the sign of the curvature and slope. This is equivalent to reversing the motivations in an economic model.

Let’s consider the motivation of the policy makers. They are the key players in the game because their policy decisions shape the dynamics of the game. An executive of a publicly traded company necessarily has a responsibility to increase shareholder value—e.g., increased profit, increased revenue, increased market share. “Over budget” for a contract equates to increased revenue. “Late” sustains revenue for longer and preserves market share. If the customer pays for rework, that rework becomes a valuable revenue stream that delays delivery. If integration must deal with poor quality, it will take longer and be more expensive, again providing increased revenue sustained

longer. If integration planning is lightly done or late to need, it will run into more unexpected issues and take longer, and the associated rework will create more revenue.

If a DoD acquisition executive is incentivized for success and cash flow in his portfolio of contracts and possibly disincentivized for contract failures, again, eventual declaration of success serves well. The executive will be likely to pick an acquisition method that ensures known behavior



**If the  
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delivery.**

that meets needs for executive career advancement. Managing a larger cash flow that eventually results in a “successful” outcome can do that even if late and over budget. The policies crafted by this executive will likely help keep programs “sold” and away from “failure.”

If a large enough defense contractor picks where to source the work, certain congressional districts stand out as very important because those elected officials participate in key congressional committees. Those members of Congress will value money spent in their districts if it creates jobs, because those jobs generate votes toward their re-election. Spending more money longer has value in re-election campaigns. Favorable funding and approval votes are likely forthcoming. Having a substantial political action committee can also help by making well-targeted campaign donations.

If any one of these players changes strategy while the others remain the same, there will be a clear negative consequence. This is the essence of a Nash Equilibrium: It is stable. It takes a change of motivation for all three players to reverse the character of the equilibrium state. To align with what the engineers often are asked to do, all three motivations must align with “better, faster, cheaper.”

Per process stability analysis, the primary focus must be “better.” Otherwise, the project will be unstable against schedule or cost challenges leading to process non-compliance with resulting chaos and attendant schedule slips and cost overruns. (See my article, “Identifying Good Independent Variables for Program Control,” *Crosstalk Magazine*, May-June 2014.) In that case, if schedule is reduced too far, costs increase; and, if cost is reduced too far, schedule slips. In both cases, quality is likely to take a substantial hit.

Using more than 3 decades of documented cases, the business finance professor demonstrated that this rather toxic inverted motivation permeated all major defense contracting methods that had been in place for 15 years or more as of 2004. The details change, but the motives don’t. The equilibrium remains the opposite of “better, faster, cheaper.”

It takes a major external consideration to overcome the stabilizing forces. Two examples come to mind: the World War II Manhattan Project that developed the atom bomb; and the first Satellite Early Warning System. Both involved potential threats to human survival.

Before the advent of electronic computers, it was not possible to prove that the first atom bomb would not ignite the atmosphere and blow it off the planet unless a state of nearly perfect symmetry applied to the bomb components. Quality was a critical enabler for species survival, and it won every confrontation with other motivations. The bomb was developed, delivered, tested and succeeded in about 4 years without being a decade late and a factor of 2 to 4 over budget.

Similarly, a failure of the first satellite early warning system due to a quality defect could ignite a third world war and lead to a Nuclear Winter with the prompt death of 120 million Americans and half of the world’s population at risk for a generation or more, if recovery of civilization as we know it would even be possible. Again, quality focus won all policy debates and the system was delivered on time, within budget, and it worked flawlessly for several decades. This was not a simple project. The total system development (function points equivalent to 60 million lines of code) could not use anything that wasn’t developed from scratch with less than perfection in mind. (See Robert T. McCann, “Cost-Benefit Analysis of Quality Practices,” *IEEE Ready Note*, 2012, Dedication.) Commercial off-the-shelf components simply were not a credible choice.

Here’s some advice to those who would recraft defense contracting: better, faster, cheaper can work—but first deal with the motivations of all three stakeholders together, make quality the primary objective for project management, then ensure that the customer does not pay

for rework (either explicitly or implicitly). Otherwise, success will be unlikely, and—because they will take much too long to deliver—we will have fewer working tools for the money spent.

It may be possible to create a quantitative predictive three-party Nash model to demonstrate what it takes to switch equilibria. Biochemist and science fiction author Isaac Asimov described this kind of mathematical sociology modeling in his *Foundation Series*; it is not a simple project to consider. It is well beyond the scope of this article, but we can describe general characteristics such a model would have to display.

In two and three dimensions, there are only two possible dynamics near a stable equilibrium. Either the flow is directly downhill, or it spirals down like water near a sink drain—or air and debris near a tornado. Per Nash, the response curve will have at least one stable equilibrium point. Flipping the motivations flips the sign of the curvature, changing the topography from hill to basin. If the response curve has one bowl and one mountain, flipping the motivation of all three stakeholders will switch between mountain and valley. Instead of poor quality driving late and over budget as the stable equilibrium, we get high quality driving early delivery at lower cost. (See again McCann, *IEEE Ready Note*, 2012) To do that, all three motivations must switch sign. Clearly, a concern about the end of civilization as we know it would provide sufficient motivation. The challenge to defense contracting is to find other less severe and risky motivations that also suffice to change the strategies of all three primary participants in the policy game.

Realistically, defense contracting has many more stakeholders—e.g., the taxpayer, and voters and the military end users of such contracted systems, among many others. A more complete and thorough analysis of motivations may reveal other less extreme strategies to achieve better, faster, cheaper. The other major risk to the model is the possibility of cooperative gaming of the system, although many of these possibilities are excluded by law—e.g., the Sherman Act of 1890, Clayton Antitrust Act of 1914, Robinson-Patman Act of 1936, and the Celler-Kefauver Act of 1950, and by related regulation—as being anti-competitive and in restraint of trade. I suggest that creating and validating such a predictive model would be worthy of at least one Ph.D. thesis in defense contracting economics or social dynamics.

*Note: This article is dedicated to the memories of Professor John Forbes Nash of Princeton University and Professor Carl Clavadetscher of the Information Resources Management College, National Defense University—the two nicest geniuses with whom this author has ever had the opportunity to discuss challenging ideas.*

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# Shift Test Planning Left

## Benefits and Challenges of Doing It Earlier

Mike Caram ■ Barbara Smith

**I**N TODAY'S ACQUISITION ENVIRONMENT, there is an ever-present focus on reducing timelines without incurring unacceptable risk.

After formal program initiation, the weapon development process of the chosen approach begins in earnest. This typically involves development of prototypes that are subject to a plethora of developmental tests. This part of the acquisition life cycle, specifically system-level developmental test planning, is the subject of this article.

A best practice for consideration and discussion is to require that

all system-level developmental test plans be completed prior to delivery of the first test article. While conceptually this might appear to be too difficult given the immaturity of the design, the advantages of doing so will be discussed along with some of the challenges.

### Concept Benefits

Major benefits can be achieved when all system-level developmental test plans, including required supportability tests, are in place prior to the start of test. First, having detailed test plans early will enable meaningful Earned Value Management (EVM) tracking throughout the developmental test phase. Test points are a much better determinant of earned value than other typical metrics (flight hours, operating hours, etc.) and provide a much more accurate indication of test schedule status. And, with test points as the earned value metric, the test program is motivated toward efficient test execution.

Another benefit of early test plan development is the identification of detailed test requirements for each of the test blocks. This allows for identification of what can be done concurrently and what tests can be substituted during any time block on the schedule if an unexpected constraint surfaces (hardware failure, range availability, etc.). Moreover, maintenance demonstrations and design for supportability tests historically are relegated to unplanned windows of opportunity that often occur late in the program execution and result in more costly redesign and retest activities.

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The inclusion of these requirements in early test plan development permits early identification of the required infrastructure to support. The knowledge gained, coupled with the application of meaningful EVM measures described above, allows the program office to seek opportunities for concurrent testing and strategies for increased test intervals after confidence is achieved. As a result, credit is gained for multiple test points that improve cost and schedules. And, in the event a planned test cannot be conducted, information is available to enable other required tests that are supported by test article, infrastructure, and instrument configurations. These efficiencies can allow programs to develop testing should-cost initiatives during execution and enable earlier reduction in planned test overhead and infrastructure costs.

Another significant benefit in requiring that all test plans be written prior to first test article delivery, is that it forces a detailed determination of the scope of testing, the number and configuration of test articles, the instrumentation requirements and details, test infrastructure requirements such as Software Integration Labs, environmental test facilities, and the many other unique requirements to ensure design configuration of advanced systems. By thinking through detailed test planning, test article configuration can be optimized, instrumentation refined, and early range scheduled, avoiding schedule and cost problems. Determination of test schedules becomes considerably easier, and a more accurate estimate can be obtained of requirements, duration and costs.

### Concept Challenges

In order for early test planning to take hold as a best practice, a cultural shift is needed within the Department of Defense acquisition community. All too often the planning focus is at the perceived time of need versus the time that will most mitigate the cost and schedule risk and provide for the greatest flexibility in test execution. Traditional planning timelines must be adjusted to reflect the need for earlier delivery, review and approval of test plans. This requires the earlier assignment of personnel who write and review test plans and earlier availability of funding to support that effort. Manpower assignments to support the test planning phase and programmatic funds to execute it must be brought to the left and occur earlier on the schedule. While it is easier to affect those shifts in an acquisition scenario that imposes test plan development and execution responsibilities on the contractor as part of the Request for Proposal, it can be implemented under any scenario if upfront planning and resources are committed.

### Overcoming the Challenges

Two obvious options can be used to mitigate manpower constraints and shortages in subject-matter expertise. The

first option applies if government personnel are to write the detailed plans of the acquisition strategy. Acquisition commands can temporarily assign experienced personnel from other programs to write the detailed test plans in close collaboration with permanent program test and engineering experts. Once these people complete the test plans, they can return to other assigned duties.

The second option is to assign the test planning responsibility to the contractor in the development contract. In doing so, the detailed test plans would be contract deliverables. The contractor would know its staffing requirements in advance and could effectively plan to support the workload. The government would still need to approve the planned personnel assignments and develop any additional documentation, such as support plans, that would require personnel earlier than historically needed.

Each option has advantages and disadvantages, and the decision to select one over the other really depends on the government's desired level of involvement in writing the detailed test plans. There is a third alternative, a hybrid of the two aforementioned options, in which the government is the lead test-plan author but the contractor assists by providing subject-matter expertise. This option may be more challenging for the contractor in writing up its bid as it would not convey a clear understanding of the depth and breadth of the required resources. Any option pursued would require an earlier-than-usual shift in funding resources.

These considerations obviously will drive the program's acquisition strategy. Contract type may favor one test-plan-writing option over another. The development schedule may favor different options. If early developmental test planning is desired, the decision needs to be made early during the acquisition strategy development and not after the contract award.

How programs choose to execute early test plan development will depend on the chosen acquisition strategy, including the level of involvement and role the contractor will play in the test program.

### Conclusions

Weapons system developments continue increasing in complexity while there is an ever-present expectation of more rapid fielding. A significant portion of the development effort involves testing. Testing efficiencies will have a positive proportional effect on the fielding timeline and the programmatic cost; improved accuracy in assessing the status of testing allows for proactive management of issues before they arise.

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# RESCUING a **Failing Program**

**Can It Be Saved or Are We Too Late?**

*Eugene A. Razzetti*

**E**VERY RELATIONSHIP BEGINS WITH A CONTRACT. Contracts (aka Proposals) can be hundreds of pages long; reflect brilliant ideas and policies; be replete with ambitious goals, objectives and milestones; packed with supercharged people with “walk-on-water” resumé; display nicely designed organizational relationships; deftly cross all t’s and dot all i’s; and (of course) contain a cost proposal dogmatically intent on spending every penny you have—and then some. But what happens when these fanciful literary masterpieces don’t work? Then what do you do, or is it too late to do anything?

Program managers in the private sector measure the success (or failure) of a program in two ways:

- Results, as measured by cost control, meeting contractual requirements, on-time delivery and within-budget performance
- Managerial performance, as measured by overall program effectiveness, organization, direction, leadership and team performance

Those two measuring sticks have formed the foundation of many excellent books on project management, not to mention certification as a Project Management Professional (PMP).

The books and courses take students through (as in our case) an entire program for a product, system or service—complete with well-constructed case studies and questions. The presumption is that, if you start properly and work properly, you will, inevitably, achieve success.

**Razzetti** is a retired Navy captain, management consultant, auditor and military analyst. He is the author of five management books, including *Fixes That Last—The Executive’s Guide to Fix It or Lose It Management*.



But wait! What if you are taking over a program midway? And it's failing?

I have written for *Defense AT&L* and its successor, *Defense Acquisition* magazine, articles with title concepts such as "Synergy and Innovation," "Risk Management," "Due Diligence," "The Ethical Imperative to Cancel Ineffectual DoD Programs," and most recently: "Feedback, Follow-up, and Accountability." This article supports the others and describes how to recognize a failing Department of Defense (DoD) program, how to fix it if it is fixable, and when to cancel it if it's not fixable.

### Is It Failing? Give It the "Duck Test"

We've all heard the expression: "If it looks like a duck, swims like a duck, and quacks like a duck, then it probably is a duck." This suggests that you sometimes can evaluate a program or situation accurately by observing its physical characteristics.

If a program is "fixable," we have an obligation to report, as factually as possible, its condition, revise the approach, and get to work. If it is not fixable, we have an equal, if not greater, obligation to report a finding of "not fixable," plus an attendant obligation to cancel it before it exacts an unacceptable toll in funds—maybe even in lives.

The operative phrase may be "get to work" and not "get back to work." That's because the program may require some new faces around the table—the DoD and its contractor faces. More on that later.

Figure 1 puts the DoD program to the duck test. All inputs must be scrupulously audited and revised as necessary, and each block involves action for both DoD and the contractor.

Only the integrity of the program is sacred. The problems that you find must be fixable, and fixes must be actionable. Nothing else will work.

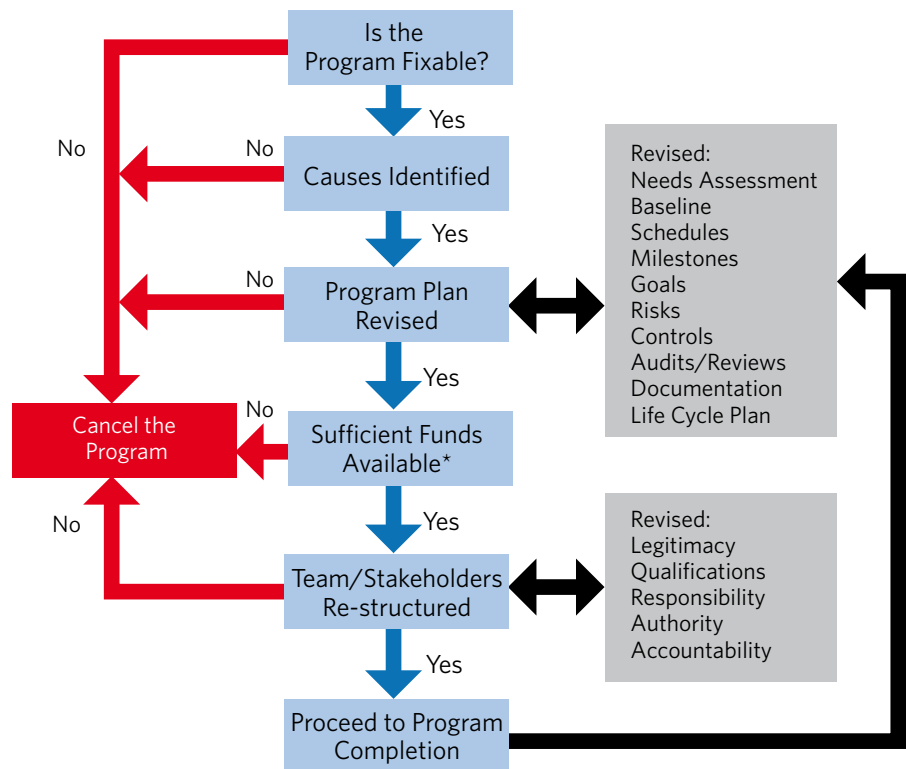
Identifying the causes is essential. Program managers must isolate the actual beginning (or source) of the program's failure, not just ancillary troubles, whose correction will only improve but not correct the situation.

Root cause analysis (RCA) is a method of problem solving used for identifying the origin of faults or problems. A factor or issue is a basic or root cause if its removal from the problem-fault sequence prevents the final undesirable outcome from recurring; a causal factor is one that affects an event's outcome but is not a root cause. RCA is applied to methodically identify and correct the root causes of events, rather than to simply address the symptomatic result. Though removing a causal factor can benefit an outcome, it does not prevent the problem's recurrence with certainty. Only identifying and correcting a root cause can do that.

To focus on correction of root causes is to prevent their recurrence. Alternately, Root Cause Failure Analysis (RCFA) recognizes that complete prevention of recurrence by only one corrective action is not always possible.

RCA is typically a reactive method of identifying event(s) causes, revealing problems and solving them. Analysis is done after an event has occurred. However, RCA is also a preemptive strategy; using it to forecast or predict probable events before they occur.

**Figure 1. Fix It or Cancel It**



\*Should not be funded at the expense of a sound, well-executed program.

All figures and tables by the author.

## Verify First, Then Trust

Revise the program plan. The books on project management mentioned earlier rightly spend lots of time and ink on team building, communication and some of the “squishier” attentions, like a lap around psychologist Abraham Maslow’s “A Theory of Human Motivation,” (*Psychological Review*, July 1943). Remember that we are talking about rescuing the program in the wake of an actual or near disaster. That means we need unvarnished assessments of people as well as products; specific, measurable, goals and objectives; fully qualified executors with the right credentials; and scrupulous documentation by competent evaluators/auditors with the power to act decisively.

A thorough review of everything that earlier went wrong must result in actionable intelligence and measurable solutions. Identify all threats and their potential impact on the mission of the product or service.

Supporting considerations include:

- Revised risk and needs assessments
- Revised goals and objectives and key performance indicators (KPI)
- Potential synergies and innovations—measured against a baseline
- Scheduling, problem solving and the relationship of smaller, supporting projects

## Available funding

Nothing new here. Even rough rules of thumb like “50 percent through the project, 50 percent through the funding” are better than nothing or a more precise metric that isn’t being followed. Most funding issues arise from overspending. This may be obvious. It also may be hidden by moving funds between lines, like using money programmed for training, mockups/simulators, software or replacement parts to cover more immediate shortfalls. Many combat systems get launched without training simulators and robust logistic support because funds specifically earmarked for them were diverted earlier. Figure 2 describes tracking the funding of a program in trouble.

DoD should never raid a sound program to throw money at an unsound one—but it does and it will. I have been involved in acquisition in one capacity or another since 1981 and have never known this approach to work for the good of the sailor on the deck plate or the soldier in the trenches.

## Team and stakeholder conflict resolution and change

Until now, we’ve discussed the quantitative aspects of the program or project: how much money is left, how much time is left, what are the threats and/or risks, and the like. The findings (for better or worse) reflect repu-

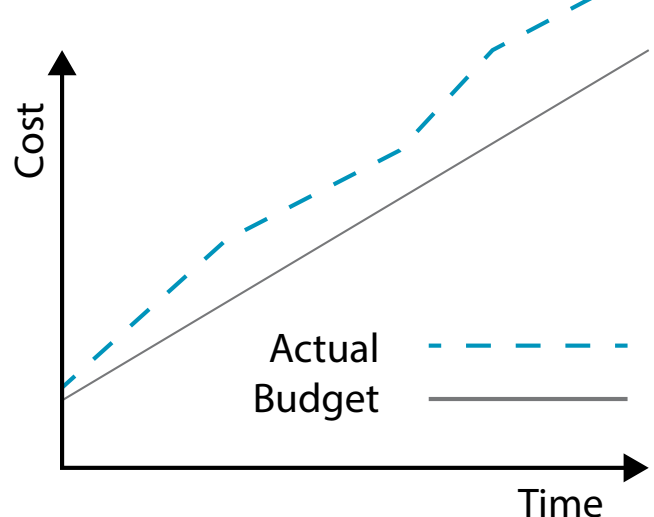
table metrics and performance indicators. Now we need also to consider the more qualitative aspects. These have to do not with the score as much as with the players.

For our purposes, a stakeholder is a person, group or organization that has an interest or concern in an organization. Stakeholders can affect or be affected by the organization’s actions, objectives and policies. Some examples of key stakeholders are creditors, directors, employees, government (and its agencies), owners (shareholders), suppliers, unions and the community from which the business draws its resources.

There are external and internal stakeholders. DoD often finds itself no longer in control when Congress steps in and tells DoD to “fix it” or “put it back.” The DoD (at gunpoint) response is the infusion of more money, usually from one or more sound programs that either get postponed, reduced or eliminated altogether. The only “stake” Congress should have in the program is the enhanced combat readiness and security of the United States. The fact that a ship, vehicle, missile, or combat weapon is being built in a congressman’s district should not figure into the matter. But it does.

As for internal stakeholders, major projects often are steppingstones for DoD employees, who may find themselves boxing above their weight class. Assignment as a project manager, contracting officer, lead engineer, or the like, should be considered neither a reward nor a punishment, nor a check in the box; but just the best possible fit. Individual team members may be trying their level best. But, let’s remember: The program is in trouble—and if these people were equal to the challenge the program might not be in trouble.

**Figure 2. Tracking Budgeted Costs Versus Actual Costs**



# Many combat systems get launched without training simulators and robust logistic support because funds specifically earmarked for them were diverted earlier.

Restructuring should include a scrupulous internal and external stakeholder identification, justification, and/or replacement.

Dr. Harold Kerzner, in one of his excellent books on project management, describes five approaches to conflict resolution: confrontation, compromise, facilitation, force and withdrawal. The meaning of each is obvious. Table 1 suggests how the approaches may apply in your program's current situation.

The "Win-Win" would be ideal, but it probably already has been tried without success. Thus it may be too late for facilitation or compromise.

Next come confrontation and force. This is the "Win-lose" and somebody always loses. It can't be DoD, because (again) the actual loser would be the sailor on the deck plate or the soldier in the trenches. Program managers have an ethical imperative to have DoD and the contractor put the right person in the job—even if he or she is a replacement.

That does not mean that the program needs a bloodbath. It does mean that preoccupations with feelings, promotability, relationships, Maslow, and the like may need to take a back seat. Do people on both sides of the failing program's contract need to get fired or (at least) replaced? Most likely. We want safe troops, not happy staffers.

Withdrawal from the contract and the program is the "lose-lose" that you tried to avoid. It may be inevitable. However, if you have done everything possible to work with a worthy contractor without success, or you have uncovered (albeit late) a pattern of provable corruption, deception and incompetence, it's probably time to pull the plug.

## Summary

In Figure 1, we see the word "revised." Your program is in trouble, and there is a need to wire-brush every bit of the program's design, structure, operation and manning. You'll need to look at personnel legitimacy, qualifications, authority, responsibility and accountability. In the pursuit of these, we will discover conflicts of interest and stakeholder interference—and try, perhaps yet again, to resolve the conflicts.

Project management textbooks usually describe the road to success as a happy one. Regrettably, the road to "revised" or "rescued" success often leaves casualties by the wayside. But a "career casualty" inside the Beltway is better than an actual casualty on the battlefield.

Nothing is off limits when you rework a failing program, or as a sign over my boss's desk once read: "Sacred cows make the best hamburger." Problems must be fixable and fixes must be actionable. Numbers must be scrubbed, threats and risks identified, objectives realistic, reports meaningful, and accountability established. Nothing else will work.


Again, if it looks like a duck, swims like a duck and quacks like a duck, then it probably is a duck. If it's late, over-budget, and fails in form or function, it's probably a dead duck.

So, is your program a duck—or is it a dead duck?


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**Table 1. Conflict Resolution**


Likely Outcome	Facilitation	Compromise	Confrontation	Force	Withdrawal
Win-Win	X	X			
Win-Lose			X	X	
Lose-Lose					X



Optimal, but probably tried



Most likely, in light of situation



Everybody loses, but losses cut

# VAT Is Where It's At

## Securing Value Added Tax Exemptions on International Acquisitions

Stephen Speciale



**O**N MILITARY SUPPORT PURCHASES abroad, should the Department of Defense (DoD) or its industry partners pay extra money that provides no value to the United States? U.S. taxpayers ultimately spend lots of money in foreign countries on products and services that support international acquisition efforts, perhaps including costs that they could save or avoid.

Value added tax (VAT), a consumption-based tax charged by foreign countries on purchases, could represent a major cost element for such acquisitions. Opportunities exist for DoD and its industry partners to receive VAT exemption. DoD's acquisition workforce members in program management, financial management, contracting, logistics and engineering can execute sound VAT exemption activities that support international acquisition efforts. The most effective application of VAT exemption includes applying a team-based approach while sharing information, pursuing VAT exemption approval prior to purchases, streamlining processes with defined areas of responsibility and maintaining documentation.

DoD's current strategy largely centers around strong alliances and partnerships with foreign nations. Specifically, the 2018 National Defense Strategy (NDS), published in November 2017, stated that "Mutually beneficial alliances and

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**Table 1. Standard Value Added Tax (VAT) Rates for Selected Countries**

Country	Standard VAT Rate	Country	Standard VAT Rate
Australia	10%	New Zealand	15%
Bahrain	0%	Poland	23%
Belgium	21%	Qatar	0%
Egypt	14%	Romania	19%
Finland	24%	Saudi Arabia	5%
France	20%	South Africa	15%
Germany	19%	South Korea	10%
Greece	24%	Spain	21%
Hungary	27%	Sweden	25%
Israel	17%	Turkey	18%
Italy	22%	United Arab Emirates	5%
Japan	8%	United Kingdom	20%

Note: Table does not include all countries that charge VAT.

Source: The author.

partnerships are crucial to our strategy, providing a durable, asymmetric strategic advantage that no competitor or rival can match. We will strengthen and evolve our alliances and partnerships into an extended network capable of deterring or decisively acting to meet the shared challenges of our time.” Therefore, it is highly likely that the United States will continue and expand its acquisitions abroad with allies to accomplish the NDS objectives.

While supporting multiple DoD major missile defense projects in Eastern European countries from 2015 to 2018, I encountered process inefficiencies that prevented consistent application and maximum cost savings or avoidances. I created and implemented streamlined business processes affecting many stakeholders that produced successful operations. This article provides information and lessons learned from actual experiences with VAT exemption on international acquisitions for increased understanding and application.

As the United States carries out international acquisition efforts, it is imperative that we seek VAT exemption from foreign countries in order to save or avoid unnecessary costs. For the purposes of this article, international acquisition efforts include international deployments, international cooperative efforts, foreign military sales (FMS) and any other major effort where the DoD could spend abundant resources within a foreign country.

### VAT in Brief

VAT rates are determined by the country where a customer makes purchases, and vary per country and type of good or service. For instance, the standard VAT rate for

Finland is 24 percent, while the standard VAT rate in Japan is 8 percent. Table 1 provides the current standard VAT rates for certain countries around the world.

**VAT exemption explained.** Such an exemption is a customer’s ability to complete purchases without paying VAT. Exemption can take place at the time of purchase or allow the customer to recoup VAT through reimbursement after the purchase. Authorization for VAT exemption is required from a foreign country’s government. DoD typically receives VAT exemption authority through a Status of Forces Agreement (SOFA) or FMS case. A SOFA is a high-level agreement between governments outlining a major effort where DoD will operate in or with a foreign country. SOFAs are a responsibility of the Department of

State (DoS) and are an integral part of DoD’s international efforts that define the legal status of U.S. personnel, property and activities outside the United States. On the other hand, all FMS cases are required to include a provision that prohibits taxation (including VAT) by foreign countries on purchases supporting U.S. assistance efforts. The Defense Security Cooperation Agency (DSCA) released guidance in 2004 specific to tax prohibition on FMS cases.

**Applicability of VAT exemption.** The exemption applies to purchases made by the DoD or industry partners so long as appropriate authority and documentation support them. Common purchases include, but are not limited to, materials, equipment, services (construction, engineering, base operations support, utilities, communications, administrative, rental vehicles, leases) and fuel.

**Methods for receiving VAT exemption.** There typically are two methods of receiving a VAT exemption: time of sale or reimbursement.

- The time-of-sale method allows a customer to receive VAT exemption at the point of purchase. For this method, the customer has exemption approval prior to purchase and does not pay the VAT for the purchase amount.
- The reimbursement method results in a customer completing a purchases (including VAT), but recapturing VAT through reimbursement after purchase.

In addition, a foreign country may allow VAT exemption on entire contracts that support an effort covered by a SOFA or FMS case. VAT exemption for entire contracts can



apply to both fixed-price and cost-plus type contracts. This option allows DoD and its industry partners to complete VAT-exempt purchases in a foreign country without required foreign country approval for each purchase.

VAT exemption is important. It can produce significant cost savings or avoidances for the DoD on international acquisition efforts and reduce the overall cost of deployments, weapon systems, facilities, etc. It also can provide the means to use taxpayer funds for other needs. For example, if the DoD has an international deployment that will require purchases totaling \$100 million in Hungary, the DoD could save up to \$27 million (based on a standard VAT rate of 27 percent) if VAT exemption is authorized and properly completed by the stakeholders executing purchases for that international deployment. Table 2 provides another example of potential cost savings from a \$500,000 VAT-exempt purchase within three countries and the resulting final purchase amount.

Although Bahrain does not charge a VAT, Finland and Japan do. DAU has an online job support tool (Value Added Tax Exemption Calculation Tool) that can help users evaluate VAT exemption on purchases or contracts within specific countries and potential cost savings or avoidances. Given the latest NDS, the VAT exemption is important now more than ever when DoD teams formulate acquisition strategies and conduct operations overseas.

**Major stakeholders involved.** Many stakeholders perform various functions within and between countries in support of VAT exemption activities. The major U.S. stakeholders include the DoS, Combatant Commands (COCOMs), DoD acquisition teams, DSCA and industry partners. A foreign country's major stakeholders include the country's DoS equivalent (such as its Foreign Ministry), DoD equivalent (such as its Ministry of Defense), tax office, and vendors selling goods and services. Table 3 provides a synopsis of key responsibilities per major stakeholder.

**Best Practices and Lessons Learned**

The following are some examples of best practices and lessons learned from actual experiences that can assist the DoD and other U.S. personnel with current or future international acquisition efforts where VAT exemp-



tion applies. The italicized sections detail my real-world experiences when supporting Missile Defense projects in Eastern Europe.

**Apply “Team” Approach and Share Information**

Two sayings relate to VAT exemption activities: “If you fail to plan, you are planning to fail” and “knowledge is power.” As seen in Table 3, stakeholders and responsibilities are widespread. Since initial planning between countries can begin well in advance of an effort beginning, it is a best practice to maintain a “team” approach throughout the effort and regularly share information with necessary stakeholders. These actions can enable all stakeholders to overcome the barriers (language, time zones or cultural) that may arise on international acquisitions.

**Table 2. Example of a VAT-Exempt Purchase and Potential Cost Savings**

Country	Standard VAT Rate	Purchase Amount (including VAT)	VAT Exemption Amount (Savings)	Final Purchase Amount
Bahrain	0%	\$500,000	\$0	\$500,000
Finland	24%	\$500,000	\$120,000	\$380,000
Japan	8%	\$500,000	\$40,000	\$460,000

Source: The author.

**Table 3. VAT Exemption Stakeholders and Key Responsibilities**

U.S. Stakeholders	
Entity	Key Responsibilities
DoS	Negotiate, create, and maintain SOFAs on behalf of the U.S. with a foreign country on a specific international effort (includes top-level VAT exemption authorization). Specific to FMS cases, the DoS determines which countries will have programs with the U.S. The DoS is not responsible for executing VAT exemption functions or day-to-day operations supporting a SOFA or FMS case (see “DoD Acquisition Teams”).
COCOMs	Oversee and coordinate DoD’s international efforts within a specific geographic location (can coordinate with DoD Services/agencies to create supplemental agreements supporting the SOFAs).
DoD Acquisition Teams	Manage and execute international acquisition efforts in/with foreign countries, including VAT-exemption activities supporting SOFAs or FMS cases. Although VAT-related functions can differ per effort, the functions could involve personnel across DoD’s acquisition functions (program management, financial management, contracting, logistics and engineering). Key functions include: managing program cost/schedule/performance, managing program requirements and cost elements from cradle to grave, managing VAT exemption activities (among DoD entities, industry partners, and foreign country stakeholders listed below), and executing contracts with VAT exemption clauses (if appropriate).
DSCA	Support U.S. national security and foreign policy interests (primarily FMS cases). DSCA leads cooperative efforts (training, educating, advising and equipping) among allied nations.
Industry Partners	Execute VAT exempt purchases of goods and services with foreign country vendors that support the DoD’s international efforts outlined by a SOFA or FMS case. Industry partners should create efficient and effective processes to support their business activities, including contract management and sub-contractor management, within the foreign country.
Foreign Country Stakeholders	
Entity	Key Responsibilities
DoS Equivalent (Foreign Ministry)	Negotiate and implement SOFAs on behalf of a foreign country with the U.S. (includes top-level VAT exemption authorization).
DoD Equivalent (Ministry of Defense)	Serve as the foreign country’s authorized representative with ability to approve VAT exemption requests on specific purchases or eligible contracts supporting efforts covered by a SOFA. The DoD and its industry partners must have approval from this entity to complete VAT exempt purchases (whether time-of-sale or reimbursement method).
Tax Office	Oversee and manage a foreign country’s VAT exemption activities. This entity collects VAT exemption documents, coordinates with foreign country vendors processing VAT exempt purchases, and reimburses the DoD or its industry partners the owed VAT reimbursement.
Vendors	Support a foreign country’s SOFA or FMS case with the U.S., including the stakeholders supporting those efforts. Vendors work with the DoD and its industry partners to ensure eligible purchases made in support of approved efforts are completed VAT exempt. Vendors also maintain documentation to support VAT exempt purchases and coordinate with the foreign country’s tax office in accordance with laws or policy.

Note: The stakeholders and responsibilities may differ between each international acquisition effort, including the foreign country involved.

Key to Abbreviations: COCOMs = Combatant Commands; DoS = Department of State; DSCA = Defense Security Cooperation Agency; FMS = foreign military sales; SOFA = Status of Forces Agreement; VAT = value added tax.

Source: The author.

*After inheriting VAT exemption duties in the middle of an international deployment, it was immediately apparent that a “team” approach did not exist and that crucial information was not appropriately shared among stakeholders. DoD entities ineffectively coordinated with one another, their industry partners and the foreign country’s various entities. As a result, DoD entities and industry partners applied inconsistent VAT exemption processes that were noncompliant with foreign country requirements. This resulted in strained business rela-*

*tions with the foreign country and untimely processed VAT exemption requests.*

*Applying an alternative approach to a new and separate international deployment produced much different outcomes. Consistent coordination and information sharing among DoD entities, their industry partners, and the foreign country’s various entities created a highly effective environment. Initiatives included interacting with stakeholders, sharing procedural*



**Also, pursuing VAT exemption for entire contracts is a best practice, when applicable, since it eliminates the need for the foreign country to approve each purchase for VAT exemption.**

*documents and required VAT forms, and providing regular training. This resulted in successful business relations and timely processing of VAT exemption requests.*

The benefits of a team approach and information sharing cannot be overstated. These efforts must be applied to ensure successful VAT exemption activities.

### **Pursue VAT Exemption Approval Prior to Purchases**

The time-of-sale method is the preferred method to receive VAT exemption since the customer never pays VAT on purchases and it places the majority of the administrative responsibilities on the foreign country vendor. The reimbursement method is not preferred since it places the majority of administrative responsibilities on the DoD or industry partner and can take significant time for that entity to receive reimbursement from the foreign country's tax office. Also, pursuing VAT exemption for entire contracts is a best practice, when applicable, since it eliminates the need for the foreign country to approve each purchase for VAT exemption.

*While working multiple international deployments, some industry partners did not pursue the VAT time-of-sale exemption method on purchases nor seek VAT exemption approval*

*for their entire contract (even though the foreign country was willing to approve an exemption). Rather, the industry partners completed purchases including VAT, with plans to pursue VAT exemption later. As a result, the industry partners struggled to submit timely and compliant VAT reimbursement documentation per the foreign country's requirements and did not receive reimbursement until more than a year after the original purchase date. In one instance, the foreign country's tax office affirmed it could not provide VAT reimbursement to the industry partner since the country lacked sufficient resources to do so. In another case, an industry partner spent months circulating VAT exemption documents back and forth to the foreign country's tax office without correct forms and required information. Such situations created financial hardships for the industry partners and difficult relations between the various stakeholders. The entities that pursued VAT exemption through the time-of-sale method and approval for their entire contracts experienced more favorable operations than those that pursued VAT exemption through the reimbursement method.*

The DoD and its industry partners should default to using the time-of-sale method and seek VAT exemption approval for entire contracts associated with international acquisitions (if the foreign country is willing to approve). If they default to the reimbursement method for VAT exemption, the process will not be as efficient since that could impose additional administrative burdens and result in an untimely recapture of VAT.

### **Streamline Processes and Define Areas of Responsibility**

It is highly likely that VAT exemption processes and responsibilities will differ for each international acquisition simply because each international acquisition with a foreign country is unique. However, since VAT exemption activities are similar in nature to other administrative activities, processes and responsibilities should be documented and available to involved stakeholders. Procedural documents, such as standard operating procedures, should include input from individuals of the foreign country and industry partners on that specific international acquisition. This will support the creation of streamlined processes that are efficient, simple to complete, and understood by all.

*During an international deployment, there were no VAT exemption-related resources available that identified general processes, stakeholders involved in the process, or areas of responsibility. Current and new personnel on the deployment could not easily identify nor complete VAT exemption efforts. It was also evident that the DoD and its industry partners had different understandings of the VAT exemption process than that of the foreign country. This caused inconsistent and inefficient processes for all stakeholders. During another international*

deployment, processes were created and documented with involvement from major stakeholders (including the foreign country) involved in the VAT exemption process. This resulted in processes being documented, consistent and efficient.

VAT exemption success directly ties back to the established processes. Streamlined processes and defined responsibilities are critical as they define who, what, when, where and why.

### **Maintain Documentation and Report Often**

Documentation applies to more than processes or procedures, as numerous parts of VAT exemption activities should be documented. This includes VAT exemption requests, VAT exemption approvals, contract documents, and vendor quotes or invoices. The documentation responsibilities apply to both DoD entities and industry partners. Documents are critical as the majority are translated into multiple languages, to meet each country's requirements, and have signatures from designated authorities. It is a best practice to maintain documentation if it supports VAT-exempt purchases or contracts. In addition, it is recommended that the DoD entity managing VAT activities for a specific program or site maintain records to document VAT exemption metrics and report as needed.

*During an international deployment, no DoD entity assumed responsibility to maintain documentation supporting the VAT exemption activity. As a result, critical supporting documents, including reference materials and reports relative to VAT exemption activity, were unavailable. This caused significant problems when industry partners and the foreign country's tax office requested specific VAT exemption information. It*

*also caused problems when the DoD entities could not provide VAT exemption metrics (such as total cost savings) to senior DoD officials. During another international deployment, a DoD entity created an electronic filing system to maintain supporting documents for all DoD and industry partner VAT exemption activities. Furthermore, the same DoD entity maintained a report that generated timely VAT exemption data and metrics upon request.*

Documents supporting VAT exemption activities are incredibly important to DoD entities, industry partners and foreign country entities. Implementing a document and reporting system can only strengthen the overall VAT exemption process.

### **Conclusion**

The DoD will likely continue and expand its international acquisition efforts in conjunction with allied nations to maintain its competitive advantage. As such, it is imperative that we pursue VAT exemption authorization, to the greatest extent possible, from foreign nations on all international acquisitions. VAT exemption can yield significant cost savings or avoidances for U.S. taxpayers and eliminate unnecessary administrative burdens during operations for the DoD and their industry partners. Successful VAT exemption efforts require a team approach, information sharing, streamlined processes, defined responsibilities and appropriate documentation. DAU is able to assist DoD acquisition teams with VAT exemption efforts on international acquisition efforts.

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## **MDAP/MAIS Program Manager Changes**

With the assistance of the Office of the Secretary of Defense, *Defense Acquisition* magazine publishes the names of incoming and outgoing program managers for major defense acquisition programs (MDAPs) and major automated information system (MAIS) programs. This announcement lists recent such changes of leadership for both civilian and military program managers.

### **Navy/Marine Corps**

**CAPT Errol A. Campbell** relieved **CAPT James G. Stoneman** as program manager for Air to Air Missile Systems (PMA 259) on Oct. 5, 2018.

**CAPT Eric A. Soderberg** relieved **CAPT Jeffrey S. Dodge** as program manager for Multi-Mission Tactical Unmanned Aerial Vehicle (PMA 266) on Oct. 18.

**CAPT Kenneth B. Sterbenz** relieved **CAPT Stephen R. Tedford** as program manager for Aircraft Launch and Recovery Equipment (PMA 251) on July 12.

### **Air Force**

**Col Matthew D. Bonavita** relieved **Col Peter K. Eide** as program manager for Advanced Pilot Trainer Program on Oct. 1.

**Col Jason E. Bartolomei** relieved **Brig Gen Heath A. Collins** as program manager for the Ground Based Strategic Defense Program on May 1.

**Col James E. Colebank** relieved **Col Christopher B. Athearn** as program manager for the Joint Air to Surface Standoff Missile Extended Range Program on Sept. 1.

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# DEFENSE ACQUISITION



# How Critical Is Critical Thinking?

Brian E. Schultz

“If everyone is thinking alike, then somebody isn’t thinking.”

—Gen. George S. Patton

**C**RITICAL THINKING IS ONE OF THE MANY BUZZWORDS WE hear a lot lately, especially in the context of defense acquisition reform. Senior leaders suggest the Defense Acquisition Workforce needs to get better at critical thinking in order to develop better strategies and plans and to make better decisions.

Even the Section 809 Panel addressed thinking in the May 2017 interim report. The 18-person panel, created in section 809 of the Fiscal Year 2016 National Defense Authorization Act (NDAA), is recommending ways to streamline and improve the defense acquisition process. The initial report stated, “The global threat is rapidly changing, the relevance of the unique defense industrial base is waning, processes for acquisition are no longer efficient or effective, and implementing these processes is left to a workforce that is mired in constricted thinking and risk aversion.”

Let’s consider some approaches to critical thinking and ideas on how to implement the thinking methods in an acquisition program office.

Start with a definition: “Critical thinking is the objective analysis of facts to form a judgment” (from “Defining Critical Thinking” on the Web page of The Foundation for Critical Thinking—an excerpt from Edward M. Glaser’s 1941 doctoral thesis, *An Experiment in the Development of Critical Thinking*, Teacher’s College, Columbia University).

While there are many other definitions, I prefer this one because it is simple, focuses on the reason for critical thinking (to form a judgment), and identifies the need to analyze information. Forming a judgment in a defense acquisition context often relates to developing plans and strategies that eventually shape our program outcomes.

Defense acquisition is not unique in valuing critical thinking skills. According to the World Economic Forum’s *Future of Jobs Report 2018*, complex problem solving and critical thinking will be the top two (of 10) skills desired by industry by the year 2020. Thus, this critical thinking is critical and is getting even more important in the next few years! So how do we ensure that we are good at it?

Before discussing ideas on how to develop and implement a critical thinking culture, let’s review some background on critical thinking approaches.

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We can categorize critical thinking based on the method or techniques used. For example, the Socratic Method (based on the instructive approach used by the Greek philosopher Socrates) is a form of debate between individuals, based on asking and answering questions to stimulate thinking. One proposes a hypothesis, the other individual suggests or counters with a competing idea (e.g., antithesis), and eventually the individuals come to a synthesis or conclusion. The strength of the evidence and arguments presented drives the conclusion. This is similar to a court of law where the prosecution presents charges and evidence, the defense counters with its case, and the jury ultimately decides the verdict.

Another approach is a more cooperative team method. Rather than the argumentative approach, team-based thinking typically involves everyone thinking about various aspects of a problem in unison, networking ideas and thoughts together. The team explores each aspect of the issue or problem before moving on to other thinking elements, eventually building a thought map. The thought map organizes thinking along various categories of thought such as facts, risks, benefits, alternatives and emotions. Edward de Bono's example of this team thinking approach is found in his 1985 book, *Six Thinking Hats*. De Bono refers to this method as parallel or lateral thinking, also known as the "Six Thinking Hats" that involve managing information, emotions, discernment, optimistic response and creativity.

Both of these critical thinking approaches can be very useful and each has pros and cons. For example, the Socratic method is useful in breaking down established ideas and methods and replacing them with new ones. Parallel thinking is an excellent method for developing a new strategy or designing a way forward. A hybrid approach incorporating elements of both also is possible.

Myriad problem-solving techniques also are available, but don't confuse these with critical thinking. Problem solving attempts to find a solution to a specific concern or issue. For our purposes here, problem solving is one of many potential sub-elements of the broader critical thinking skill set. Critical thinking aims to form a judgment, while problem solving attempts to determine the correct answer to a problem.

In conducting critical thinking workshops and training events for organizations and intact teams, I find that critical thinking apparently is a new skill for many participants. While there are several training opportunities to develop these skills, they will not flourish but eventually will degrade over time if not used. Since a typical goal of performance learning is changing behavior in order to achieve better results, we should consider how this critical skill could be cultivated in our acquisition environments. Other-

wise, the training might be interesting but of little real value if not applied when the learner returns to work. So how do we ensure that our organization applies these skills, with a goal of establishing a thinking and learning culture? I offer the following ideas that leaders at the program office can employ to ensure that the training is more than just some interesting content.

### Three Suggested Enablers

- First, leadership should establish clear expectations for critical thinking. Leadership sets the tone for priorities by communication, actions and behaviors. Many program offices make their risk and opportunity management process part of their strategic rhythm and program managers could do something similar for critical thinking efforts. For example, I would ask to review the plan of analysis when a proposed course of action or strategy was complex and needed detailed examination. This review action sent a message that the process for critical thinking is important and we had better get it right or the conclusions may lead to bad decisions. I would then set regular progress checks to see how it was going, sometimes participating in the thinking sessions. I was careful that everyone knew I was a participant, offering ideas rather than solutions or decisions.
- Leaders should establish some group norms for critical thinking. Many studies have emphasized the importance of group norms for effective teams. If we routinely seek consensus and don't question or debate judgments, the quality of decisions is likely to suffer and could even lead to groupthink.
- Finally, leaders should invest in a thinking culture similar to a venture capital, start-up approach. The venture part of the equation involves continually looking at new approaches for thinking. Given the rapid pace of technology and social change, we must stay on top of new processes and techniques that may be relevant. We should also experiment to see how different models work. The Section 804 Middle Tier Authority and increased authorities for Other Transactions are examples of new approaches that program managers can consider as part of their overall strategy. The capital part of the equation is allocating the priorities, resources and time, including training across the enterprise. Many courses and workshops are offered so that training opportunities exist, including at the Defense Acquisition University (DAU). As would be done in the case of a lean start-up, begin with a small investment, assess the value and proceed to grow it, change it or stop it as results warrant.

We should also recognize that too much thinking and collaboration might lead to "paralysis by analysis." Overcollaboration and overthinking can be counterproductive. Research by Bain and Company, Inc., conducted with the support of the *Economist* magazine's Intelligence Unit,



found that the most productive companies lose 50 percent less time to unnecessary and ineffective collaboration than do the rest of the companies studied. Other research suggests that up to a third of value-added collaborations comes from a very small percentage of employees (3 percent to 5 percent). Not everyone is interested in critical thinking, nor do they all need to engage in it. Excessive collaboration causes staff to get involved in too many tasks and can distract them, sacrificing the chance at a clear focus on important tasks. Over-collaborating can add significant opportunity costs and adds additional, unneeded complexity. Finally, some research suggests that the most effective leaders will purposely limit the tasks they engage in—enabling them to enjoy greater attention, energy and satisfaction with the work they accomplish.

Now, let's review some ideas of implementing critical thinking at a team or tactical level. I will suggest three practices teams should consider for effective critical thinking. The first one relates to Gall's law. This law from John Gall is a rule of thumb for systems design from his book *Systemantics: How Systems Really Work and How They Fail*: "A complex system that works is invariably found to have evolved from a simple system that worked. A complex system designed from scratch never works and cannot be patched up to make it work. You have to start over with a working simple system."

In applying Gall's law to critical thinking, we should start our thinking with simple, straightforward thoughts that we can then build upon. In other words, we can break complex tasks into several more simple sub-tasks. For example, when we develop an acquisition strategy, we often start with smaller sub-tasks like determining program priorities, developing a market research plan, assessing technical risks, and determining cost and schedule drivers. These foundational elements may drive subsequent conclusions and thus allow us to build up to the more challenging tasks. We also have to consider the relationship of the sub-tasks to the elements of the larger strategy and ensure the prior knowledge informs and aligns with subsequent thinking.

We use this approach in the Acquisition Strategy Development Workshop (WSM 014 in DAU's *i-Catalog*) training event. Performing these simple tasks helps scope subsequent steps and often drives additional strategy considerations such as business and supportability strategies. We also keep our thinking teams relatively small (five to seven members) as larger teams become harder to manage. We use a similar methodology in the Six Thinking Hats workshop (WSD 014 in the DAU *i-Catalog*), analyzing a problem from specific perspectives, which leads to a more complete thought map that supports a thinking objective.

A second practice is to develop and maintain critical thinking focus. While on the surface this seems obvious and easy to do, it actually is very challenging. Consider a typical acquisition program office where individuals work in a very fast-paced and high-pressure environment. In addition to multiple meetings each day, staff must develop work products and meet deadlines for multiple tasks. This makes it challenging to focus on any one issue without multiple interruptions.

In order to maintain focus, we may need to revisit our normal rhythm of activities. Trying to conduct critical thinking while multitasking will probably not yield good results. For example, an interruption in a complex-thinking task causes not only a loss of thinking momentum but also creates confusion when we try to figure out where we were before the interruption. Some of these initial thoughts and ideas may get lost and will never come back. To avoid interruptions, block out the appropriate time, make the task a priority, and avoid the temptation to break away. How effective will your critical thinking be without this kind of focus? As Dr. de Bono stated, "Confusion is the biggest enemy of good thinking."

A third idea involves improving creativity and innovation. The basic premise is that, in order to do this effectively, we must break away from our normal thought patterns. We have to learn to think differently. Research indicates that we are subject to various biases and thinking patterns based on our life experiences. In order to break out of these thinking patterns, we need to stimulate different thought patterns. Given the changing paradigms in acquisition, the idea of breaking our previous thought patterns becomes essential as we attempt to adopt new cultures and methods. There are various ways to do this, but they all have one thing in common: We often need some type of catalyst or stimulus to help start the process. Teams should practice and experiment with these catalysts. They can lead to great ideas.

Critical thinking is one of the key skills in defense acquisition. In order to gain greater proficiency, one must invest the time, training and continued application. Leaders must carefully plan how best to apply critical thinking in a larger organizational context. An ad hoc approach will lead to confusion. Finally, critical thinking is becoming even more important as we face demands to reform our processes, use new methods and deliver capabilities faster. In order to develop a thinking culture, leaders must invest in developing the skills of their staffs and establish group norms and expectations. If you haven't already, now is the time to start the journey. It will pay dividends, but you must invest!

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# Career Management in the 4th Estate

Scott Bauer

**L**AST YEAR WAS A BUSY ONE FOR THE 4TH ESTATE THAT SAW CONTINUED large-scale classroom and on-site Defense Acquisition University (DAU) training as well as leadership opportunities. Late August saw the first ever “Leaders Building Leaders” week—expected to be an annual event—sponsored by the Director for Acquisition Career Management (DACM) office.

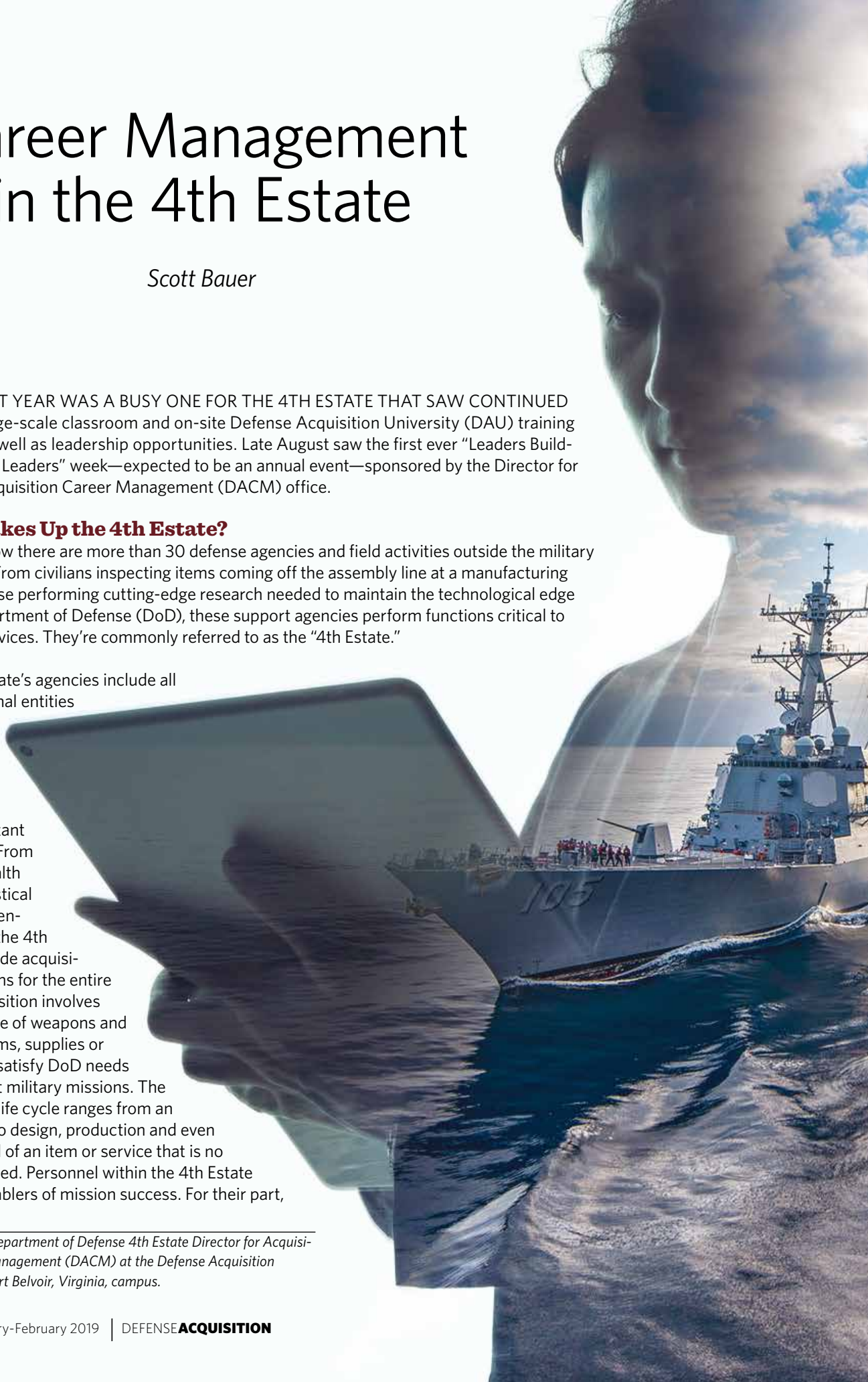
## Who Makes Up the 4th Estate?

Did you know there are more than 30 defense agencies and field activities outside the military branches? From civilians inspecting items coming off the assembly line at a manufacturing plant to those performing cutting-edge research needed to maintain the technological edge of the Department of Defense (DoD), these support agencies perform functions critical to military Services. They’re commonly referred to as the “4th Estate.”

The 4th Estate’s agencies include all organizational entities in the DoD that are not a military branch or a combatant command. From defense health care to logistical support, agencies within the 4th Estate provide acquisition functions for the entire DoD. Acquisition involves the purchase of weapons and other systems, supplies or services to satisfy DoD needs and support military missions. The acquisition life cycle ranges from an initial idea to design, production and even the disposal of an item or service that is no longer needed. Personnel within the 4th Estate are vital enablers of mission success. For their part,

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the 4th Estate Office, referred to as the DACM, invests in the career development of more than 28,000 civilian acquisition workforce members.

### **What Does the 4th Estate DACM Do?**

The 4th Estate DACM is responsible for the oversight and execution of statutory training, professional credentialing, continuous learning, and career development for acquisition workforce members across 14 career fields. This includes all DoD auditors and a large number of personnel working in production, quality and manufacturing, as well as contracting.

### **DAWIA: What Is It?**

Do you remember the acquisition stories of the 1980s? The \$600 hammer? What about the \$1,000 toilet seat? Well, in 1990, Congress enacted the Defense Acquisition Workforce Improvement Act (DAWIA) to address the negative press with the goal of improving acquisition outcomes.

DAWIA required the DoD to establish education, training and experience requirements for each acquisition position to professionalize the workforce and ensure judicious use of taxpayer dollars.

### **What Is the DAWDF?**

Faced with increasingly complex weapons system procurements and a reduction in government personnel, the Defense Acquisition Workforce Development Fund (DAWDF) was created to increase the size and improve the quality of the acquisition workforce. The fund has been a critical enabler, helping to create a highly qualified and agile acquisition workforce. It provides funds for the recruitment, training and retention of DoD acquisition personnel. In Fiscal Year (FY) 2018, the 4th Estate used the fund to provide advanced education, DAU



training, career-broadening assignments, leadership opportunities, and student loan repayments.

### **How Are Personnel Supported?**

The DACM Office provides civilian acquisition professionals with development opportunities through its Leadership and Talent Management Portfolio. These courses develop an individual's technical, functional and soft skills needed to succeed in the workplace. Participants often report that these programs prepare them to become leaders and help them tackle future challenges.

Being in uniform is not the only way to serve in the DoD—thousands of civilians directly support the warfighter. The

Strategic Plan, to “Improve the Quality and Professionalism of the Acquisition Workforce.” The portfolio furthers this goal by providing career development, leadership training and advanced education to build candidate pools at all levels of the workforce. These centralized opportunities provide leadership training to early-, mid- and senior-level acquisition professionals and prepare the workforce to meet future acquisition requirements. More than 1,250 workforce members have taken at least one of the courses centrally offered.

The 4th Estate DACM Office constantly seeks to leverage best practices but sometimes leads the way by coming up with a joint solution. The 4th Estate DACM

## **The 4th Estate DACM Office constantly seeks to leverage best practices but sometimes leads the way by coming up with a joint solution.**



DoD has made significant progress toward strengthening workforce capabilities and promoting acquisition workforce professionalism in alignment with the National Defense Strategy. The 4th Estate DACM Office is building on this progress.

Let's take a look at how the 4th Estate DACM Office uses its strategic assets to support a motivated, diverse and highly skilled civilian workforce. In FY 2018, it provided DAU training quotas and travel funding to the 4th Estate's acquisition workforce, and this resulted in:

- A total of 8,284 DAU classroom graduates
- Eighty-one on-site courses that did not cost the taxpayer any student travel funding
- Students being trained at the most cost-effective location

In alignment with the 2018 National Defense Strategy's aim to cultivate workforce talent, the 4th Estate DACM Office is focused on developing leaders who are competent in national-level and interagency decision-making processes. Recognizing the demand signal for leadership training, the 4th Estate DACM Office will offer a broad talent management portfolio in 2019—leadership training to help mature acquisition decision makers.

The 4th Estate DACM Office's Leadership and Talent Management Portfolio was developed to support Strategic Goal Number 3 of the Defense Acquisition Workforce

Office recognized an opportunity to consolidate and reduce costs by creating a Tri-Service Leadership Contract to sustain the Army, Air Force, and 4th Estate's gold standard Acquisition Leadership Challenge Program (ALCP) that was at risk of being discontinued due to an expired contract vehicle. When compared to the previous contract, the new contract vehicle provides significant savings to the government.

In transitioning to a culture of performance, leadership is critical to a well-trained and agile workforce. In response to the signaled demand for more mid-career leadership opportunities, the 4th Estate DACM Office sponsored its first “Leaders Building Leaders” event, a leadership and talent management week held Aug. 28-30, 2018. More than 130 aspiring 4th Estate acquisition leaders gathered for this 3-day event at DAU's Fort Belvoir, Virginia, campus. The purpose of this event was to provide the 4th Estate acquisition workforce an outlet for building skills, developing interpersonal leadership, gaining insight and motivation from senior leaders in defense acquisition and industry, and networking with other defense agencies, as I explained during opening remarks at the event.

Participants chose a core leadership course from among several offered. The goal of the select suite of courses offered was to provide attendees with insight into accountability, leveraging diversity of thought, how to best develop

others, the art of mentoring and succession planning, as well as a plethora of other soft skills leadership training. In addition to the primary leadership course, participants were able to choose several breakout sessions. Options included Critical Thinking, Recruitment Strategy/Interview Skills, Wellness/Energy Management, Feedback/Mentoring and Speed Networking.

Thirty participants selected Speed Networking, a rare opportunity to meet one-on-one with senior leaders in defense acquisition and ask them for career advice. Speed mentors included Shay Assad, director of DoD Defense Pricing and Contracting in the Office of the Under Secretary of Defense for Acquisition and Sustainment (USD[A&S]); retired Air Force Maj. Gen. Joe Balskus; Glenda Scheiner, director of Human Capital and Resource Management in the Office of the Under Secretary of Defense (Comptroller); Roxanne Banks, deputy director for acquisition, Defense Logistics Agency; René Thomas-Rizzo, chief operating officer for USD(A&S) and former director of Human Capital Initiatives; and Frank Kelley, vice president of DAU.

In addition to this full lineup, each morning started with a guest speaker presentation. Robert "Cujo" Teschner, a retired Air Force F-22 squadron commander and founder,

president and chief executive officer (CEO) of the VMax Group, opened the event with his motivational story as an Air Force leader and cancer survivor, whose lessons tied directly back to the need for personal accountability. Kevin Fahey, Assistant Secretary of Defense for Acquisition (ASD[A]), kicked off Day Two as the keynote speaker. Fahey provided his thoughts on leadership from both Senior DoD acquisition leader and private industry perspectives. He provided an update on the reorganization of the Office of the USD(A&S), re-emphasized the DoD priorities and stressed the importance of formal mentoring. Finally, Casey Lucius, Ph.D., a Navy veteran and founder and CEO of Launch Learning Systems, encouraged attendees to understand their own learning and communication styles and provided tools to improve their leadership skills.

### **In Summary**

The 4th Estate defense agencies and field activities continuously evaluate their workforce as part of readiness to strengthen cohesion and meet challenges. Enabling a world-class acquisition workforce underpins all of the 4th Estate DACM Office's efforts to achieve and maintain acquisition excellence.

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## ***Defense Acquisition Wins Another MarCom Gold Award!***

The *Defense Acquisition* magazine has received a gold award for publications quality from MarCom, administered by the Association of Marketing and Communication Professionals (AMCP), headquartered in Dallas, Texas. This is the 10th award received in the last 4 years.

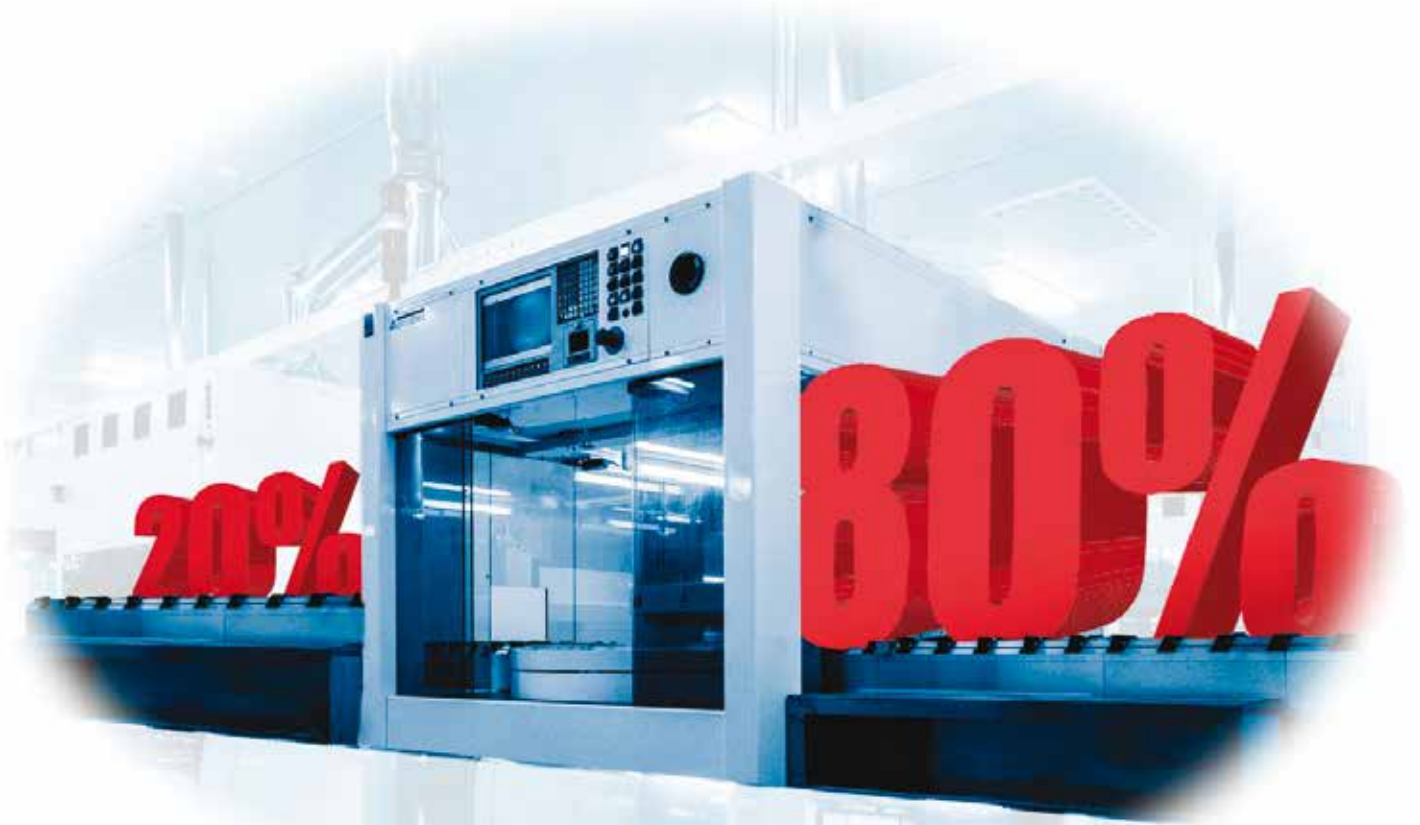
The award recognized the September-October 2018 issue, the first issue under the new name of what was formerly the *Defense AT&L* magazine. This illustrates that *Defense Acquisition* continues the reputation for excellence established by *Defense AT&L*.

This is the second MarCom gold award for our publication, and the third from AMCP.

However, the satisfaction of our regular readers, contributors and customers is our most important objective. To facilitate our work in this regard, we again invite comments through the readership survey found on Page 27.

—Benjamin Tyree, managing editor





# Readiness Workups Versus Investments

*Jennifer Miller, D.B.A.*

**B**Y DEFINITION AND IN PRACTICE, PROGRAM MANAGEMENT IS PRIMARILY ABOUT PLANNING, CONTROLLING, ORGANIZING, STAFFING AND LEADING. Each of these program management elements relies heavily on influence and information.

One key source threaded throughout a program's management is financial management. Choosing between funding near-term operations or investing in future capability is a challenging and difficult choice in many federal agencies whether viewed through a program or organizational perspective. Program managers (PMs), financial managers (FMs), cost estimators, engineers, attorneys, and many others steer federal agency leadership through the quagmire of choices. Department of Defense (DoD) leadership's public statements and testimony, along with those of other federal agencies, convey the challenges faced in balancing today's readiness and future weapon systems. Fortunately, there are some great options like the Pareto Principle, "maximax" and "maximin" strategies, constraint theory, and an Integrated Priority List (IPL) that both PMs and FMs can use to inform and develop readiness rather than

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investment recommendations for leaders. These specific, theory- and practice-supported actions are described in detail below in a hypothetical view about being a PM or FM who advises leaders.

### **Looking for Leverage**

While a PM will focus on planning, controlling, organization and staffing, and leading the overall program, an FM takes a narrower perspective to support the PM and higher levels of leadership. A PM and a chief financial officer (CFO) could tag-team to inform and develop readiness versus investment recommendations to leaders by leveraging the popular Pareto Principle to lay the groundwork for the choice at hand. The PM would provide a coveted macro level view while a CFO would provide a micro-level review of the inputs and outputs to a program.

With the Pareto Principle, observers can see the unequal relationship between inputs and outputs. The Pareto Principle provides that 20 percent of the invested input is responsible for 80 percent of the results obtained. Given this, a DoD CFO, in particular, could use the Pareto Principle to inform and remind leaders that the relationship between inputs and outputs is not balanced and that the accumulation of both readiness and investment spending plans does not necessarily reflect the accumulated, absolute requirement to attain at least 80 percent readiness and investment goals. Rather, there is a worthwhile probability that leaders should entertain: that 80 percent or more of an agency's readiness and investment may be achievable with far less than the currently identified funding requirements. An effective PM could highlight and seize the opportunities raised from the Pareto Principle's big-picture look at relationships by influencing interrelationships among a program's elements and then steering funding, pushing schedules, and adjusting performance objectives and thresholds as needed.

As an armed CFO or seasoned PM, I would go a step further with a combination of historical data and particular examples from the agency to show the application of the Pareto Principle in our practices. With the actual information and reminder of a repeatedly proven principle, I would also include caveats that researchers and practitioners have observed. One major caveat is the figures of 80 percent and 20 percent need not equate to 100 percent because the "80/20 rule" is merely a guide concerning typical distributions, and each input unit does not necessarily equate to the same output of another input unit. The PM's in-depth understanding of interrelationships supports this idea as sensitivity analyses, Monte Carlo simulations, and modeling can show the lack of perfect equations in real-life programs. Instead of leaders making a difficult choice between funding near-term operations or investing in future capability, they may choose from an a la carte

menu of recommendations to address both the near-term readiness and future investments.

A option available to PMs and CFOs for informing and developing readiness versus investment recommendations is to apply maximax and maximin strategies to the menu of recommendations formulated from the first specific action (i.e., laying the groundwork with the Pareto Principle). PMs frequently confront scenarios where some version of maximax and maximin strategies are applied because of their understanding and need to control requirements, address environmental factors, lead and manage organizations, influence activities, manage constraints, mitigate risks and assess impacts to the assigned program.

### **Weighing Choices by Outcomes**

Like the Pareto Principle, maximax theorem was first formulated generations ago. In short, game theory includes multiple strategies. In a maximax strategy, a decision maker chooses a recommendation that yields the best of the best outcome whereas a maximin strategy involves a recommendation that yields the best of the worst outcomes. Some may argue a PM's daily job is to apply maximax strategy and maximin strategy when and where necessary.

Decision theory uses maximax and maximin for optimal decision making among options with varying risk or expectations of gain or loss, dependent on the outcome. Opportunity cost, benefits and risk are significant drivers behind the maximax and maximin strategies. One primarily CFO goal would be to steer agency leaders toward the best-value recommendations promising the greatest benefit possible for the near-term readiness operations and future investment while accepting the lowest possible risk and opportunity costs. Similarly, a PM goal would be to guide agency leaders toward the best-value recommendations considerate of the widest stakeholder pool possible including defense industry contractors, in-house subject matter experts, contracting officers, direct and indirect support, political leadership, related programs in the same or different life-cycle stages, and others. Thus, this application of maximax and maximin strategies provides the best courses of action (COAs) for present readiness and future investment inclusive of many stakeholders. When PMs or CFOs advise leaders, leveraging the Pareto Principle and these two strategies allows them to provide the informative groundwork for the situation and the best COAs for decision-making.

In the next potential stage, my hypothetical PM and CFO team will have executed the specific actions of leveraging the Pareto Principle for an initial assessment of the landscape followed by applying maximax and maximin strategies. Then, the PM would be best suited to advise

leaders to consider the theory of constraints (TOC) when combining the information and remaining recommendations heavily fueled by CFO input.

This specific action could be the most significant due to a likely learning curve. The cursory information would include how the TOC also is known as constraint theory, and the TOC is a system management philosophy applicable to every system, including the federal government's Defense Acquisition System; Joint Capabilities Integration and Development System; and Planning, Programming, and Budgeting System. Also, the TOC is a global manage-

ment method for critical factors makes the TOC a significant, specific action that a PM and CFO can work together to use to inform and develop readiness versus investment recommendations to leaders.

Finally, after overcoming the TOC education hurdle and learning curve, an IPL would be derived from using the TOC's five steps and managers' and leaders' three decisions. Remember, a PM or multiple PMs, maybe derive an IPL from the five-step TOC process and subsequent three decisions mentioned earlier. First and foremost for a CFO-centric example, the biggest constraints of DoD's Planning,



**In a maximax strategy, a decision maker chooses a recommendation that yields the best of the best outcome whereas a maximin strategy involves a recommendation that yields the best of the worst outcomes.**

rial methodology for managers to focus on the most critical factors of management. Management in this context is not limited to program management, risk management, resource management, financial management, personnel management, software management and many other obvious management roles.

Finally, in the TOC, a system must have one or more constraints representing improvement opportunities. TOC creator Eliyahu Goldratt identified five steps: (1) identify the system's constraint(s); (2) decide how to exploit the system's constraint(s); (3) subordinate everything else to the above decision; (4) elevate the system's constraint(s); and (5) if, in the previous steps, a constraint is resolved, go back to Step 1, and do not allow inertia to cause another system constraint.

### **The Direct Management Role**

Then there is the direct role of management and leadership, usually performed by PMs, in making three decisions: what to change, what to change to and how to cause the change. There are two measurements to guide managers' and leaders' follow-on actions: global (e.g., profit, return on investment, and cash flow) and operational (e.g., throughput, inventory and operating expense). It is likely that a CFO would focus on the global measurements while a PM would focus on the operational measurements. Researchers from the 1990s reported most applications of the TOC in North America with more than 100 cases and no failures. The TOC reportedly also works well if partially applied. Applicability to every system and a global manage-

ment method for critical factors makes the TOC a significant, specific action that a PM and CFO can work together to use to inform and develop readiness versus investment recommendations to leaders.

Programming, Budgeting, and Execution (PPBE) system would be identified, such as resources. One could argue that DoD has too many people (e.g., civilians, military, contractors, etc.), places (e.g., installations, office spaces, etc.), and things (e.g., planes, ships, tanks, etc.). Then, considering how to exploit the PPBE system constraints would include changes to quantities, scopes of service or span of footprint, retiring assets, and general prioritization of requirements. A PM would be better suited for addressing these constraints as a PM possesses a more strategic view and has the authority to develop, manage and execute programs. These two steps are taken simultaneously with the first direct role in which management and leadership decide what to change. For example, leadership may decide to change the people constraint.

The next step is to subordinate everything else to deciding how to exploit constraints. This is when the second direct role of management and leadership emerges because management and leadership must decide what to change to. Leadership may decide to elevate a single constraint of people and subordinate the remaining constraints of places and things. Again, PMs operate from a macro level or big picture posture, making the PM a better party to prioritize than a CFO. However, a CFO remains a critical source of decision support and information to PMs. In this example, the "what to change to" could be more of one type of personnel and less of another, a complete overhaul, or adjustments to segments of the workforce. Obviously this example would warrant significant input from financial managers, workforce managers, potentially the union(s),



judge advocates, and more. In other words, the most important "how to(s)" for exploitation take priority, and an organization would implement that decision set while the runner-up options get tabled for future consideration.

Subordinating everything else to the decision allows for the next step of elevating system constraints for a whole-of-agency approach that aligns with the third direct role of management and leadership in the TOC, where leaders and managers must decide how to cause the change. Since a PM's core roles include managing and leading, it is likely that a PM would take the senior most leader or manager's choice among competing options and execute. In this hypothetical example, causing the change might be a single approach or multiple as we have witnessed with Voluntary Early Retirement Authority, Voluntary Separation Incentive Payments, sabbatical leave programs, termination for convenience of contracts, Office of Management and Budget A-76 reviews (of economy of effort and principal reliance on commercial sources), enlistment and re-enlistment bonuses, etc. Finally, managers and leaders have follow-on global and operational measurements of constraint resolution. Assuming the constraint is resolved (i.e.,

recruitment, retention and retirement result in a workforce that is supportable despite budget constraints), then the five-step process can be used for another round of constraint identification and subsequent attack. PMs would execute their responsibilities based on continuous monitoring and reporting on the implemented solution from those representing functional and technical communities, such as CFOs. Of course, leaders and followers must be alert to inertia, which could cause other system constraints to arise (i.e., if the workforce balance is upset).

In closing, the congressional testimonies and public statements of DoD and other agencies' leadership portray the challenges confronted in balancing today's readiness and investing in future weapon systems. PMs and CFOs together can be a dynamic team when informing, developing and executing the decisions in the above suggested, specific actions of posturing with a principle, masterminding maxi strategies, applying theory, and integrating priorities for an agency's leaders.

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# DEFENSE ACQUISITION

## WRITERS' GUIDELINES IN BRIEF

### Purpose

*Defense Acquisition* is a bimonthly magazine published by DAU Press, Defense Acquisition University, for senior military personnel, civilians, defense contractors and defense industry professionals in program management and the acquisition, technology and logistics workforce.

### Submission Procedures

Submit articles by e-mail to [defacq@dau.mil](mailto:defacq@dau.mil). Submissions must include each author's name, mailing address, office phone number, e-mail address, and brief biographical statement. Each must also be accompanied by a copyright release. For each article submitted, please include three to four keywords that can be used to facilitate Web and data base searches.

Receipt of your submission will be acknowledged in 5 working days. You will be notified of our publication decision in 2 to 3 weeks. All decisions are final.

### Deadlines

Note: If the magazine fills up before the author deadline, submissions are considered for the following issue.

Issue	Author Deadline
January-February	1 October
March-April	1 December
May-June	1 February
July-August	1 April
September-October	1 June
November-December	1 August

### Audience

*Defense Acquisition* readers are mainly acquisition professionals serving in career positions covered by the Defense Acquisition Workforce Improvement Act (DAWIA) or industry equivalent.

### Style

*Defense Acquisition* prints feature stories focusing on real people and events. The magazine seeks articles that reflect author experiences in and thoughts about acquisition rather than pages of researched information. Articles should discuss the individual's experience with problems and solutions in acquisition, contracting, logistics, or program management, or with emerging trends.

The magazine does not print academic papers; fact sheets; technical papers; white papers; or articles with footnotes, endnotes, or references. Manuscripts meeting any of those criteria are more suitable for DAU's journal, *Defense Acquisition Research Journal (ARJ)*.

*Defense Acquisition* does not reprint from other publications. Please do not submit manuscripts that have appeared elsewhere. *Defense Acquisition* does not publish endorsements of products for sale.

### Length

Articles should be 1,500-2,500 words.

### Format

Send submissions via e-mail as Microsoft Word attachments.

### Graphics

Do not embed photographs or charts in the manuscript. Digital files of photos or graphics should be sent as e-mail attachments. **Each figure or chart must be saved as a separate file in the original software format in which it was created.**

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