DEFENSE ARJ JOURNAL

Defense Acquisition Research Journal
A Publication of the Defense Acquisition University

2013 Hirsch Research Paper Competition

Improving Acquisition Outcomes in the AGE of AUSTERITY

Presented on behalf of DAU by:

April 2013 Vol. 20 No. 1

ISSUE 65

Defense Acquisition University

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ISSN 2156-8391 (print) ISSN 2156-8405 (online)

The *Defense Acquisition Research Journal,* formerly the *Defense Acquisition Review Journal,* is published quarterly by the Defense Acquisition University (DAU) Press. Postage is paid at the U.S. Postal facility, Fort Belvoir, VA, and at additional U.S. Postal facilities. Postmaster, send address changes to: Editor, *Defense Acquisition Research Journal,* DAU Press, 9820 Belvoir Road, Suite 3, Fort Belvoir, VA 22060-5565. Some photos appearing in this publication may be digitally enhanced.

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The success of the Defense Acquisition Workforce depends on experience, and since the majority of what it learns is on-the-job, a wide array of learning techniques dominates. Together, they behave as a learning ecosystem full of opportunities—and even learning hazards. While all these learning techniques jockey for the fastest learning lane amid variable workplace demands, proven learning methodologies help form the foundation of an organization's learning faith. Many organizations already promote learning in the workplace. But, what have Department of Defense acquisition organizations that operate as Learning Organizations (LOs) implemented to achieve performance gains? The authors of this research sought out such organizations to better understand the key ingredients that make them authentically high-performing and appropriately armed LOs.

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p. 27 *Ginny Wydler, Su Chang, and Erin M. Schultz*

Research shows that continuing competitive pressure applied during development and production leads to better industry performance, often at reduced cost. However, the entrenched practice of one-time competition for an entire program life cycle often endows the winner with a very strong monopolistic power that lasts for decades. This article describes continuous competition as leverage to acquire more effective results. It offers an alternative method for continuous competition—Competitive Multisourcing with Distributed Awards—under an applicable set of conditions and an appropriate business case.

Past Performance as an Indicator of Future Performance: Selecting an Industry Partner to Maximize the Probability of Program Success

p. 49 *James Bradshaw and Su Chang*

The federal contracting process should enable a government organization to select a contractor that will become a true business partner. Today's source selection processes evaluate how well a contractor proposes a solution; however, the government's processes are ill suited to evaluate how well a contractor can deliver on its proposal. The Department of Defense (DoD) relies too heavily on the contractor's proposal versus evaluating past performance. The lack of past performance data and processes to evaluate companies' qualifications has contributed to program failures, cost overruns, and schedule delays. Without adequate data and processes, the DoD increases its risk of duplicating previous program failures and misses the opportunity to capture this information, thereby preventing repeated mistakes with the same contractor.

Acquisition Program Funding Stability—A Myth

p. 71 *COL Robert D. Morig, USA (Ret.)*

Program stability and funding stability are continuously promoted as key to successful acquisition reform. Funding stability, according to prevailing wisdom, leads to program stability. Unfortunately, the dynamic, evolving, and methodical requirements generation, technology enhancement, and resourcing processes prevalent throughout the Department of Defense (DoD) are not conducive to funding stability. This article discusses results from a survey of financial management practitioners that provide insight into factors that both enable and detract from achieving funding stability. The author presents program stability as a myth in the real world environment where the "norm" is characterized by changing program requirements, technologies, and funding. He further hypothesizes that stability cannot occur without major change in the Planning, Programming, Budgeting and Execution, and Congressional Enactment processes.

Dynamic Consequences of Cost, Schedule, and Performance Within DoD Project Management

p. 89 *Patrick R. Cantwell, Shahram Sarkani, and Thomas A. Mazzuchi*

Project management has been a constant challenge for the U.S. Department of Defense (DoD) acquisition community. While most DoD projects are technologically advanced, the tools and methods to manage these projects are the same as for simple, repetitive projects. The authors argue that traditional approaches fail because they only evaluate the relationships between two of the three elements of cost, schedule, and performance. Instead, they have developed a system dynamics model that allows cost, schedule, and performance to interact and influence one another. This model is complementary to other research and intended to be usable by the practicing project manager. The results from model runs will provide consequences for three potential control alternatives in DoD project management.

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The *Defense Acquisition Research Journal (ARJ)* is a scholarly peer-reviewed journal published by the Defense Acquisition University (DAU). All submissions receive a blind review to ensure impartial evaluation.

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From the Deputy Executive Editor

The opening words of one of Thomas Paine's essays captured the spirit that guided the founders of a fledgling nation as they resolved challenges they faced in 1776.

> These are the times that try men's souls. The summer soldier and the sunshine patriot will, in this crisis, shrink from the service of their country; but he that stands by it now, deserves the love of man and woman. (Paine, 1776, p. 1)

Ironically, these words hold true for contemporary acquisition professionals. To garner the best possible return on public treasure invested, acquisition professionals must continually strive to deliver cost-effective systems and services that meet users' needs. The challenges inherent in achieving that outcome become more difficult whenever defense budgets contract, as they do on a cyclical basis. The word 'crisis' seems appropriate when shrinking budgets are squeezed further with the uncertainties of continuing resolution and sequestration.

The Defense Acquisition University Alumni Association Hirsch Research Paper Competition for 2013 reflected the idea that workforce members must learn new skills, tools, and ideas to face the challenges they encounter. The theme for this year's competition was: "Improving the Defense Acquisition Workforce in the Age of Austerity."

The first article in this issue is the winning paper in that competition. Winning authors Col Robert L. Tremaine, USAF (Ret.), and Donna J. Seligman, in "Learning Organizations: Their Importance to Systems Acquisition in DoD," conducted research to highlight how proven learning methods can be brought to bear in government organizations. The remaining articles in this issue illustrate that identifying tried and innovative best practices provides members of the workforce with the tools and ideas they need to tackle challenges they face.

Two of the articles were presented as papers at a research symposium hosted at DAU's Fort Belvoir campus last fall (September 18–19, 2012) under the conference theme "Limits of Competition." Ginny Wydler teamed with two of her colleagues (Su Chang and Erin M. Schultz) to explore various options for maintaining the benefits of "Continuous

Competition as an Approach to Maximize Performance," including multisourcing with distributed awards. Also James Bradshaw and Su Chang (appearing twice as a coauthor in this issue), in "Past Performance as an Indicator of Future Performance: Selecting an Industry Partner to Maximize the Probability of Program Success," emphasized the importance of evaluating contractors' past efforts and key personnel during source selection.

COL Robert D. Morig, USA (Ret.), addressed a topic that is particularly relevant in view of current events. His survey of financial management practitioners provided insight into the factors that enable or detract from achieving funding stability. His conclusions, in "Acquisition Program Funding Stability—A Myth," might surprise you. Patrick R. Cantwell, together with coauthors Shahram Sarkani and Thomas A. Mazzuchi from The George Washington University faculty, offers a system dynamic model in "Dynamic Consequences of Cost, Schedule, and Performance Within DoD Project Management," which examines the interaction among cost, schedule, and performance to predict project behavior and develop control strategies for given situations.

Collectively, these articles reflect the purpose of acquisition research—providing empirical knowledge that supports practitioners in managing and executing their programs effectively. Particularly in an austere age, we can all heed words that also appeared in Paine's essay: "The present winter is worth an age, if rightly employed." As acquisition practitioners, we must not "lose or neglect the opportunity" presented by austere times to experiment and generate knowledge that will help us make more effective use of the constrained resources available. In that spirit, I hope you will enjoy the offerings in this issue.

Dr. Mary C. Redshaw
Deputy Executive Editor
Defense ARJ

Reference

Paine, T. (1776). *The American crisis* (No. I) [Pamphlet]. Retrieved from http://libertyonline.hypermall.com/Paine/Crisis/Crisis-TOC.html

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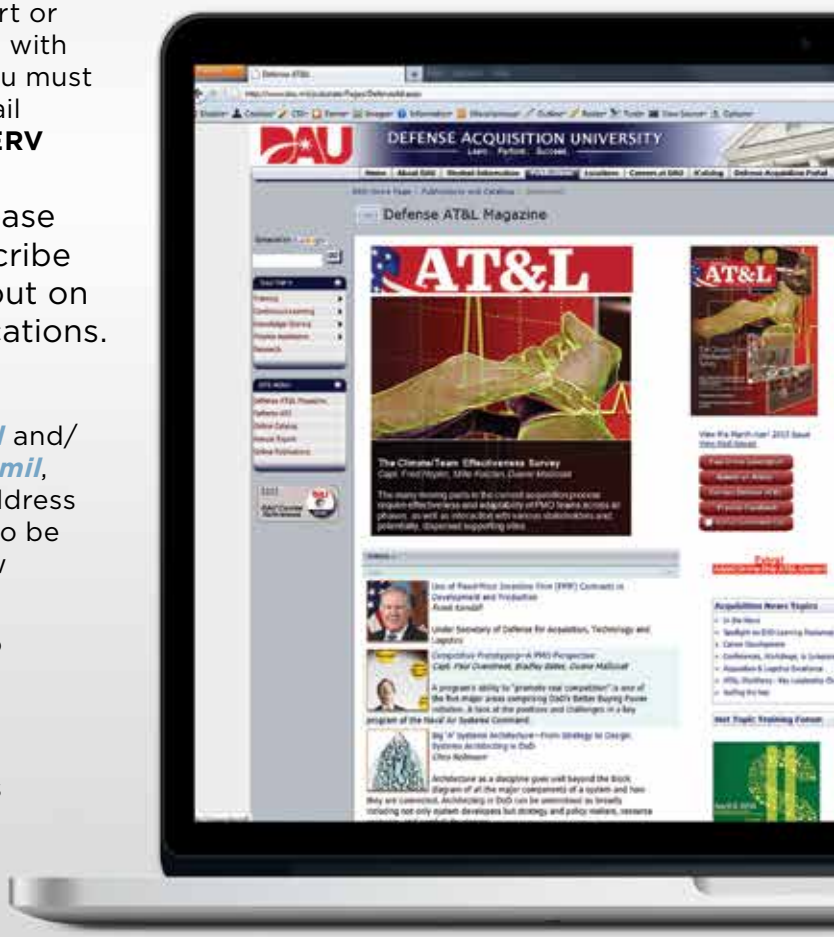


DAU Center for Defense Acquisition Research

Research Agenda 2013

The Defense Acquisition Research Agenda is intended to make researchers aware of the topics that are, or should be, of particular concern to the broader defense acquisition community throughout the government, academic, and industrial sectors. The purpose of conducting research in these areas is to provide solid, empirically based findings to create a broad body of knowledge that can inform the development of policies, procedures, and processes in defense acquisition, and to help shape the thought leadership for the acquisition community.

Each issue of the Defense ARJ will include a different selection of research topics from the overall agenda, which is at: http://www.dau.mil/research/Pages/researchareas.aspx

Affordability and cost growth

- Define or bound "affordability" in the defense portfolio. What is it? How will we know if something is affordable or unaffordable?
- What means are there (or can be developed) to measure, manage, and control "affordability" at the program office level? At the industry level? How do we determine their effectiveness?
- What means are there (or can be developed) to measure, manage, and control "Should Cost" estimates at the Service, Component, program executive, program office, and industry levels? How do we determine their effectiveness?
- What means are there (or can be developed) to evaluate and compare incentives for achieving "Should Cost" at the Service, Component, program executive, program office, and industry levels?

- Recent acquisition studies have noted the vast number of programs and projects that do not make it successfully through the acquisition system and are subsequently cancelled. What would systematic root cause analyses reveal about the underlying reasons, whether and how these cancellations are detrimental, and what acquisition leaders might do to rectify problems?

- Do Joint programs—at the inter-Service and international levels—result in cost growth or cost savings compared with single-Service (or single-nation) acquisition? What are the specific mechanisms for cost savings or growth at each stage of acquisition? Do the data support "jointness" across the board, or only at specific stages of a program, e.g., only at research and development or only with specific aspects, e.g., critical systems or logistics?

- Can we compare systems with significantly increased capability developed in the commercial market to DoD-developed systems of similar characteristics?

- Is there a misalignment between industry and the government priorities that causes the cost of such systems to grow significantly faster than inflation?

- If so, can we identify why this misalignment arises? What relationship (if any) does it have to industry's required focus on shareholder value and/or profit, versus the government's charter to deliver specific capabilities for the least total ownership costs?

DEFENSE *ACQUISITION RESEARCH* JOURNAL

ISSUE 65 APRIL 2013 VOL. 20 NO. 1

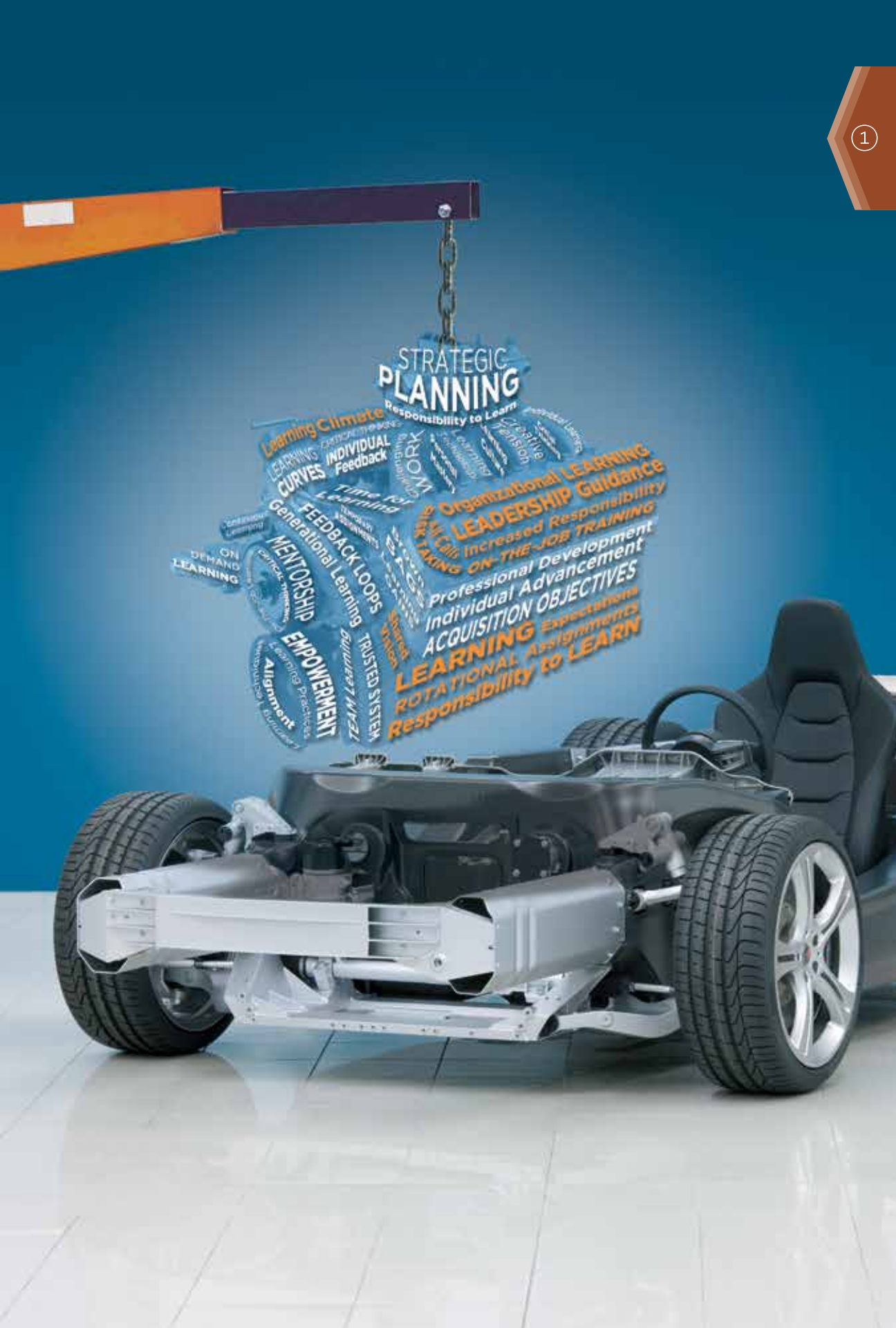
Keywords: *Learning Organization (LO), DoD Acquisition, Learning Dividends, Professional Development*

Learning Organizations: *Their Importance to Systems Acquisition in DoD*

Col Robert L. Tremaine, USAF (Ret.), and Donna J. Seligman

The success of the Defense Acquisition Workforce depends on experience, and since the majority of what it learns is on-the-job, a wide array of learning techniques dominates. Together, they behave as a learning ecosystem full of opportunities—and even learning hazards. While all these learning techniques jockey for the fastest learning lane amid variable workplace demands, proven learning methodologies help form the foundation of an organization's learning faith. Many organizations already promote learning in the workplace. But, what have Department of Defense acquisition organizations that operate as *Learning Organizations* (LOs) implemented to achieve performance gains? The authors of this research sought out such organizations to better understand the key ingredients that make them authentically high-performing and appropriately armed LOs.

Image designed by Diane Fleischer »


STRATEGIC
PLANNING
Responsibility to Learn
Learning Climate
INDIVIDUAL
Feedback
CURVES
Time for Learning
Organizational LEARNING
LEADERSHIP Guidance
Increased Responsibility
ON-THE-JOB TRAINING
Professional Development
Individual Advancement
ACQUISITION OBJECTIVES
LEARNING Expectations
ROTATIONAL Assignments
Responsibility to LEARN
FEEDBACK LOOPS
Generational Learning
MENTORSHIP
ON DEMAND LEARNING
EMPOWERMENT
Alignment
TEAM LEARNING
TRUSTED SYSTEM

1

Every day, organizations face routine learning challenges. To tackle them, U.S. organizations spent approximately $156.2 billion on employee learning in 2011 (Miller, 2012). DoD acquisition organizations that design, develop, produce, and maintain essential capabilities required to meet U.S. security needs have instituted their own learning solutions. However, few have formally adopted all the learning practices that address their unique learning challenges or have reenergized previous learning practices that have lost their charge. With the continued focus on finding greater efficiencies in the workplace coupled with any companion reductions in weapon systems costs, the concept of LOs deserves a closer look for every DoD acquisition organization looking to boost its learning mileage. Why is this important? The DoD's human capital workforce—acquisition practitioners from all acquisition functional areas—depends heavily on learning gains, especially if it expects to fulfill warfighter capability needs and meet Better Buying Power objectives promulgated by the Office of the Secretary of Defense, which seek greater current as well as future efficiencies over the long haul in weapon systems procurement for today's warfighters.

LOs have actually been around for some time. Lately, their relevancy has come into question. Some argue they are too subjective, elusive, ambiguous, and lack feedback loops (Grieves, 2010). Many authors have

written about them or alluded to them in some fashion. In his book *The Fifth Discipline: The Art and Practice of The Learning Organization* (1990), Peter Senge first defined LOs as:

> Organizations where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning to see the whole together. (p. 3)

He further characterized LOs in the context of (a) Systems Thinking, (b) Personal Mastery, (c) Mental Models, (d) Shared Visions, and (e) Team Learning.

Learning vs. Training

Misunderstanding the distinction between formal learning and training can derail the promise of more workplace learning—a necessity for LOs. The difference is often obscured because learning and training are so tightly intermingled. A "training experience" is seldom on the same plane as a "learning experience," albeit some training experiences, like simulations, closely resemble learning experiences. More often than not, training occurs outside the workplace or work group. Seen as preparatory, training fills a crucial "know-how" gap where workers practice what they learn without fear of failure. After the "training experience" is over, workers head back to their workplaces and apply what they learned. But, external training cannot address every aspect (Good & Brophy, 1990). In the workplace, training takes the form of on-the-job training (OJT), or more precisely on-the-job learning (OJL), and becomes much more informal, transparent, ubiquitous, and continuous. Mandatory learning comes back as formal training (in the form of an intervention) after something goes wrong like reduced profits, higher costs, design flaws, manufacturing defects, safety violations, or even major accidents resulting in loss of life. Learning in this context is not a continuous activity either. It is more reactive and short-lived. Understanding how fully embodied LOs leverage OJL and other key learning components might help reverse several other misconceptions about learning and raise them to more reputable levels.

1

Reforming Our Thinking About Learning

Despite the program type or life-cycle phase, learning in DoD acquisition organizations is compulsory. A vast array of learning methods, practices, and techniques prevails. In various ways, each contributes to workplace learning. Some are more effective than others, especially those that actually mimic the *job*. Far from a perfect science, the literature (Kerka, 1995) suggests *effective* LOs:

- Provide continuous learning opportunities.
- Use learning to reach their goals.
- Link individual performance with organizational performance.
- Foster inquiry and dialogue, making it safe for people to share openly and take risks.
- Embrace creative tension as a source of energy and renewal.
- Maintain continuous awareness and interaction with their environment.

Even though these active learning features help organizations achieve their objectives, most organizations have only a modest understanding of how these features generate the success upon which their organizations depend. Consequently, they spend less time thinking about learning since future benefits are not readily apparent. If DoD organizations recognized the significance of powerful workplace learning architectures, would they take them more seriously?

The researchers selected an unconventional framework to characterize LOs under four categories: Learning Pathways (L_P), Learning Engines (L_E), Learning Lubricants (L_L), and Learning Additives (L_A), but used a traditional mathematical formula to express them.

$$\text{Learning Organizations} = \sum_{i=1}^{n} ((L_{Pi}(L_{Ai}) + L_{Ei}(L_{Ai}) + L_{Li}(L_{Ai}))$$

Methodology

This research used a combination of interviews and surveys to assess learning practices operating across 18 different DoD acquisition program offices (Figure 1). They constitute a rich blend of functional professionals who apply expertise every day in programs spring-loaded with risks and uncertainty. As a distinctive group, the researchers responded that the current leaders in DoD's acquisition program offices could readily characterize the learning practices making a difference for them and the organizations they lead. Accordingly, diverse acquisition leaders from Acquisition Category (ACAT) I and II program management offices, representing all military departments, were interviewed. These DoD acquisition leaders would offer informative "top-down" views. A 63-question survey was administered to them and their acquisition foot soldiers, who would offer equally informative views from the ground "looking up." What learning attributes made a difference, and which ones required more learning voltage?

FIGURE 1. LISTING OF PROGRAM OFFICES AND DIRECTORATES INTERVIEWED AND SURVEYED

18 Interviewed and Surveyed	
Ballistic Missile Defense System (BMDS)	RQ-4A/B Unmanned Air System (UAS) GLOBAL HAWK
Navy Virginia (SSN 774) Class Attack Submarine	Wideband Global Satellites (WGS) (Military Satellite Communications Systems Directorate [MILSATCOM], Advanced Extremely High Frequency [AEHF], Family of Advanced Beyond Line-of-Sight Terminals [FAB-T], Global Broadcast Service [GBS])
C-130 Aircraft Modernization Program	National Polar-Orbiting Operational Environmental Satellite System (NPOESS)
B-2 Bomber and SATCOM and Computer Increment I	Space Based Infrared System (SBIRS) — High Satellite
F-35 Lightning II	Evolved Expendable Launch Vehicle (EELV)
C130J - Super Hercules	Global Positioning Systems (GPS) Directorate — GPS IIIA and NAVSTAR GPS
MQ-9 Unmanned Air System (UAS) REAPER	Apache Block IIIA (AB3A) Remanufacture
KC-46 Tanker	Guided Multiple Launch Rocket System (GMLRS) and GMLRS Alternate Warhead (GMLRS-AW)
F-22 Raptor	Program Executive Office, Command, Control, Communications, Computers and Intelligence (PEO C4I)

1

Findings

The researchers invited 4,158 acquisition program office personnel to take part in this survey. Of that group, 2,125 personnel responded. Their aggregate views exposed the prevalence and dominance of many learning components. Their views also confirmed the active implementation of 16 preselected LO components (independent variables) and the resulting workplace learning dividends (dependent variables) expressed as positive or negative gaps.

FIGURE 2. PROGRAM OFFICE TOP BOX GAPS

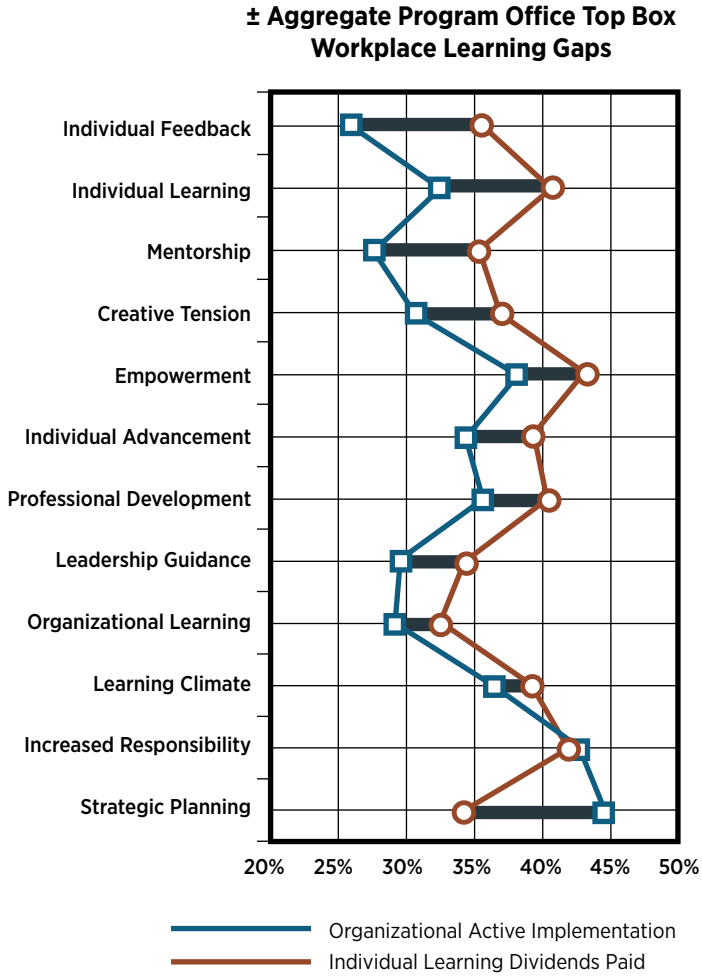


Figure 2 represents the combined percentages for the top two boxes for the 18 organizations on a Likert scale (1–7). Some of the LO component percentages were strikingly low. The subsequent discussion addresses each component one-by-one by top box.

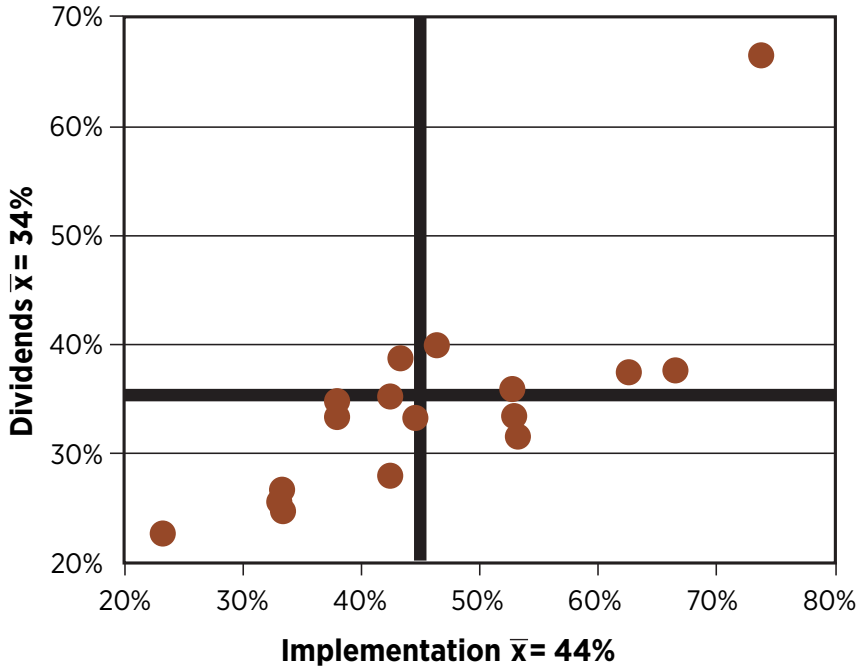
Learning Pathways (L_{Pi})

At any given time, the direction of workplace learning matters (Marquardt & Reynolds, 1994, p. 21). To give a clear site picture of an organization's learning heading, LOs underscore the significance of Strategic Planning, Organizational Learning, Leadership Guidance, and Learning Climate (Figures 3–6).

Strategic Planning (L_{P1}). *Organizations averaged 44 percent for their top box on organizational implementation while only 34 percent in learning dividends.* This first learning pathway component emphasizes the connection to an organization's mission and goals. Since workplace learning has been found to be "the most effective when it's aligned to corporate objectives and strategies" (The Conference Board of Canada, 2009), the impacts of learning outcomes become more visible when they are woven into an organization's strategic plan. In this study, many leaders conducted strategic planning initiatives. In their current state, the data indicated conspicuously reduced learning returns for the respondents. To increase learning dividends, one organization made its strategic plan a "trusted system" by instituting a corporate management board that met monthly to verify worker contributions. The organization inculcated the strategic plan into its learning culture by tightening the connection between individual performance and mission accomplishment. In most organizations, however, strategic plans seemed to satisfy more of a literary requirement than a means to a learning end. Several leaders considered them to be overly burdensome and costly. They decided against a formally written strategic plan and substituted it with "all calls" or monthly/quarterly meetings where they discussed progress against their overall goals. Another organization equated its Integrated Management Plan to a strategic plan since it anticipated little return by investing in another plan. Over 30 years ago, Shell Oil learned the strong relationship among strategic planning, learning, organizations, and corporate success (Marquardt, 2011). DoD acquisition organizations have not appeared to find the same linkage, or at least exercised it enough to show any tangible value to sustain it as a universal practice. The workforce was more confounded by strategic plans. The respondents who

rated this component as operating below average responded that their plans were confusing, poorly communicated, disconnected, not tracked, and/or had little to no impact on learning.

FIGURE 3. STRATEGIC PLANNING (L_{P1})

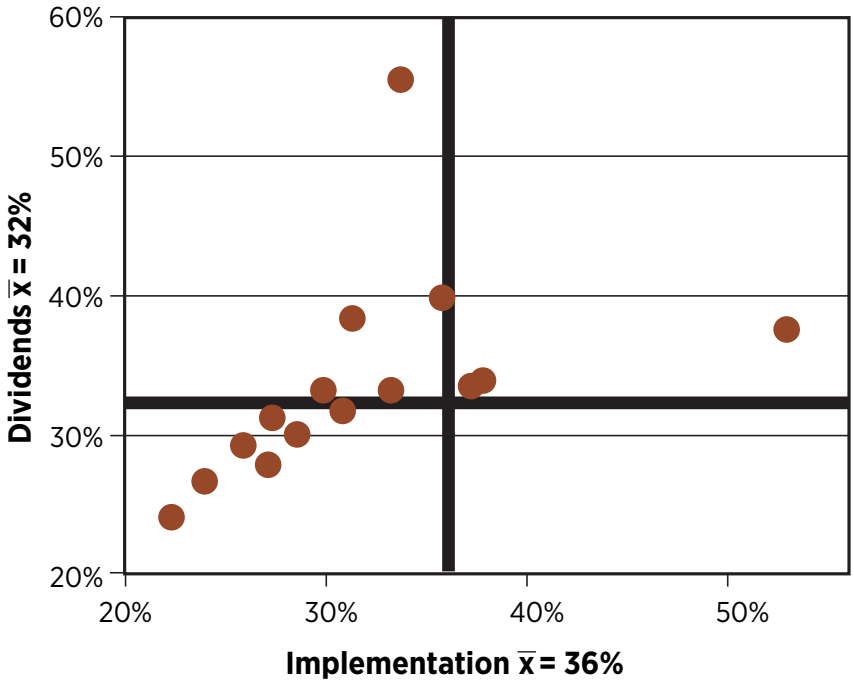


Note. Each dot represents aggregate top box responses from the 18 program offices.

Organizational Learning (L_{P2}). *Organizations averaged 36 percent for their top box on organizational implementation and 32 percent in learning dividends.* Organizational learning forms the centerpiece for LOs and incorporates the concept of adaptive learning, where workers respond to changes in the environment by detecting errors and correcting the errors through modifying strategies, assumptions, or norms (Choo, 2006). To strengthen their learning bridges, many leaders instituted rotational assignments, OJT checklists, and hosted recurring "brown bag" discussions. Others established microuniversities inside their workplaces that teach unique processes and product line technologies. To be effective though, this second pathway component requires the presence of three critical factors: meaning, management, and measurement (Garvin, 1993).

The respondents who rated this component as operating below average reported that they found noticeable deficits in all three. Their organizational learning goals had little connection to their work, were overcome by program pace, or lacked meaningful metrics.

FIGURE 4. ORGANIZATION LEARNING (L_{P2})

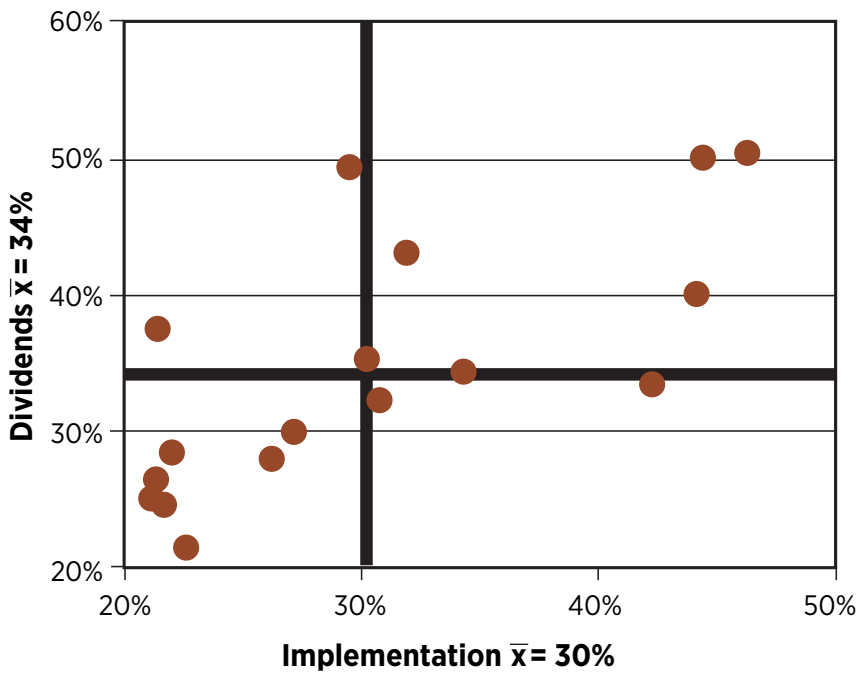


Note. Each dot represents aggregate top box responses from the 18 program offices.

Leadership Guidance (L_{P3}). *Organizations averaged 30 percent for their top box on organizational implementation and 34 percent in learning dividends.* Aside from serving as a compass, leaders are expected to remove learning obstacles so their organizations can make more learning inroads. They also have an incumbent responsibility to introduce workplace "learning initiatives…legitimize managers…and be deeply involved in the learning process" (Miller, 2003). This third learning pathway component also requires leaders to serve as the model for continuous learning while encouraging their employees to do the same. Often, the opposite is true (Marquardt & Reynolds, 1994). Actions speak

louder than words. One leader who reported higher gains encouraged his workforce to seize learning as their number one priority and held supervisors accountable for making sure their subordinates gave it sufficient attention. Several leaders reported that their workforce did not challenge the status quo nearly enough. Others expressed the view that their daily demands were compounded by excessive administrative burden, leaving them with less time to address all their learning curves. The respondents who rated this component as operating below average said they needed much more definitive direction or more frequent communication regarding learning expectations.

FIGURE 5. LEADERSHIP GUIDANCE (L_{P3})

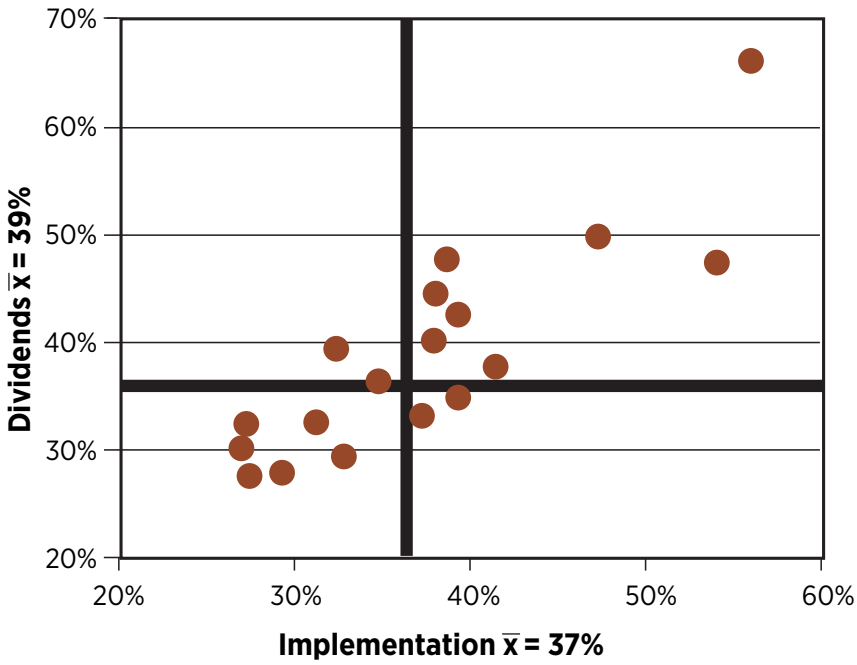


Note. Each dot represents aggregate top box responses from the 18 program offices.

Learning Climate (L_{P4}). *Organizations averaged 37 percent for their top box on organizational implementation and 39 percent in learning dividends.* This last pathway component speaks to the workplace safeguards in place to mitigate the learning turbulence that can emanate

from leadership expectations, workplace processes, or workplace cultures. Effective LOs ground these key elements by instituting resilient and sustainable learning practices that encourage and condition their employees to value the need to continually learn new skills and "avoid the erosion of their knowledge stocks" (Cooke & Meyer, 2007). One leader offered that he actively pushes his workforce to think critically and challenge the status quo. He further reported that his organization could never meet its technical challenges without it. Another leader reminded his workforce to actively think differently. Respondents who worked in organizations where this component rated below average reported their learning climates were too weak to face the pressures of risk. People took shelter to avoid it since their leadership did not endorse it.

FIGURE 6. LEARNING CLIMATE (L_{P4})



Note. Each dot represents aggregate top box responses from the 18 program offices.

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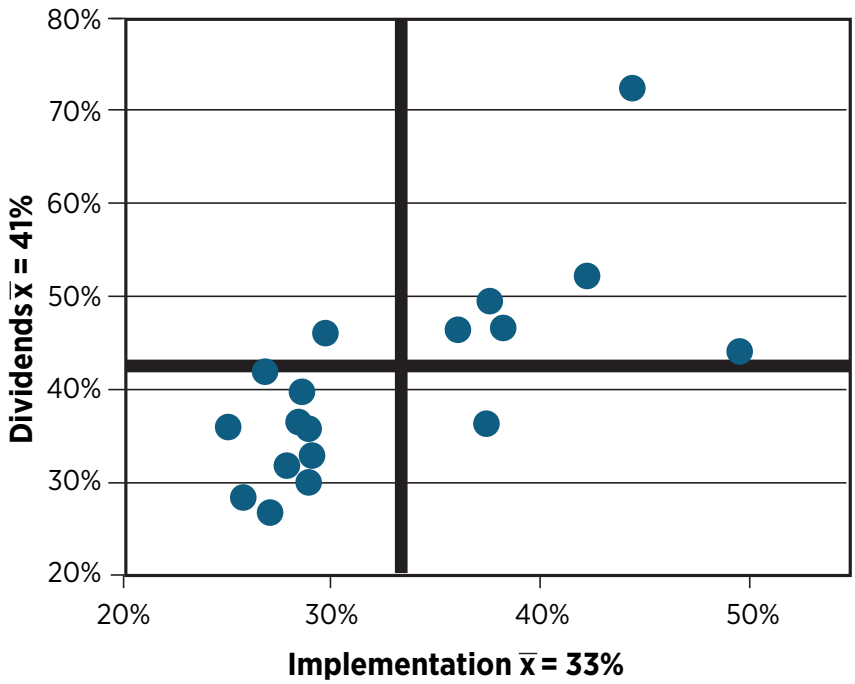
Learning Engine (L_{Ei})

Learning engines are the source of an organization's learning muscle. They depend heavily on individual learning, increased responsibility, professional development, and individual advancement (Figures 7–10). Properly sized learning engines give organizations the ability to tackle uncertain and variable learning terrain with lesser strain. Learning engines also have to operate at peak levels to achieve enough momentum to safely negotiate steep learning grades.

Individual Learning (L_{E1}). *Organizations averaged 33 percent for their top box on organizational implementation and 41 percent in learning dividends.* A vehicle's towing capacity depends on the horsepower and torque its engine produces. In a similar way, individual learning represents the source of an organization's intellectual muscle. Like any muscle, it needs to be exercised. Individuals must value and keep their new learning skills fit enough to promote "psychological states of competence" (Cooke & Meyer, 2007). This first learning engine component is closely linked with L_{P2} in an explicit and structured way (Marquardt & Reynolds, 1994). Individual learning gives organizations immediate traction by serving as a "core resource and mechanism" that moves organizations toward their goals (Srihawong, Srisa-Ard, & Chiwpimai, 2012). It also helps organizations respond to strong learning counterforces like competition from other workplace demands and daily programmatic risks that subject individuals to continuous learning pressure. To help strengthen individual learning development, one leader had his junior personnel teach others what they had learned. He ensured they had learning in the correct gear so they could effectively react to workplace eventualities while operating at peak proficiency levels. The respondents who reported below average dividends questioned the amount of time set aside for individual learning, or the link between learning and performance improvements was missing.

FIGURE 7. INDIVIDUAL LEARNING (L_{E1})

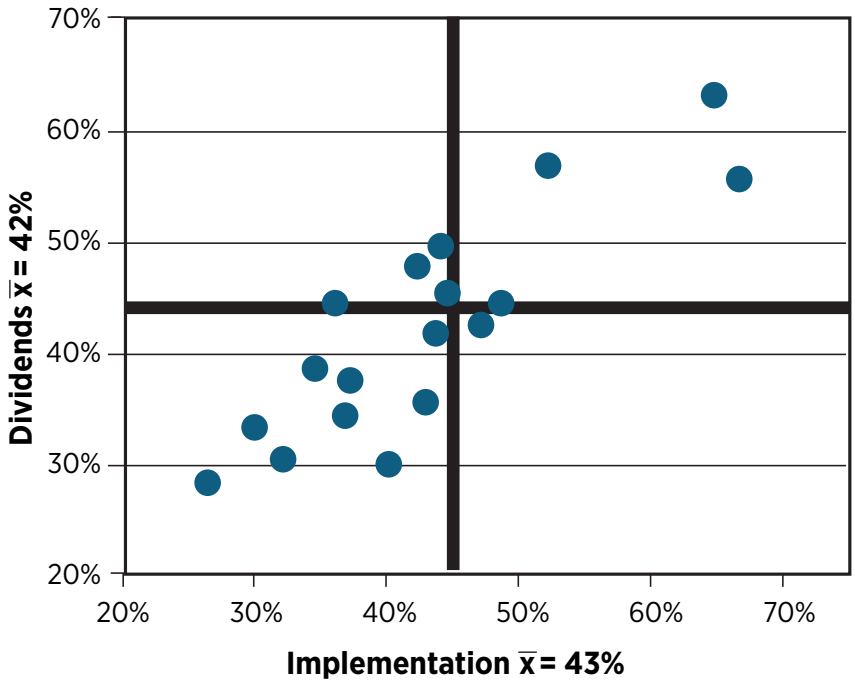


Note. Each dot represents aggregate top box responses from the 18 program offices.

Increased Responsibility (L_{E2}). *Organizations averaged 43 percent for their top box on organizational implementation and 42 percent in learning dividends.* LOs are known to evenly distribute responsibility across their enterprises in the same fashion that air shocks and assisted breaking systems safely handle heavier loads "on demand." Although occasionally tenuous, this second learning engine component also keeps employees intellectually challenged enough so they do not seek employment elsewhere (Emery, 2010). One leader reminded his workforce that "Innovation doesn't live in the routine, and takes persistence and the responsibility to challenge themselves instead." The opposing forces (e.g., lack of motivation and shortage of available time) can inhibit the pursuit for some workers to seek or accept increasingly more responsibility. However, the distribution of responsibility deserves frequent inspection since it behaves as a catalyst for forces leading to change management inside LOs (Beaver & Hutchings,

2004). The respondents who reported lower than average results cited the preponderance of responsibility placed on select positions as not always evenly distributed, minimized, or even overlooked.

FIGURE 8. INCREASED RESPONSIBILITY (L_{E2})

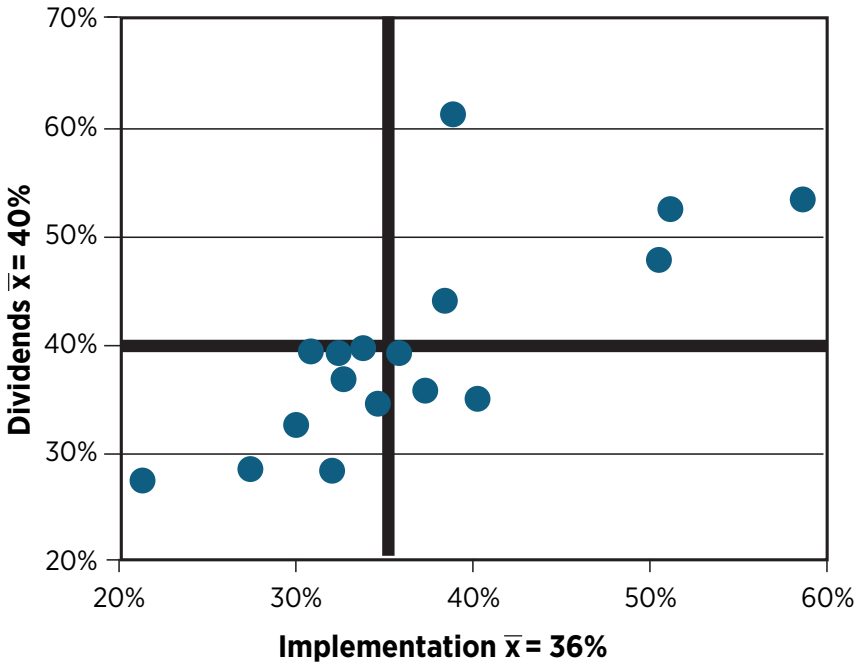


Note. Each dot represents aggregate top box responses from the 18 program offices.

Professional Development (L_{E3}). *Organizations averaged 36 percent for their top box on organizational implementation and 40 percent in learning dividends.* Professional development helps learning engines burn leaner by improving learners' "time to competence" (Senge, 1990). Additional knowledge found in collaborative opportunities like professional conferences, communities of practice, or cooperative deep intellectual dives on functionally specific topics favorably boost learning effects. Internal development programs make strong impacts since they are more workplace-specific. One leader crafted an internal Career Development Guide that created a comprehensive glide path for a wide range of experiential and collaborative learning opportunities inside his learning house. Another leader modified his organization's reporting structure to allow more junior personnel to assume roles that

increased their developmental momentum. The respondents who rated this third learning engine component as below average reported that professional development was either poorly promoted, unorganized, ad hoc, or inactive.

FIGURE 9. PROFESSIONAL DEVELOPMENT (L_{E3})

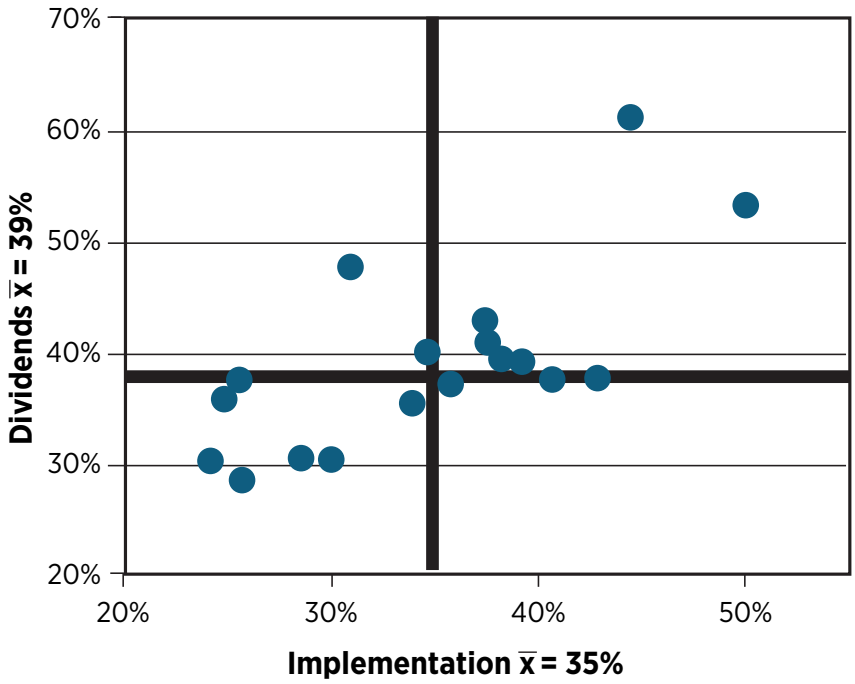


Note. Each dot represents aggregate top box responses from the 18 program offices.

Individual Advancement (L_{E4}). *Organizations averaged 35 percent for their top box on organizational implementation and 39 percent in learning dividends.* LOs help their workforce seek advancement by applying more force to their learning opportunity accelerator. One leader whose organization reported the highest workforce learning dividends in this last learning engine component instituted (a) functionally focused internal meetings to show what it takes for personnel to advance; (b) a program where competitive individuals could diversify into other functional areas; and (c) an accession model that illustrated the experience required for progression. Interestingly enough, advancement does not always imply more supervision, which could be holding back some from seeking it (Kosteas, 2011). Respondents who reported below average

advancement opportunities expressed the view that more promising prospects existed outside their own workplaces or lacked the time to pursue the required qualifications to compete for internal advancement.

FIGURE 10. INDIVIDUAL ADVANCEMENT (L_{E4})



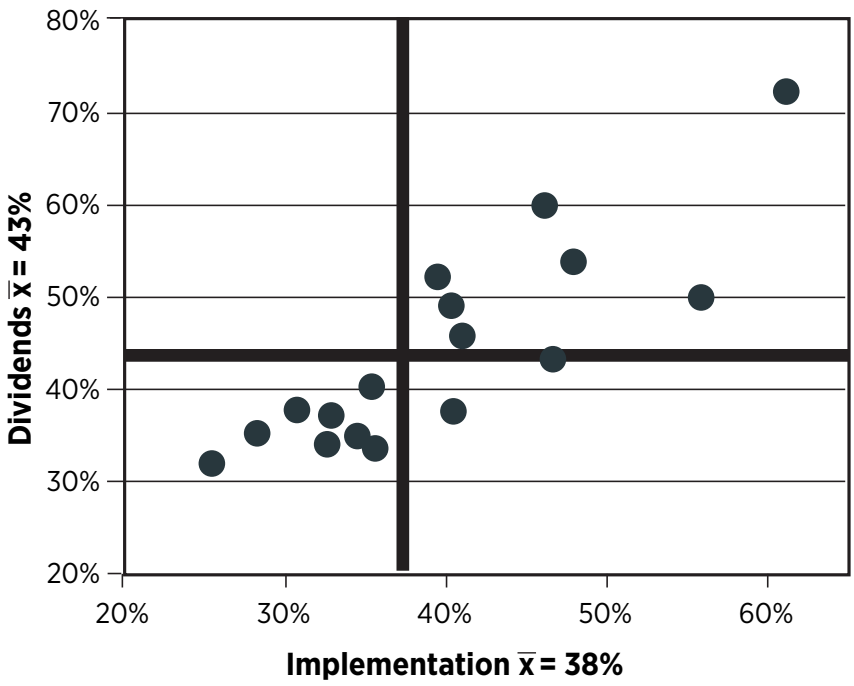
Note. Each dot represents aggregate top box responses from the 18 program offices.

Learning Lubricants (L_{Li})

Purposeful, timely, and active learning in the workplace is an important component for organizational success. But, under this third category, friction can easily interfere with expected gains if four components—empowerment, mentorship, individual feedback, and creative tension—are not at their ideal viscous states. The variable and unrelenting learning pace found inside acquisition organizations requires all four components to keep workplace learning moving freely (Figures 11–14).

Empowerment (L_{L1}). *Organizations averaged 38 percent for their top box on organizational implementation and 43 percent in learning dividends.* When it comes to learning, empowerment might be the most highly underestimated component of them all. In this study, it signaled the highest individual learning dividends paid. Companies like General Electric actively push empowerment by applying a risk quotient where they "measure employee performance based on their capacity to take risk in championing ideas, learn from the experience, and drive improvement" (Peters, 2012). Leaders who reported high learning dividends from empowerment widely delegated "the authority" across their organizations. Respondents in organizations that operated below average reported that empowerment was visibly absent, not fostered, or underwhelming at their workplaces.

FIGURE 11. EMPOWERMENT (L_{L1})



Note. Each dot represents aggregate top box responses from the 18 program offices.

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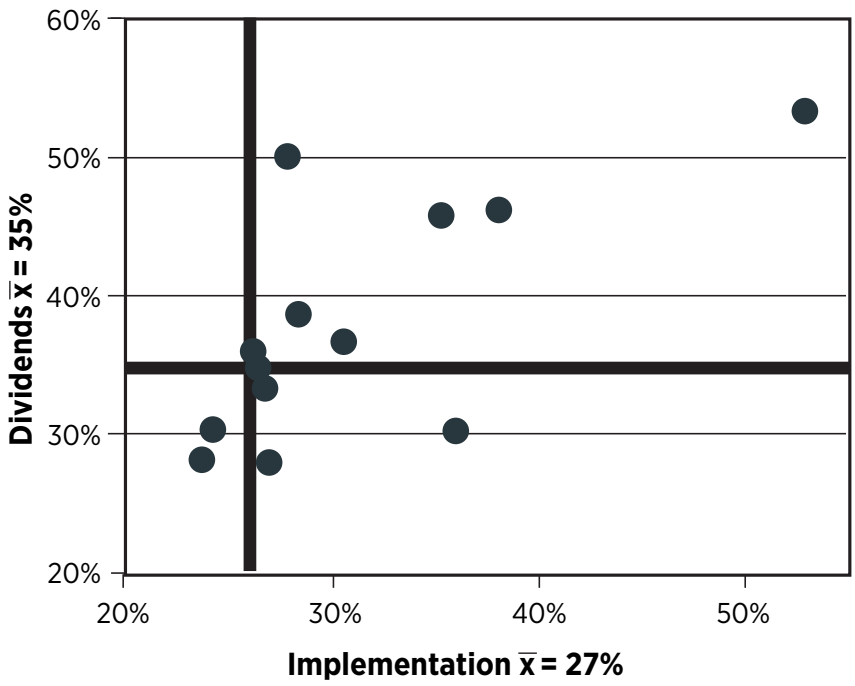
Mentorship (L_{L2}). *Organizations averaged 27 percent for their top box on organizational implementation and 35 percent in learning dividends.* LOs seize mentorship since it helps employees avoid costly mistakes. LOs also recognize that mentors must be willing to bear the responsibility for their employees' growth and development in their dual role as a "performance confronter" and "career counselor" (Gilley & Maycunich, 2000, p. 32). One leader noted that making mentorship too formal would lead to its death. He selected certain personnel to fill positions that demanded mentorship. The respondents who reported below average dividends for this second lubricant component saw little evidence of mentorship even though they felt it could pay huge returns if it found its way into their development.

FIGURE 12. MENTORSHIP (L_{L2})



Note. Each dot represents aggregate top box responses from the 18 program offices.

Individual Feedback (L_{L3}). *Organizations averaged 26 percent for their top box on organizational implementation and 35 percent in learning dividends.* LOs recognize the importance of feedback—the only facet of knowledge and skill development that is significantly associated with individual impact (Cooke & Meyer, 2007). In its raw form, this third learning lubricant operates like a learning performance regulator. Too little feedback can slow the learning flow. Too much feedback can lead to excessive focus where learners are always altering their performance, leading to inconsistent and variable performance-impaired learning (Lee & Carnahan, 1990). Premature feedback can have an adverse learning effect much like an engine backfires when an explosion occurs in the air intake or exhaust system rather than inside the combustion chamber. Negative feedback can be toxic and contaminate learning climates. In its ideal form, feedback needs to be timely, respectful, accurate, carefully communicated, and void of negative undertones. Leadership plays a significant role in feedback by ensuring it remains constructive and freely flows, but sticky enough to reduce workplace propaganda and eliminate counterproductive interference. Most leaders reported that feedback directly affects their ability to accomplish workplace challenges and made it a priority across their organizations. The respondents who experienced below average learning dividends noted either little or less constructive feedback, no connection to learning plans, or a failure to close the feedback loop.

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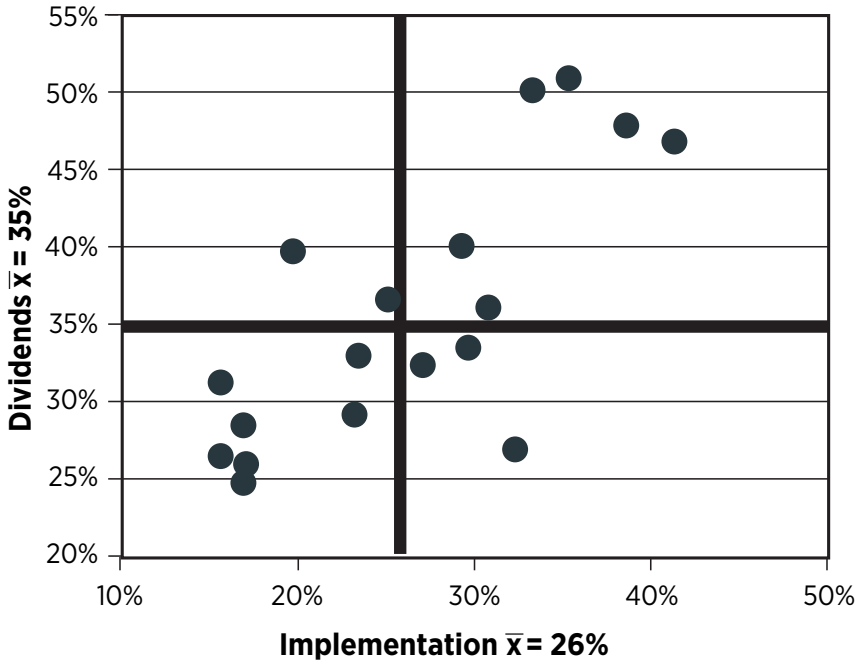
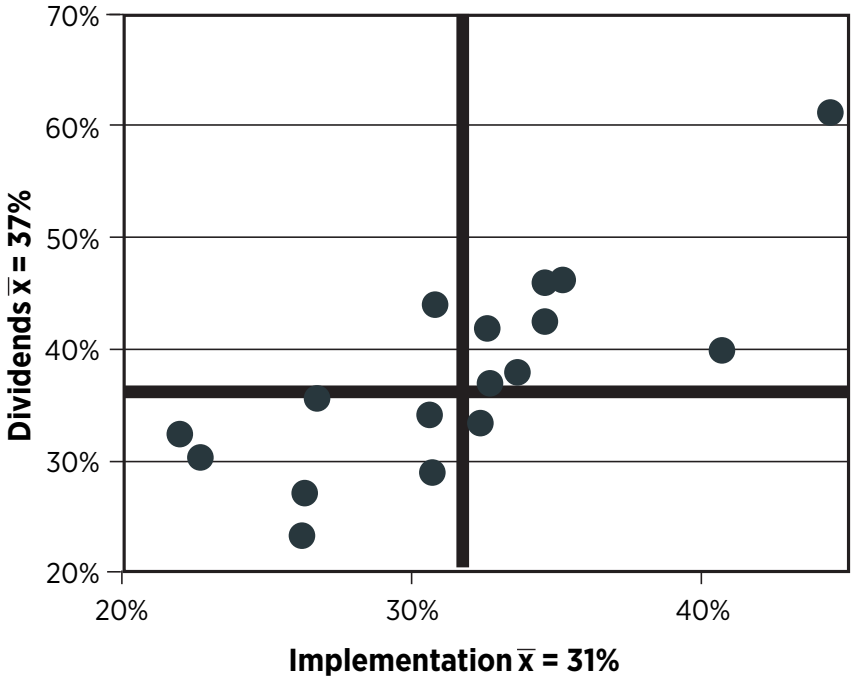
FIGURE 13. INDIVIDUAL FEEDBACK (L_{L3})



Note. Each dot represents aggregate top box responses from the 18 program offices.

Creative Tension (L_{L4}). *Organizations averaged 31 percent for their top box on organizational implementation and 37 percent in learning dividends.* LOs encourage their personnel to seek new learning methods and embrace creative tension as a positive attribute because it generates resolution (Senge, 1990). One leader stitched healthy tension into his own learning formula and encouraged his workforce to voice their disagreement at every meeting if they felt strongly about an issue. He could not think of a better way for them to shoulder more "ownership" at the workplace. Some respondents misunderstood the concept of this last learning lubricant, but the respondents who noted lower than average dividends reported little evidence of tension in their workplace, especially the creative type, and it resulted in missed learning opportunities.

FIGURE 14. CREATIVE TENSION (L_{L4})



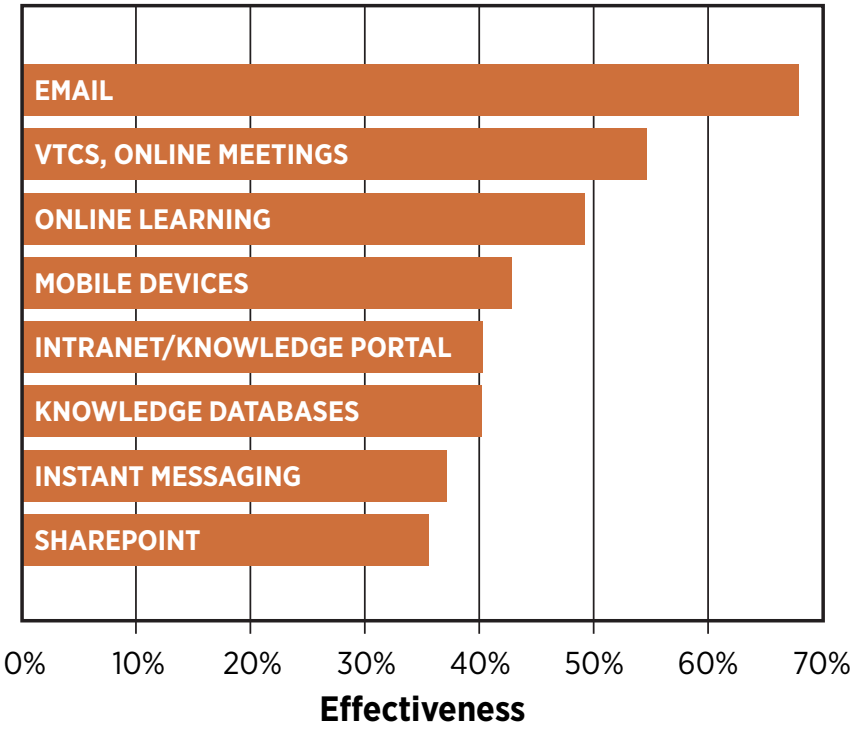
Note. Each dot represents aggregate top box responses from the 18 program offices.

Learning Additives (L_{Ai})

LOs recognize the need for certain learning additives under this last category such as new technologies, challenging work, time for learning, and generational learning solutions (Figures 15–18). They give workplace learning added momentum and can raise learning outcomes to even more favorable levels. This last category evaluated the effectiveness of each.

Learning Technology (L_{A1}). *Organizations averaged 46 percent for their top box that technology was effectively used.* Technologies are becoming more and more predominant in the workplace. They can help organizations save money, save time, increase productivity, manage knowledge, and improve learning. In the last several years, social media has skyrocketed. In an earlier survey that polled 125 learning and training leaders, 82 percent used social media to advance their own professional skills and resources while another 81 percent believed social media offers valuable learning opportunities (The CARA Group, 2010). In another study, Twitter® and YouTube® ranked number one and two, respectively, as tools for workplace learning among 545 learning professionals worldwide (Hart, 2011). In this LO study, e-mail was seen as the most effective learning technology, although it also created issues (Figure 6). Several program managers instituted more restrictive e-mail discipline to reduce the e-mail barrage by instituting no more "reply to all" and no more e-mails to their leadership team without "action recommendations." Another reminded his personnel to "send less so they would get less." One in particular issued an e-mail "stand-down" day and directed his personnel to either communicate by phone or talk face-to-face. Afterwards, he noticed a shift in cooperative learning. People started to talk again and shared knowledge more openly. The low rating of social media in acquisition organizations could most likely be attributed to limited access to certain sites. Generational preferences may also play a role since far fewer "millennials" are yet working in acquisition organizations. Nonetheless, learning technologies serve as a gateway to both information and knowledge sharing. However, some organizations in this study had limited means to leverage more effective solutions or the knowledge to understand this first additive's association to learning. Many key learning technology decisions were left to the information technology specialists.

FIGURE 15. LEARNING TECHNOLOGY (L_{A1})



Challenging Work (L_{A2}). *Organizations averaged 65 percent top box for presenting challenging work.* Adding challenging work into the learning mix helps individuals achieve greater self-efficiency (Huys, De Rick, & Vandenbrande, 2005). One leader said that until he got his people exposed to this second learning additive, he risked losing them. Another leader encouraged his personnel to read the book *StrengthsFinder 2.0* by Tom Rath, and then had them list five strengths to share with others. He reported that the organization as a whole could achieve more challenging work if it understood the sum of its parts.

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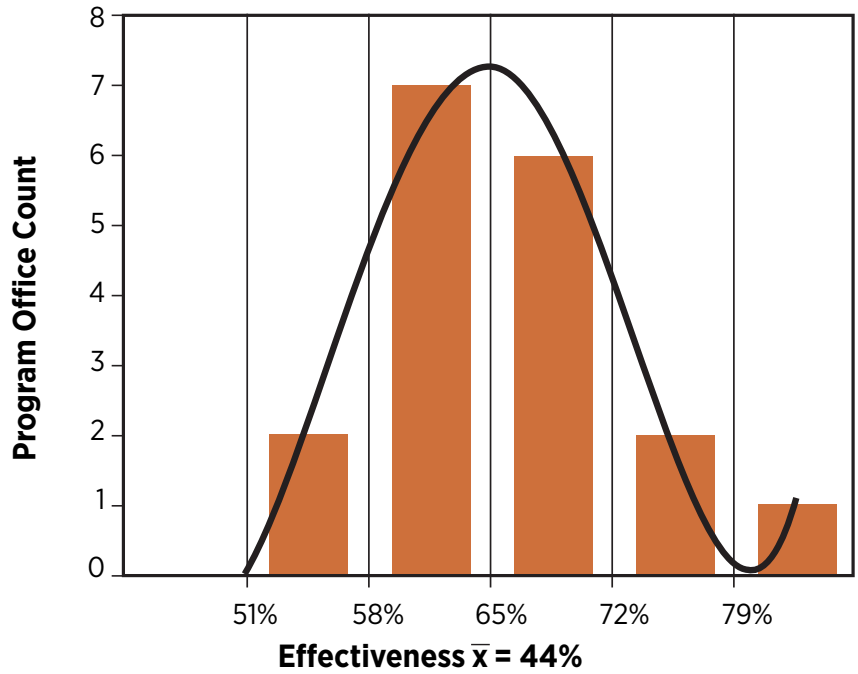
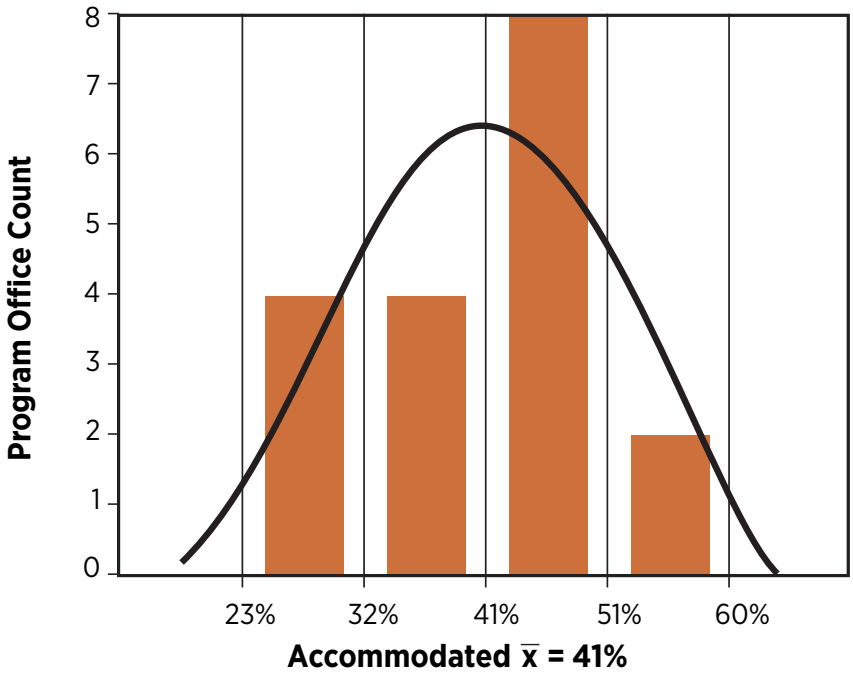
FIGURE 16. CHALLENGING WORK (L_{A2})



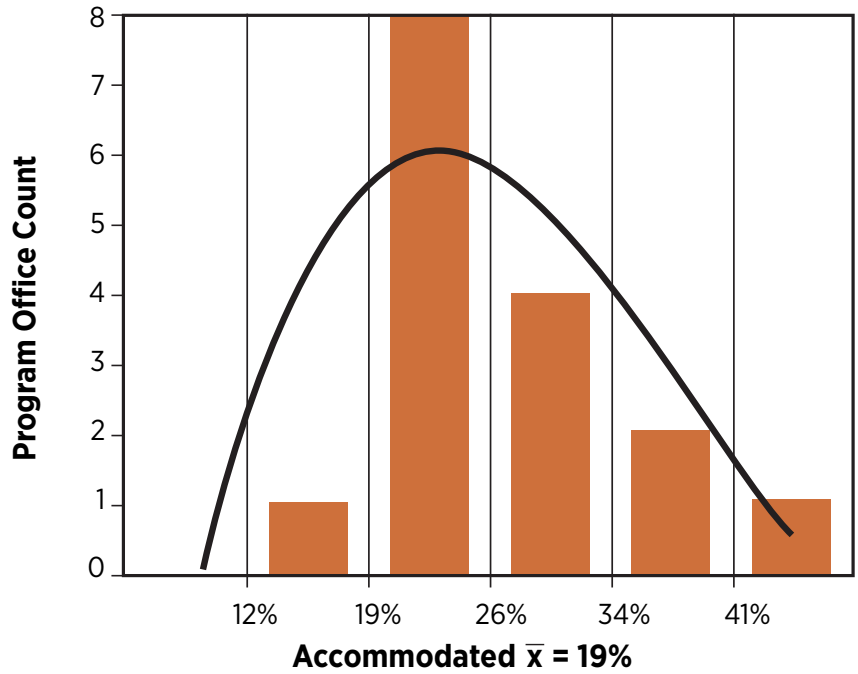
Time for Learning (L_{A3}). *Organizations averaged 41 percent top box for giving enough time to master skill.* For workplace learning to be meaningful, LOs allow adequate time for learning to "warm up" and give learners time to reflect, practice, network, and seek any necessary training (Vaughan, 2008). Many leaders blended "just-in-time" learning into their learning mixtures whenever new processes or initiatives surfaced. Others reinforced the importance of taking time to build expertise. One leader reminded his personnel not to leave the organization without becoming proficient in their fields. Another leader created time for thinking experiments inside his organization. One of his teams decided to run a product line contest out of graham crackers, peanut butter and marshmallows, and toothpicks. To them, the competition ended up reinforcing the importance of product resiliency and a resilient workforce.

FIGURE 17. TIME FOR LEARNING (L_{A3})



Generational Learning Accommodations (L_{A4}). *Organizations averaged 26 percent top box for accommodating differences in generational learning.* Looming changes in workforce demographics have placed even more pressure on an organization's learning ecosystem. However, while generations have their own learning preferences, how they actually learn is not significant enough to "warrant different instructional designs or learning technologies" (Reeves, 2006). None of the leaders instituted any generational-unique learning techniques although many leaders reported that they gave more attention to the development of their junior workforce. One leader ensured his junior personnel understood that performance would evolve them as "hot runners." Another leader specified that teaching the next generation at his workplace was the most important thing he could do.

FIGURE 18. GENERATIONAL LEARNING (L_{A4})



Recommendations

With a conspicuous mix of entry to senior-level personnel who run the experience scale, the acquisition workforce demonstrates a wide range of "know how" that constantly fluctuates. While they relish what they learn on the job, few fully appreciate the magnitude of all the learning elements that affect their learning development. Even though the DoD organizations surveyed in this study confirmed the presence of all the LO architectural components, no single acquisition organization has fully energized them all. Based on extrapolation, more active implementation could result in a stronger learning footing and create more positive learning dividends for every individual and organization. Consequently, the researchers recommend the following for those in a position to champion the learning charge:

Become your organization's Chief Learning Officer. Take the time to understand all the key learning practices that should be prevalent and highly active in your organization. Assess their contribution to mission outcomes. Involve yourself in your organization's total learning equation. If you haven't yet done so:

- *Energize your strategic plan.* Communicate it and measure progress against it. Whatever the manifestation, it needs to be grounded, connected to both individual and organizational outcomes, flexible, well-communicated, and understood.

- *Codify your organization's OJL program.* It is where most workplace learning occurs, and organizational competence depends on it (Olmstead, 2002). Decide what needs to be formal and what does not.

- *Recognize that learning and formal training are distinctively different.* Remind your workforce that learning is more formal and incidental. Learning is a contact sport. Make time to reflect.

- *Monitor your learning climates closely.* Inspire and condition your workforce to value the need to continually learn new skills to avoid the erosion of its knowledge stocks. Promulgate the virtues of innovative thinking.

- *Eliminate the seam between "time for doing" and "time for learning."* The difference is too close to call. "Doing" *is* experiential learning.

- *Distribute responsibility across your enterprise.* It increases learning health and reduces personnel turnover.

- *Create opportunities for professional development.* It produces greater depths of expertise and strengthens an organization's learning core.

- *Encourage advancement.* It makes workers think more about their own skillsets and how they can make even greater impacts.

- *Empower your people and give them a solid sense of responsibility.* It increases their learning capacity and reinforces their confidence. Give your personnel permission to switch gears. Encourage them to take risks.

- *Make mentorship a top priority and actively promote it.* Mentors help build more sustainable careers for junior workers who are running low on experience.

- *Provide more performance feedback.* There is no stronger learning barometer.

- *Embrace creative tension.* Ask your workforce where your organization needs to be (i.e., vision) versus the "as is." Explain that any gap between the two restricts the achievement of critical outcomes. Allow your workforce to challenge the status quo in a thoughtful and respectful way.

- *Maintain learning agility.* Whenever learning needs change, maintain agility (e.g., presence of interns, changes in mission, changes in personnel, etc.).

- *Strategically manage your technology needs.* Ground them to organizational goals. Don't let them short-circuit the ability to get work done (Allen, 2012).

Conclusions

People have always been an organization's secret weapon, and no cutting-edge system capability could have ever been built let alone conceived without it. After 22 years since their inception, LOs are still very relevant since learning is omnipresent in the workplace. It may be hard to visualize, but fully embodied LOs can help DoD acquisition practitioners think more deliberately about effective learning solutions. Indeed, LOs can provide just enough escape velocity to leave less productive learning practices behind, including the patterns that could be undermining learning itself, and ultimately—over the long haul—help raise learning to more efficient levels.

Authors' Note

A year ago, the authors began this research to better understand the acquisition learning dynamic. They would like to personally thank the program office interviewees for their time and the frank responses to their interview questions, as well as all the program office personnel who took the time to complete this LO survey. Without their participation, this research would be without the rich data so crucial to the findings and the researchers' ability to make any justifiable LO architectural recommendations.

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Keywords: *Acquisition, Competition, Contracting, Down-Select, Source Selection, Competitive Multisourcing with Distributed Awards*

Continuous Competition as an Approach to Maximize Performance

Ginny Wydler, Su Chang, and Erin M. Schultz

Research shows that continuing competitive pressure applied during development and production leads to better industry performance, often at reduced cost. However, the entrenched practice of one-time competition for an entire program life cycle often endows the winner with a very strong monopolistic power that lasts for decades. This article describes continuous competition as leverage to acquire more effective results. It offers an alternative method for continuous competition—Competitive Multisourcing with Distributed Awards—under an applicable set of conditions and an appropriate business case.

Image designed by Diane Fleischer »

Distributed Awards

2

Competition has always been a cornerstone of the Department of the Defense (DoD)'s acquisition system. Competitive contract awards have yielded notable benefits, including reduced weapon systems costs and improved contractor performance, efficiencies, and innovation. However, competition rarely continues after contract award. Instead, the winning contractor often establishes monopolistic advantages and gains "vendor lock." As a result, programs can experience cost growth, schedule delays, and average or even poor performance. By contrast, experience has shown that continuous competition can drive both incremental improvement and game-changing innovation in weapon systems acquisition.

This article proposes that the DoD adopt an innovative form of continuous competition: Competitive Multisourcing with Distributed Awards. Under this approach, DoD programs would select more than one contractor to develop, produce, and sustain a program throughout its life cycle: a primary source and one or more secondary sources that contribute a lower level of design development and work share.

As envisioned, this approach offers multiple benefits to the DoD.

- Having multiple contractors would provide programs with an "insurance policy" in the event that the primary contractor fails to perform adequately. Thus, it would reduce single points of failure—a critical advantage in today's increasingly complex and interdependent acquisition environment.

- The existence of one or more alternative providers can spur the prime contractor to maintain a high level of performance by maintaining the pressure of price competition throughout the system life cycle. It would also help prevent monopolistic behavior by the primary contractor.

- The risks inherent in contract transition would be minimized by the availability of a second source that is already knowledgeable about the day-to-day operations of the program. Should the prime contractor fail to meet DoD expectations, the second source could quickly ramp up to fill the primary contractor's obligations.

- The expanded opportunity to win a share of a large contract should stimulate additional companies to develop their capabilities and become credible competitors. This would address widespread concern about the shrinking defense industrial base, in which four companies have dominated the market since 1999.

Competitive Multisourcing with Distributed Awards would have particular benefits for certain types of programs, including those that have applied dual sourcing successfully in the past. It would also enable the DoD to take advantage of two product designs rather than choosing a single solution and foregoing the features of a promising alternative. Engaging a low-level second source early in the program could generate high pay-off in production. Finally, programs with high cost overruns could apply Competitive Multisourcing with Distributed Awards to engage a low-level second source in developing additional technology. This would encourage both contractors to refine and mature their technical designs, thus permitting better cost analysis and cost containment. This article describes the current defense contracting environment, and shows how the practice of awarding single contracts has led to unnecessarily high costs and poor performance. It then uses historical examples to illustrate the benefits of a dual-source approach, and presents examples of continuous competition. Finally, the article presents Competitive Multisourcing with Distributed Awards as a recommended form of continuing competition, and examines the advantages that such an approach would bring to the DoD.

Competition in Defense Contracting

Both government and industry have long recognized the benefits of competition in improving performance and reducing costs. The value of competition has been incorporated into every major piece of legislation on acquisition reform and is continually touted in political speeches and public engagements. However, the vast majority of DoD programs continue to rely on a single-provider acquisition approach and spend most of their life cycles without real and enduring competition. As a result, too many DoD acquisition programs fail to achieve their cost, schedule, and performance objectives.

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The absence of a continuous competitive force, such as a credible industry competitor, may contribute to this situation. Once a contractor is chosen to develop a major new system, the DoD is locked into a relationship with that contractor that could last 20 years or more (Arena & Birkler, 2009, p. 5). As a result of this de facto monopoly, the DoD has little opportunity to obtain broad insight regarding engineering changes or technology upgrades, other than from the prime contractor, and that contractor may not be entirely objective.

Congress enacted the Competition in Contracting Act of 1984 and later reaffirmed its importance by passing the Weapon Systems Acquisition Reform Act (WSARA) of 2009. Under this new legislation, Congress mandated that the Secretary of Defense require that each major defense acquisition program (MDAP) include in its acquisition strategies measures to ensure competition, or the option of competition, throughout a program's life cycle (Weapon Systems, 2009, § 202, p. 18). Dr. Ashton Carter, then Under Secretary of Defense for Acquisition, Technology and Logistics, emphasized competitive contracting as one of the five "affordability tools" to be utilized within the DoD in his "Better Buying Power" memorandum of 2010 (Carter, 2010, p. 9). With recent declining budgets, the competitive environment is at risk because the DoD lacks the funds to invest in making companies capable of challenging the top defense contractors.

In spite of the attention focused on improving competition, major systems acquisition continues to experience problems in development and production. Fewer than half of the programs in DoD's 2010 MDAP portfolio meet the established performance metrics and cost-performance goals agreed to by the DoD, the Office of Management and Budget, and the Government Accountability Office (GAO) (GAO, 2011a, p. 6). According to a study by the Center for Strategic and International Studies (CSIS), 32 percent of the programs awarded competitively experienced cost overruns, amounting to $19 billion (Hofbauer, Sanders, Ellman, & Morrow, 2011, p. 11). A recent GAO study on "Trends in Nunn-McCurdy Cost Breaches for Major Defense Acquisition Programs" identified 74 breaches involving 47 major programs from 1997 to 2011 (GAO, 2011b, p. 5). Breaches occur when unit costs increase by at least 25 percent over the current baseline estimate or at least 50 percent over the original baseline estimate. GAO's analysis showed that nearly half of

Nunn-McCurdy breaches occurred after a production decision had been made—when a program has fewer options for restructuring. For example, the DDG-1000 Destroyer and F-35 Joint Strike Fighter (JSF) were required to recertify and restructure in 2010. The Air Force's Evolved Expendable Launch Vehicle (EELV) breached in May 2012, exceeding its original projected per-unit cost by 58 percent.

Recent DoD guidance and oversight suggest a need for more focused investment of funds to promote better design decisions and performance outcomes in acquisition. DoD Instruction 5000.02 (2008) now requires a materiel development decision before a program enters the acquisition process. As a result, programs must invest more funds in alternative design analysis before entering development or production. WSARA emphasizes investment in competitive prototyping and trade-off analysis before development starts. A 2012 GAO report (GAO, 2012a, p. 2) and the Better Buying Power memorandum emphasize investing in design, development, and production to mitigate performance failure. Maintaining competition throughout the system life cycle by investing in alternative products can help meet the government's cost, schedule, and performance goals, and at the same time expand the marketplace of qualified firms.

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The Shrinking Competitive Marketplace

Following the large increase in defense acquisition dollars during Operation Iraqi Freedom, the DoD now faces a period of declining budgets. This pattern was last seen at the Reagan-era defense buildup in the 1980s and the drawdown at the conclusion of the Cold War in the 1990s. Both patterns were marked by the significant consolidation of the defense industrial base, making acquisition through competition more difficult to realize.

Many capable firms competed for contracts in the 1980s, and dual sourcing was used as an acquisition strategy for several weapon systems. Today, dual sourcing is rare in weapon systems' procurements because the marketplace contains fewer suppliers and the DoD has less investment dollars to develop a second source. The top four contractors delivering defense products—Lockheed Martin, Boeing, General Dynamics, and Raytheon—have not changed from 1999 to 2010 (Ellman et al., 2011, p. 27).

In an interview with Reuters in 2011, Deputy Secretary of Defense Ashton Carter expressed concern about another round of mergers in the defense contractor base, emphasizing the need for a strong, technically vibrant defense industry (Carter, 2011). He suggested several strategies to nurture such an industry, such as increased attention to more dynamic lower tier companies and greater opportunity for entry of smaller firms and start-ups.

In Fiscal Year (FY) 2011, the DoD reported that it spent a total of $374 billion on contracts for products and services and research, and awarded 58 percent of its contracts competitively (GAO, 2012b, p. 8). However, products alone represented only 41 percent of competitive bidding, and major weapon systems accounted for a large part of this number. The DoD had 96 MDAPs in 2011, with an overall 2011 development and production cost of $170 billion.

The following review of several defense products illustrates how competitive practices have shifted since the 1980s.

Contracts for aircraft are competitively awarded to a single bidder, with little evidence of continued competition during the program life cycle. This approach has persisted since the 1980s, largely because of

proprietary data, high barriers to entry, and an unwillingness to change contractors once a design decision has been made. The number of competitors has decreased drastically since the sharp reduction in defense spending during the mid-1990s. Today, only a few companies can vie for aircraft contracts, and the competitions most often result in a single award. For example, the Air Force recently made a hotly contested (and controversial) single award for replacement of the KC-135 tanker, covering production of 179 aircraft at a cost of $35 billion; and the Navy P-8 Poseidon is being developed and produced under a single award for 117 aircraft. Even though GAO found that more than half of aircraft programs are known to experience design problems and cost growth (GAO, 2011b, p. 11), neither program involves competition from an alternate source or lower tier company.

Similarly, contracts to build ships are competitively awarded to a single contractor because of the high investment in infrastructure and low production volume. In the 1980s, ship production was high and six commercial shipbuilders accommodated the world reach of a planned 600-ship Navy. Today, the fleet is smaller (fewer than 300 ships), and only two major commercial shipyards (General Dynamics and Huntington-Ingalls) survive within the defense industrial base. Shipbuilding has suffered extensive program stretch-out due to reduced budgets and cost overruns. Aircraft carriers take 4 years to complete; each one (e.g., the new Gerald Ford Class) costs $12 billion to develop and $14 billion to build. Given that level of investment in time and money, it would be difficult to engage a second shipyard to provide continuous competition.

Historically, engine development and production have been highly competitive, due to the high volume and advancing propulsion technology in both the commercial and military market. During the 1980s, dual sourcing was used very successfully in this market. The "engine wars" for multiple military aircraft drove prices down and introduced much-needed improvements in power and fuel efficiency. For example, in the 1980s the Air Force added General Electric as a second source with Pratt & Whitney for the F-15 and F-16 fighter engines, saving $2–3 billion over the 20-year life cycle and doubling the reliability-per-1000-engine-flight-hours (Gansler, Lucyshyn, & Arendt, 2009, p. 27). Each year, the award for the production quantity was split between the two sources. The additional benefit during the 1980s was that GE invested its own money to develop and deliver its engines. In the 21st century, contracts

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for engines have moved away from this dual-source environment. The DoD decided to cancel the second source for the F-35 JSF because the development costs were too high ($2.9 billion).

According to various studies, dual-sourcing for 14 tactical missile programs between 1975 and 1995 saved 20 percent over the life cycle. The Navy Tomahawk missile made annual split awards, saving over $270 million and improving performance reliability from 80 percent to 97 percent. The DoD made only a minor investment to develop the second source (2 percent of production costs) (Gansler et al., 2009, p. 30). Today, missile programs have returned to single awards, and many experience design issues and cost overruns. The cost of the Army Patriot PAC-3 increased by 77 percent, from about $3.9 billion in 1994 to about $6.9 billion in March 2000, due to design issues and program stretch-out (GAO, 2011b, p. 14). The Pentagon's Missile Defense Agency (MDA) has spent nearly $56 billion researching and deploying various systems since 2002; GAO estimates that MDA contractors overran budgeted costs by $152.4 million in FY08.

Subsystems and components have also had success with continuous competition. The Joint Direct Attack Munition (JDAM) program conducted dual-sourcing competitions in the late 1990s and 2000s to effectively control unit costs (Meyers, 2002). The Navy has used multiple sources for its sonobouys since the 1980s, but now awards are made to single entities. Recently, the Navy awarded a major contract for over 50,000 passive sonobuoys to ERAPSCO, a joint venture of Sparton Corporation and Ultra Electronics (USSI) (Sparton Corporation, 2013). In December 2011, the Navy had awarded a $25 million contract to Signal Systems Corporation under the Small Business Innovation Research (SBIR) program to explore new underwater measurements, which could provide an alternative to the sonobuoys. During 2004 to 2006, the U.S. Army Forward Looking Infrared Program Office considered bringing in additional sources to motivate the primary manufacturer to build a limited number of prototypes. Although the prototypes never went into production, the effort did provide leverage to control the technology and price in subsequent design and production units.

Competitive Acquisition Approaches

The Federal Acquisition Regulation (FAR) and the Defense Federal Acquisition Regulation Supplement (DFARS) contain regulatory and policy guidance for implementing competitive acquisitions. With limited exceptions, contracting officers are required to promote "full and open competition"; that is, ensure that all responsible sources may compete.

Procurement Methods That Support Competition

The FAR recognizes several competitive acquisition methods. Awards are made to a single winner or multiple sources, thereby influencing the presence of competition for the remainder of the life cycle. Dual sourcing and leader-follower are two established acquisition methods used to implement continuous competition throughout the life cycle. DFARS (subpart 207.1) recognizes dual sourcing as a viable approach to acquisition. This method creates competitive pressure through having two or more sources deliver systems that meet requirements. Dual sourcing has been used primarily by programs with reasonable start-up costs that produce large quantities of an item at the least total cost. Under leader-follower sourcing, described in FAR (subpart 17.4), an otherwise sole-source "leader" contractor provides "assistance and know-how" to a "follower" contractor to achieve the benefits of multisourcing.

DoD agencies use several other techniques to bring alternative prices to the development or production phase of a life cycle. Military depots use both organic and contracted industry services for maintenance and repair to provide a dual source and alternative pricing. Government laboratories offer competitive cost comparisons by evaluating technology against industry designs and validating costs for Engineering Change Proposals (ECPs). DoD uses independent verification and validation contracts to conduct independent reviews of aspects of a program and give the acquiring organization leverage in negotiating with potential contractors. The SBIR program can add value by exploring new technology and costs. The DoD Broad Agency Announcements call for alternative source data for better engineering design decisions and cost estimating.

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Commercial competitive development model. This open-market strategy encourages all contractors to develop products at their own cost. The government has the option to buy these products at a per-unit cost once the items are fully developed and ready for production. Firms are willing to fund the development if they believe the government will choose to buy their products at a price and quantity that enables them to recoup costs and earn a reasonable profit in the production phase. This approach is best suited to information technology systems that allow contractors to develop applications on an existing infrastructure. However, it can also be used in developing components on top of open hardware platforms. For instance, airframes, ships, and vehicle classes present a standard platform, but competition could occur for the various subsystems (e.g., avionics, navigation, and fire control systems).

Competitive orders (indefinite delivery/indefinite quantity). The government awards contracts to multiple, qualified contractors to meet a broad set of requirements. The government negotiates pricing, terms, and conditions with each vendor. The multiple awardees vie for task/delivery orders in a post-award competitive environment, keeping competitive pressures in play throughout the life of a contract. This strategy works best when requirements can be broken into several manageable tasks that different contractors can perform independently over a period of time.

Competitive dual sources. The government fully funds two contractors to execute their designs or solutions to meet a need. The contractors fully develop and produce their designs, thus providing the government with two viable solutions. The two sources continuously drive down prices while also improving the performance and reliability of their products over time. Of the continuous competition strategies, this approach requires the greatest up-front investment by the government, but it also creates the most competition and the highest probability of meeting program mission needs on schedule.

Competitive multisourcing with distributed awards. Under this new approach, the government awards contracts to two (or more) sources, with a primary contractor receiving the majority of funding. A second contractor is selected to create a continuous competitive environment and to provide a viable backup should the primary contractor fail to meet program objectives. The next section of this article explores this approach in greater detail.

Competitive Multisourcing with Distributed Awards

Competitive Multisourcing with Distributed Awards offers an alternative to full dual sourcing, enabling the government to maintain multiple viable sources without having to "fully" fund or "share" work among competitors. Under this approach, the second contractor does not deliver an equal share, but receives sufficient funds to mature an alternative design and bring competitive pressure into the environment. This can provide the government with a viable alternative contractor if the prime underperforms.

Definitions

Under this model, the government awards the majority of funding to a prime contractor, and at the same time provides a smaller amount of funding to a secondary source. Keeping a second source under contract at even a low level (e.g., 5–10 percent of prime contract costs) maintains significant competitive pressure on the prime contractor by greatly reducing the barriers of entry into the program (i.e., it lowers the costs of switching if the prime does not perform satisfactorily). It also allows the second source to refine and mature its technical approach and gain familiarity with the program's operations. The cost of implementing this competitive multisourcing approach can be relatively small compared to the benefits of competition that it provides.

The DoD can apply this approach in several ways to maintain continuous competition in all stages of the acquisition life cycle.

Percentage-based distributions. Under this strategy, a set percentage of funding is allocated to each source. For example, Vendor A submits the best offer and receives the majority of funding (e.g., 90 percent) as the primary source. Vendor B submits the second-best offer and receives a smaller percentage of funding (e.g., 10 percent) to partially develop its design or to work on a particular subset of the contract requirements. This strategy keeps a second viable source in play during the prototyping, development, production, and sustainment phases, which will provide competitive pressure to motivate the primary contractor.

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Full development with scaled production. Under this strategy, two or more contractors are fully funded to develop prototype products. After the two prototypes have been delivered, the government selects one contractor for full-scale production and awards a contract for limited production to the second source. This strategy can work best for products to minimize risk during the design phase of the program.

Next increment prototype model. Under this strategy, the DoD uses a primary source to maintain engineering capability for the current production unit. A lesser amount of funding is provided to a secondary source to build a prototype for the next program increment. In addition to getting a head start on the next spiral of development, this mechanism allows the DoD to introduce a second capable source and position it to compete with the prime for the next program increment.

Partial contractor-funded development model. Under this strategy, the DoD caps the amount of development funding to a second contractor (e.g., 30 percent of proposed costs). The contractor has the option to fully fund the development of the proposed design. This gives the contractor the potential to recapture these development costs during the production phase if the government selects the second contractor's design for production.

Conditions for Use of Competitive Multisourcing with Distributed Awards

Certain conditions favor the successful application of Competitive Multisourcing with Distributed Awards during development of contracting strategies for acquisition programs. These conditions are derived from the historical perspective and lessons learned addressed earlier in this article.

High quantities with economic production rates. This condition can apply in both development and production phases of the acquisition. Competition can be maintained in the production phase in situations where investment costs are low, production accounts for the majority of the costs, and contractors go head-to-head for high-volume returns. Maintaining a second source in the development phase will work best when the government declares the intent to maintain dual sources in production.

Credible competition. The second source must represent effective leverage and alternatives to the single-source environment. This situation can occur in an environment where industry competes on a regular basis, and the prime contractor recognizes the second source as a peer competitor. The contracting arrangement must also facilitate alternating from one source to the other.

Sufficient technical knowledge in industry. Both the prime and secondary source must already have enough knowledge and intellectual property to offer credible competitive products. At the very least, the secondary source must have adequate technical and manufacturing readiness to be viewed as legitimate competition. The contract and program reporting mechanism must track the costs of both competitors in order to close the design maturity gap and improve the Technology Readiness Level (TRL).

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Effective cost-benefit analysis. While it may cost 5–10 percent of the program budget in the short term, in depth cost-benefit analysis has the potential to save far more over the long term. The analysis can consider items such as reduced barriers to program entry, lower costs for switching between contractors, and the benefits of technology development and design maturity. The business case must also include budget and schedule considerations. Executing an acquisition strategy and keeping a second source in the competition increase the likelihood that the prime contractor will perform closer to budget and schedule.

Challenges

The WSARA, "Better Buying Power" tenets, and GAO reports recommend prototyping and maturing designs in a price-competitive environment. An acquisition strategy of this kind does bring several challenges. First, the DoD has declining discretionary funding. However, investing in alternative sources will allow better design and technical decisions during the program life cycle. Second, writing an additional contract for the second source creates an administrative burden for the contracting staff. Still, the ability to control engineering design changes can mitigate the risk of Nunn-McCurdy program breaches, which can impose inordinate administrative costs on a program office. Third, most program offices prefer to stay with the same contractor rather than incur the time and expense of new competitions. A second source could be a controlling factor for cost growth and schedule creep. The largest hurdle to overcome is creating an industrial environment that encourages competitive forces to invest in this acquisition approach. The DoD can meet this challenge by providing the potential for increased business in previously closed markets.

However, the challenges do not involve only cost, budget, and resource constraints. The government must take various actions to minimize the risks of adopting this new and innovative method of continuous competition.

Ensure the Second Source Poses an Actual Threat to the Prime Source

With the shrinking industrial base, only a handful of companies now compete for major weapon systems. The second source must be credible and known in the market. The government can identify a viable second source in various ways, such as by evaluating commercial products or considering a company's level of independent research and development to complement government investments.

Coordinate the Activities Between the Two Sources to Ensure Delivery of Products and Solutions at Set Program Milestones

Both contractors must be effectively evaluated along the same path or according to the same milestones, taking their different solutions into account. The challenge is to coordinate activities for both contractors, such as testing, to ensure synchronization.

Close the Maturity Gap at the Same Rate and TRL

The second source should have a relatively mature product, or should invest in developing such technology on its own. Any newcomer to the industry or the market will experience technology lag and will therefore not pose any competitive threat to the prime contractor.

Recognize and Accept the Fact That Cost Savings Will Not Be Realized Until the Production Phase

A business case is critical to identify the long-term benefits of competition. It may be difficult to clearly articulate savings without empirical data, but benchmarking historical successes and establishing clear measures for technology maturity levels will help quantify the benefits.

Recognize Supply Chain Risks

Multiple prime sources can impact the number and type of suppliers. Ensuring that there is a sufficient and security-assured supply chain for the prime and the second source will be critical to uninterrupted delivery in a competitive environment.

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Benefits and Measures of Success

In this period of fiscal austerity, funding a second source may appear to be a luxury. To maximize the advantages of continuous life-cycle competition, the DoD needs to adopt a dual or multiprovider strategy from the outset of the program planning process. While continuous competition approaches may require greater up-front funding, they have the potential to save far more over the long term and to provide additional, nonmonetary program benefits.

Benefits

Dual sourcing has already proven effective in reducing costs, as evidenced by the engine wars, referenced earlier. According to a 2001 study by the RAND Corporation (Birkler et al., 2001, p. 16), the introduction of a second source during the production of the Tomahawk missile led to estimated savings of $630 million, while improving the missile's reliability from approximately 80 percent to 97 percent. The same study also revealed that the 10 DoD aircraft programs that involved no competition during the production phase experienced an average 46 percent increase in cost over the original budget.

Continuous competition places competitive pressure on the prime contractor through the presence of alternative sources. The most significant benefits include:

Allowing a second source to refine and mature its technical design. The WSARA, GAO, and DoD all recognize the need for better investments in engineering design and technology to improve decision making in choosing a contractor. Furthermore, problems with engineering design caused the majority of Nunn-McCurdy breaches. The additional design maturity would produce alternative cost estimates for ECPs to enable better cost analysis and cost containment (GAO, 2011b, p. 3).

Maintaining the pressure of price competition. The FAR addresses the critical nature of competitive environments and the importance of maintaining the spirit of competition throughout the life cycle. Distributed competition would create an environment of competition for the prime manufacturer, even though that competition would not be at the full, traditional, dual-source production level.

Having a viable second source available as insurance for transition in case of performance failure by the prime. A second contractor, if perceived as a viable alternative, can prevent monopolistic behavior by the primary contractor. The average time to compete a major program is 12 to 18 months, and, quite often, that does not include the critical transition time necessary for the new contractor to become fully functional.

Measures of Success

Recent program reviews by DoD and GAO highlighted three main areas of concern: cost growth, schedule slip, and performance failure. The government could determine the success of Competitive Multisourcing with Distributed Awards by measuring:

- The ability to contain costs, measured against statistical cost growth percentages over the life cycle of selected programs, and benchmarked with CSIS, GAO, and Nunn-McCurdy cost figures.

- The ability to reduce known causes for schedule slips in production, such as a lack of alternate sources of critical suppliers or unplanned engineering changes.

- The ability to improve performance by achieving or exceeding technical performance against key performance parameters that are a part of program requirements.

Implementation

The DoD can apply the following guidelines in adopting Competitive Multisourcing with Distributed Awards as an alternative to standard dual sourcing:

- Apply the method under a clear set of conditions and using a business case where the value of an additional source will improve performance and control costs.

- Evaluate the cost of the additional source as an investment to improve decision making and enhanced life-cycle cost estimating.

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- Develop risk/reward factors that clearly incentivize both the prime and the second source contractor.
- Include clauses in the contract specifically to accommodate technology sharing and ease of transition from one contractor to another.
- Engage industry through clear direction and defined outcomes.

The DoD should consider Competitive Multisourcing with Distributed Awards for the following products and programs:

Products with Known Dual Sourcing Success

In the past, dual sources have achieved success in developing and producing engines because of the large volume and economic production rates. High costs prevented the F-35 JSF program from pursuing a second-engine source. This program would be a good candidate for Competitive Multisourcing with Distributed Awards, allowing the Air Force to retain a second contractor at a lower level to mature the design and become a potential production source.

Products in Highly Competitive Environments That Resulted in A Single Award

The recent competition for the Air Force tanker resulted in a single award. The selected solution was rated at TRL 6, so further design and development will occur before full production. Keeping a second source in play would leverage technology brought to the table during the competition and could enable higher TRL levels at a faster pace.

Programs with High Cost Overruns

The EELV is under Nunn-McCurdy review because of skyrocketing costs. The Air Force plans to introduce competition, currently under a single-award joint venture contract, by 2018 (Butler, 2011, p. 4). Applying Competitive Multisourcing with Distributed Awards to this program with a low-level second source would allow development of additional technology and would contain costs.

Recommendations

In 1954, President Dwight D. Eisenhower's Secretary of Defense, Charles Erwin Wilson, notably used the phrase "bigger bang for the buck" to capture the concept of greater worth for the money spent. The phrase perfectly summarizes the benefits of continuous competition and Competitive Multisourcing with Distributed Awards. DoD should adopt Competitive Multisourcing with Distributed Awards as an alternative method for continuous competition and dual sourcing. The DoD should redefine competition so that it is no longer viewed merely as an up-front activity limited to the contracting process. Applying continuous competition to the right set of DoD acquisition programs could replicate proven successes at a far broader scale, yielding significant benefits to our nation's warfighters as well as to the program offices that deliver capabilities to them.

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Keywords: *Past Performance, Key Personnel, Behavioral Interviewing, Alpha Contracting*

Past Performance as an Indicator of Future Performance: *Selecting an Industry Partner to Maximize the Probability of Program Success*

James Bradshaw and Su Chang

The federal contracting process should enable a government organization to select a contractor that will become a true business partner. Today's source selection processes evaluate how well a contractor proposes a solution; however, the government's processes are ill suited to evaluate how well a contractor can deliver on its proposal. The Department of Defense (DoD) relies too heavily on the contractor's proposal versus evaluating past performance. The lack of past performance data and processes to evaluate companies' qualifications has contributed to program failures, cost overruns, and schedule delays. Without adequate data and processes, the DoD increases its risk of duplicating previous program failures and misses the opportunity to capture this information, thereby preventing repeated mistakes with the same contractor.

Image designed by Diane Fleischer »

Selecting the right contractor is perhaps the most critical factor in achieving future program success. This research identifies processes and proposes strategies that could strengthen how the government, specifically the DoD, selects an industry partner to maximize the probability of program success.

Ideally, the relationship between the government and a contractor should be a genuine business partnership. When awarding a contract for a major weapon system or program, especially one that requires significant development, the DoD must expect the relationship to be a long-term commitment. The contractor and government program management office (PMO) each play numerous critical roles throughout the program planning, executing, and reporting cycles. In a successful program, a contractor organization and the PMO work in harmony to strive toward program success. They understand and leverage each other's strengths; they communicate frequently; they collectively manage the vast web of program stakeholders; and they collectively establish the reputation and credibility of the program.

The government must therefore strive to enter into business relationships that provide high confidence of success. Selecting an experienced and qualified business partner is a critical step in achieving this objective. While evaluation of the contractor's proposal is important, this review can provide only a prediction of what *may* happen and a description of how the contractor *plans* to perform. By contrast, the contractor's experience and past performance offer an objective measure of what the firm has *actually* accomplished in the past.

The article identifies three key problem areas:

1. **The DoD evaluates the contractor's proposed solution rather than the contractor's record of actual performance.** During the source selection process, the DoD evaluates a contractor's proposal, which consists of cost, technical, and past performance volumes. In most cases, however, past performance has little or no impact on the final selection of a contractor. Instead, this aspect is often minimized as a superficial pass/fail test rather than being viewed as an effective tool to predict how well a contractor will perform in the future. Without objective information on past performance and processes to

evaluate contractor qualifications, DoD is reluctant to discriminate among proposals based on past performance, especially given the risk of protest.

2. **The DoD lacks consistent and thorough processes to evaluate key personnel.** The personnel on the contractor program team make vital contributions to program success, and as such, their qualifications should be an important evaluation factor. Contractors generally identify key personnel, and include their resumes as part of the proposal package. However, most source selections limit evaluation of these key personnel to a simple determination of whether the proposed team members meet the minimum experience criteria.

3. **The DoD lacks adequate tools to collect, analyze, and report past performance information consistently across contracts.** The ability to evaluate past performance effectively depends heavily on the availability of tools and the quality of data content. The government is currently improving and consolidating its repositories of past performance data; however, the DoD lacks capabilities for information collection and has not consistently enforced data entry requirements.

These problem areas represent three different deficiencies in the evaluation of a contractor's past performance. Evaluation is hampered by the lack of adequate tools to collect, analyze, and report relevant information. The lack of processes to assess the capabilities and experience of key personnel puts at risk the government's ability to predict future contract performance. In addition, the ability to collect, analyze, and report information on past performance is impaired by the lack of policies and processes to incentivize better reporting. Together, these shortcomings affect the overall contracting process, and contribute to a cycle of inadequacies that has resulted in the numerous contracting challenges we face today. The DoD needs to take a comprehensive, coherent approach to resolve these problems to achieve overall past performance improvements.

Background

With the passage of the Federal Acquisition Streamlining Act of 1994, Congress acknowledged that it is appropriate and relevant for the government to consider a contractor's past performance in evaluating whether that contractor should receive future work (DoD, 2008, p. 1). In response, federal departments initiated procedures and systems to record and use information on past contractor performance during source selection. Although the government recognizes that systematically documenting the contractor's performance becomes a powerful motivator for a contractor to sustain high-quality outcomes, consistent processes for recording performance have been difficult to instantiate and maintain (Office of Federal Procurement Policy [OFPP], 2000, p. 1).

In May 2010, the OFPP directed government agencies to integrate past performance data systems to provide consistency and ensure reliability of data across the federal government. The Acquisition Committee for eGovernment determined that the entire federal government will use the DoD Contractor Performance Assessment Reporting System (CPARS) as the single system for collecting and transmitting performance evaluations to the Past Performance Information Retrieval System (PPIRS, n.d., p. 1). The Navy created CPARS in 1998 to meet information requirements established by the Federal Acquisition Regulation (FAR). Due to inconsistent CPARS data collection and reporting, the DoD published a best practices guide titled *A Guide to Collection and Use of Past Performance Information* in May 2003. In June 2007, the DoD issued another *CPARS Policy Guide* that required all new contracts within a certain dollar threshold to register in CPARS within 30 days of contract award (DoD, 2008, p. 5).

On January 21, 2011, former OFPP Administrator Daniel Gordon sent a memorandum to Chief Acquisition Officers and Senior Procurement Executives on enhancing assessments of contractor past performance, which included steps and strategies for improving the collection of information. The memorandum emphasized that while compliance with reporting requirements is important, the quality of the reports submitted is far more crucial. It also acknowledged various challenges that contribute to the low number and quality of these assessments, which include staff shortages and the transition to the new federal-wide system that integrates the PPIRS, CPARS, and the Federal Awardee Performance and Integrity Information System (Gordon, 2011, p. 1).

Despite efforts by the DoD and other government organizations, the policies and mandates lack enforcement mechanisms to incentivize better behavior and improve past performance practices. This article recommends solutions that will strengthen the data, processes, and tools associated with evaluating past performance, and provide the government with a strategy to benefit from the implementation of these resources.

Problem

The DoD evaluates the contractor's proposed solution vs. evaluating the contractor's record of actual performance. FAR Pt. 15.3 covers the selection of a contractor in competitive negotiations. According to the FAR, the government is required to evaluate three areas for acquisitions: the quality of the proposed product or service, the price or cost to the government, and past performance (for acquisitions that exceed the simplified acquisition threshold). The government often requests the contractor to submit volumes covering technical, cost, and past performance as part of its proposal. The technical proposal conveys the contractor's proposed technical solution or response to a requirement; the cost proposal identifies the proposed costs of delivering the proposed technical solution; and the past performance volume shows how the contractor performed on previous similar or related efforts as an early indicator of potential future performance.

Unfortunately, the DoD currently lacks both adequate data on past performance and effective processes to evaluate a company's qualifications, including key personnel. Thus, evaluation of past performance is not used as effectively as it could be to predict future performance on a contract. These conclusions are borne out by a 2009 study by the U.S. Government Accountability Office (GAO, 2009). The study examined past performance practices by analyzing 62 procurements in five agencies that perform major acquisitions: the DoD, the Department of Energy, the U.S. General Services Administration (GSA), the Department of Homeland Security, and the National Aeronautics and Space Administration. The study found that 82 percent of the past performance evaluations did not contain narratives sufficiently detailed to establish that the resulting ratings were credible or justifiable (GAO, 2009, p. 8).

In many of these acquisitions, the government cited a company's technical approach as the most important noncost factor. More than 60 percent of the contracting officers stated that "past performance is rarely or never a deciding factor in selecting a contractor" (GAO, 2009,

p. 8). However, the acquisition requests for proposal (RFP) that placed emphasis on past performance noted that this encouraged companies to perform better (GAO, 2009, p. 2). The report succinctly concluded: "Regardless of the source used, contracting officials agreed that for past performance information to be meaningful in contract award decisions, it must be documented, relevant, and reliable" (GAO, 2009, p. 8).

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Without such information, the government evaluation must rely heavily on factors (primarily technical and cost) in the contractor's proposal that describe a hypothetical situation: how the contractor plans to perform on a contract. In essence, this means that evaluations are based on the quality of a document produced by a professional proposal writing team during the 45- to 90-day solicitation timeframe. These teams specialize in showcasing their company's capabilities; they are not necessarily experts in devising solutions within the company's technical capabilities, nor in describing within the RFP how the company can execute with acceptable risk. Proposals are often written with little or no input from the staff members who will execute the day-to-day contract requirements. As a result, proposals submitted for competitive source selections often present "optimistic" solutions that carry significant inherent risk. This risk often materializes during contract execution, which directly contributes to program failures, cost overruns, and schedule delays, which are endemic to the DoD acquisition process. The heavy scrutiny of technical and cost proposal evaluations can prove to be a wasted exercise when contractors continually overrun budgets or require major engineering change proposals throughout the life of the acquisition.

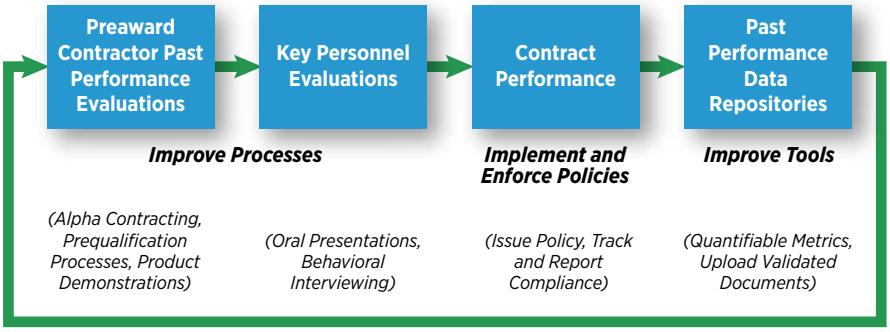
Given the shortcomings described previously, the evaluation of past performance often becomes a superficial pass/fail test. The majority of best value source selections require the government to evaluate past performance on the basis of a sliding scale that ranges from high-confidence to no-confidence. The DoD uses this scale to assess its level of confidence in a contractor's ability to perform based on previous related experience. Without adequate information about all offerors, the DoD is reluctant to place strong emphasis on past performance, especially due to the high risk of protest. As a result, the DoD usually assigns all offerors a similar confidence rating to level the playing field, and uses other evaluation

factors to discriminate among proposals. Therefore, and not surprisingly, the government often fails to select a business partner with an established history of high performance and relevant experience.

The OFPP conducted a pilot test with 30 contracts that used past performance as a significant evaluation factor. Those contracts identified a 20 percent increase in average customer satisfaction, confirming the assertion that the increased use of past performance data supports positive program results (GSA, 1997). To improve how the DoD leverages past performance in its source selections, the remainder of this section reviews proposed solutions that incorporate well-founded best practices to mitigate the risks associated with inadequate past performance evaluations.

Proposed Solutions

FIGURE. PAST PERFORMANCE CYCLE



The Past Performance Cycle depicted in the figure highlights four stages where we concentrated our research to improve processes and tools, and recommended implementation and enforcement of policies.

Alpha contracting negotiations with prequalified vendor candidates. Alpha contracting negotiations with prequalified vendors leverage the best practices of the Qualifications-Based Selection (QBS) strategy authorized for Architecture and Engineering (A/E) contracts under FAR Pt. 36. The QBS strategy was originally developed because certain creative professional services cannot be fairly priced before the creative process has taken place. The QBS process improves innovation, quality, and creativity by allowing the government to negotiate the

contract requirements and pricing jointly with the contractor against an independent cost estimate. The Brooks Act of 1972 delineates the framework for QBS using the following four-step phased approach:

1. The government determines the desired qualifications, including the experience and demonstrated competence of interested parties. The information provided by the offerors should emphasize technical ability (cost is not considered as part of the initial evaluation).

2. The government creates a short list, ranking the bidders by their qualifications.

3. The government conducts interviews with the firms on the short list and then reranks the firms.

4. Finally, the government negotiates a statement of work (SOW) and fair price with the most qualified firm.

Unfortunately, the FAR only allows use of QBS for contracts involving the construction or building trades, including transportation systems. However, the DoD could leverage some of the benefits offered by the A/E procurement strategy by combining some QBS attributes with other contracting best practices and strategies. For example, the DoD can use a prequalification process to narrow the pool of qualified vendors, similar to step 1 in the QBS process. This can be done by using an advisory multistep process described in FAR Pt. 15.202, or by establishing a competitive range based entirely on past performance criteria. Narrowing the field of vendor candidates would ensure that the DoD optimizes its time and resources by conducting RFP activities only with the vendors that have the highest likelihood of being selected for contract award. This approach also benefits potential contractors since they do not have to expend valuable proposal development funds for solicitations they have little chance of winning.

Processes to narrow down the pool of qualified vendors on the basis of past performance and experience can require up-front time and investment from the government. However, these strategies can save significant time during the "back-end" of the proposal evaluation process. Ranking the vendors also helps keep competitive pressures in play during

negotiations. The government mitigates the disadvantages associated with a sole-source negotiation environment because it maintains the flexibility to move to the next-ranked vendor at any point in the negotiations.

Additionally, the DoD can use a question-and-answer (Q&A) session as part of an oral presentation strategy, similar to the QBS interview process. Open communication with vendors to verify experience and qualifications is an important, but often overlooked activity. Usually the government accepts the qualifications and experience stated in a company's proposal at face value. However, greater insight regarding the contractor's related experience and the qualifications of the proposed key personnel would increase the accuracy of the government's assessment.

Lastly, the DoD can apply the same SOW and contract price negotiation process described in step 4 of the QBS through the use of alpha contracting—an innovative strategy that allows the government to perform many activities jointly with the contractor. Together, the government and contractor develop the SOW and proposal in a streamlined fashion. This process offers a number of advantages and performance improvements, such as enhancing communication, refining and clarifying requirements, and ensuring the technical solution is bounded by the capabilities of the contractor. The alpha contracting process also has the potential to yield significant savings in time and cost. For example, the Army PM-Tank Main Armament Systems M830A1 procurement utilized the alpha contracting process and reduced the lead-time for procurement administration by 55 percent, thus saving $1 million, which was subsequently used to buy additional units (Jones, 2012, p. 1).

It may be possible to combine all of the above techniques and use a GSA Blanket Purchase Agreement (BPA) to model the QBS strategy from steps 1 through 4. Under this arrangement, the DoD could select a set of contractors from a GSA schedule and use a prequalification process to narrow the field of vendors. Next, the DoD would use a Q&A process to interview candidates and rank order the potential vendors. The DoD could then utilize the alpha contracting process to negotiate a BPA with the highest ranked firm. If negotiations with the top-ranked vendor resulted in unfair pricing, or if the DoD and the vendor were unable to agree on a SOW, the DoD would have the right to conduct negotiations with the second-ranked firm. When negotiations are complete, the DoD would issue a BPA using a GSA schedule contract authorized under FAR Pt. 8.405-3.

This GSA BPA approach has certain restrictions that may limit applicability across a broad range of acquisitions (e.g., GSA BPAs are limited to commercial products and services and do not allow cost-type contracts) (GAO, 2009, p. 1). Furthermore, the QBS approach is currently limited to A/E contracts authorized under FAR Pt. 36. However, the need for creativity and innovation is not limited to A/E procurements. Agile software development, for example, values flexibility, innovation, and collaboration, and can greatly benefit from a QBS-like acquisition approach.

As a result, the DoD should pursue an amendment to FAR Pt. 15 to allow a QBS-like process that can be leveraged for many different types of acquisitions. The DoD can achieve maximum benefit from this approach if the amendment allows a prequalification process to narrow the field of potential vendors. An interview or Q&A process can facilitate the vendor ranking process, and alpha contracting would allow the DoD to negotiate a SOW and pricing based on the ranking of firms. All of these individual strategies are permitted under different areas of the FAR; however, a FAR Pt. 15 amendment would allow the DoD to combine them into a single process to obtain maximum benefit.

Solution demonstrations as a source selection technique. The limited availability of past performance information makes it difficult to verify the relevance of previous experience. As an alternative strategy, the DoD can use demonstrations as part of the source selection process to validate previous experience. A demonstration could include any material representation of past experience (e.g., prototypes, software demonstrations). Using this strategy, the DoD would require vendors to submit a functioning prototype or a previously developed relevant product, and to demonstrate its capabilities as part of the proposal process. The DoD could apply this strategy to both hardware and software procurements; for example, screen mock-ups and software demonstrations from previous efforts can be used to evaluate certain software procurements. The demonstration could be submitted prior to the formal proposal process, or could be used to supplement a written technical proposal. The proposal instructions would specify the desired functionality of the demonstrated product, and thoroughly describe how the DoD would evaluate the demonstration.

This source selection strategy will not only help to narrow the pool of qualified vendors, but will also offer a way for vendors to establish recent and relevant experience. The demonstration becomes a tangible piece of evidence that the contractor has verified and proven its experience with the technology and/or solution proposed.

Problem

The DoD lacks consistent and thorough processes to evaluate key personnel. The overall experience and business processes of the contractor are central to evaluation of past performance. However, the qualifications of the personnel proposed for key roles on the contract have even greater importance for the future success of the program. The capabilities and attributes of the key personnel proposed should be directly relevant to the successful completion of the program's requirements and supported by the strength of the company's experience. The DoD processes should aspire not only to select the strongest contractor, but also to ensure that the contractor assigns the "A Team" to the program. When companies know their key personnel will be closely evaluated, they have an incentive to offer their best performers, rather than simply personnel who meet minimal qualification requirements. Top-performing personnel with a proven track record will also be inclined to ensure the technical solution proposed can be executed with acceptable risk, potentially providing internal checks and balances with the proposal writing team.

Today, contractors generally identify key personnel, and include their resumes as part of the proposal package, but most source selections limit evaluation of these key personnel to a simple check of whether the proposed team members meet experience criteria. The DoD should have consistent and thorough processes for the evaluation of key personnel that go beyond a checklist of experience criteria. This article recommends that the DoD increase the use of oral presentations and Q&A sessions to verify the qualifications of key personnel.

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Proposed Solution

Evaluate key personnel using oral presentations. Throughout the government, oral presentations are often used in conjunction with written proposals to clarify or support all or some aspects of the contractor's technical and/or management proposal (Sade, 2009, p. 1). The *U. S. Air Force Source Selection Procedures Guide* states that discussions may be either oral or written, and specifically requires such discussions for those areas of the proposal, such as past performance, that are significant enough to affect the source selection decision (U.S. Air Force, 2000). These presentations can greatly enhance the evaluation process. They give the government an opportunity to evaluate the effectiveness of the contractor's communication style, clarify the contractor's proposal, and assess important attributes and group dynamics of the contractor's key personnel team. In addition, oral presentations remove the gloss created by professional proposal writers and give the government an opportunity to interact directly with the contractor team that will perform the day-to-day tasks required in the contract.

The DoD should take advantage of this opportunity to interact directly with key vendor personnel. To further enhance the benefits of these interactions, the DoD should mandate that proposed key personnel present the oral proposals. This prevents contractors from using their best marketing representatives to make presentations, and gives the government an opportunity to evaluate the overall strength of the contractor team that will perform the actual program tasks.

In addition, the DoD should use the Q&A portion of the oral presentation to verify the qualifications and experience of key personnel. The Air Force recommends maximum use of oral presentations to complement or replace written technical volumes where they best fit the acquisition (U.S. Air Force, 2000, p. 10). The DoD can review the resumes of the proposed personnel ahead of time, and prepare targeted questions that

will help the government understand the breadth and depth of the team member's actual experience relative to the program's requirements. The government should structure questions according to behavioral interviewing techniques: asking questions that require the candidates to describe a past situation in which they exhibited a specific capability, such as problem solving, teamwork, or planning and organizing.

The premise behind behavioral interviewing is that the most accurate predictor of future performance is past performance in similar situations. This strategy is used by more than 70 percent of Fortune 500 companies, which credit it with being 55 percent predictive of future on-the-job-behavior, while traditional interviewing has been determined to be only 10 percent predictive (Hansen, n.d., p. 1). This method of interviewing provides two types of information that improve insight regarding proposed key personnel: (a) examples of how they actually exhibited the desired behavior, versus a hypothetical discussion, and (b) evidence of the success or failure of the solution.

The DoD's evaluation of key personnel should go beyond verifying a checklist of experience criteria. Key considerations must include formal assessments of the contractor's trustworthiness with respect to foreign influence and control, the rigor of corporate security protocols, and the integrity of the contractor's global supply chain relationships.

Lastly, the contract should include key personnel clauses that protect the government from "bait and switch" tactics. In some instances, contractors have replaced the team originally proposed with potentially less qualified candidates shortly after contract award. To mitigate this risk, the DoD contracts should require that the key personnel originally proposed on the contract remain with the program for a minimum time period (e.g., 12–18 months), unless that individual leaves the company. This becomes especially important if the government uses key personnel as an important evaluation factor in the source selection process.

Problem

The DoD lacks the adequate tools and information to collect, analyze, and report past performance information consistently across contracts. A high-quality data repository greatly strengthens the government's ability to evaluate past performance as part of the source selection process. Well-documented information, easily accessible in such repositories, enables the government to defend its position during a

contract protest. Thus, a data-driven process to collect, analyze, and report past performance information is critical in allowing the government to incorporate past performance in a source selection decision.

Two important past performance tools used today are CPARS and PPIRS. CPARS is a suite of Web-enabled applications that document contractors' past performance in accordance with the FAR. It uses electronic workflow to automate contracting officers' evaluations of contractor performance. It also allows contractors to submit comments electronically in response to a government assessment and either concur or nonconcur. The DoD-developed PPIRS is a Web-enabled government enterprise application supporting source selections. Since the FAR requires all federal agencies to post contractor performance evaluations in PPIRS, it now acts as the government-wide warehouse for information on contractor past performance (PPIRS, n.d., p. 1). However, it should be noted that while all federal acquisitions are required to use the PPIRS, not all government organizations have complied. As a warehouse, it allows query-based, read-only retrieval and review of contractor data by qualified government acquisition personnel. Contractors can view their own data by using a central contractor registration to gain access.

Although the FAR requires the government to evaluate past performance, the collection and reporting of past performance data have been inconsistent and often untimely. The lack of consistent, available, and reliable data hinders the DoD's ability to make past performance an effective part of the proposal evaluation process. The government has recently made improvements to many of the past performance tools, including CPARS and PPIRS, to provide commonality of data entry format and increase the availability of data for retrieval. Despite these improvements, current data repositories still perform their functions inadequately, or are used inaccurately across the DoD. The problems with the government's current data repositories have plagued the DoD for years. Poor data quality, incompatible data formats, inconsistent reporting timeliness, lack of data entry, diffused accountability, and subjective evaluations are among the issues associated with the way the DoD has collected, analyzed, and reported past performance information.

Proposed Solutions

Implement and enforce the DoD policies for past performance. The OFPP and the Director, Defense Procurement and Acquisition Policy (DPAP), Office of the Under Secretary of Defense for Acquisition, Technology and Logistics (OUSD[AT&L]) have recently issued guidance and policy that emphasize the importance of information on past performance. Current policies, however, lack appropriate enforcement mechanisms to make this policy effective and actionable. The Director, DPAP and OUSD(AT&L) should therefore issue a DoD-wide mandate to populate past performance databases in a timely and consistent manner. Per FAR Pt. 42.15, the responsibility for reporting past performance resides with the contracting officer, but it is important to make this a shared responsibility between the PMO and the contracting office. The program team (e.g., program manager, contracting officer's technical representative) should evaluate how well the contractor is performing against the SOW requirements. The contracting office should collect this information from the PMO, and also provide input on the contractor's performance against the contract requirements (e.g., reporting requirements, terms, and conditions). The contracting office should have ultimate responsibility for collecting this information and populating the past performance database in a timely and consistent manner.

The DoD should increase enforcement of this policy through a variety of mechanisms. Agencies should be required to report metrics on how well they are complying with this mandate. The Director, DPAP and OUSD(AT&L) should collect these metrics on a monthly basis and publish the results on DPAP's Web site. The head of each Combatant Command, Service, or Agency (C/S/A) should be held accountable for C/S/A-wide compliance with this policy.

Additionally, the DoD should require that past performance reviews become a mandatory part of acquisition program reviews by the Program Executive Office. This will ensure that program offices are held accountable for meeting this policy requirement. As a further incentive, the DoD should prohibit programs from exercising option awards, award terms, or award fee payouts until they have populated past performance information into a database.

Lastly, the DoD should include an evaluation of compliance with this process as part of each contracting officer's annual pay and performance review. Metrics that report compliance with this mandate at the individual contracting officer level will further enhance the enforcement of this policy.

Identify quantifiable metrics for agency-wide reporting. Past performance evaluations today tend to be based on subjective judgments by the evaluator. This makes it difficult to compare performance across programs and contractors. Additionally, observations show that program managers and contracting officers are often reluctant to report negatively on past performance because this can reflect poorly on their own ability to manage the program or contract. Furthermore, to avoid conflict with the contractor, the government may refrain from documenting performance deficiencies in official databases. As a result, the past performance write-up does not always reflect a contractor's performance accurately.

The DoD should agree on a set of quantifiable metrics to capture objective data within standardized past performance databases. The use of such quantifiable and simple yes/no metrics can provide a consistent and reliable way to compare contractor performance across contracts. For example, Earned Value Management (EVM) data can be used to report cost and schedule performance on complex acquisitions. Award fee determinations can also provide a metric, since contractors often use this metric to measure their own performance. Simple yes/no metrics can be used for non-EVM contracts. Such questions could include: Did the contractor perform within proposed cost? Did the contractor deliver on time? Did the program encounter a Nunn-McCurdy breach? Each of the metrics and questions can be followed by a data field that allows the government to explain the evaluations provided in greater detail.

Include validated and approved contract deliverables in past performance databases. The DoD can increase the quantity and quality of the data in past performance databases by incorporating information on validated and approved contract deliverables. For example, summary narratives on award fees provide a wealth of information on how the contractor performed during the award fee period. This type of information can be very useful during evaluations of past performance, since it gives the DoD a more complete picture of how well the contractor performed over the life of a contract.

Lastly, past performance databases should include a mechanism for uploading documents directly into CPARS to share with other government counterparts. This would greatly enrich the quality and quantity of past performance data.

Conclusions and Recommendations

The lack of adequate past performance data, tools, and processes hinders the government from effectively evaluating the qualifications of companies and key personnel. The DoD tends to deemphasize past performance evaluations during the competitive source selection process, largely because data that would allow it to discriminate among proposals are unavailable. Current government tools have proven inadequate to collect, analyze, and report information on past performance. The absence of timely, reliable, documented data impedes the entire cycle of collecting, reporting, and evaluating past performance during source selection (see figure). The inability to use past performance as a predictor of future contract success places the DoD at risk of repeating program mistakes.

Evaluating a company's performance record allows the government to assess the effectiveness of a contractor's management processes, tools, and resources. Because effective performance depends on qualified and experienced personnel who know how to replicate success, the ability to evaluate proposed key personnel also becomes an important aspect of estimating a company's ability to meet the contract requirements. Yet, the DoD is not utilizing the necessary processes to fully assess the capabilities of the key personnel proposed on a contract.

The DoD currently lacks a comprehensive approach to tackle the issues identified in this article. Since the problems are interdependent, they require a holistic approach that addresses the tools, processes, and policies surrounding the past performance cycle pictured in the figure. The processes will not improve without adequate tools to *provide* the data. They will not be effective without the proper policies in place to *enforce* them, and they cannot be implemented without the proper processes and tools to *support* them.

The recommendations summarized below have been brought forward throughout this article as important steps toward improving the DoD's probability of achieving successful future program outcomes:

1. Use alpha contracting negotiations with prequalified vendor candidates. Amend FAR Pt. 15 to allow for a QBS-like approach across a broader range of acquisitions.

2. Use solution demonstrations as part of source selection to increase accuracy in evaluations of the contractor's performance record.

3. Include oral presentations in the evaluation process; improve the consistency and depth of personnel evaluations by using the behavioral Q&A process to verify the relevant qualifications and experience cited in proposed key personnel resumes.

4. Issue a policy-wide mandate that enforces past performance data entry standards. Use an online tool to track and report compliance with this policy requirement.

5. Agree on a set of quantifiable metrics to capture objective data within standardized past performance databases.

6. Increase the quantity and quality of data in past performance databases by incorporating relevant contract performance documentation from validated and approved contract deliverables.

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Keywords: *Funding Stability; Program Stability; Requirements; Technology; Planning, Programming, Budgeting, and Execution (PPBE)*

Acquisition Program Funding Stability—A Myth

COL Robert D. Morig, USA (Ret.)

Program stability and funding stability are continuously promoted as key to successful acquisition reform. Funding stability, according to prevailing wisdom, leads to program stability. Unfortunately, the dynamic, evolving, and methodical requirements generation, technology enhancement, and resourcing processes prevalent throughout the Department of Defense (DoD) are not conducive to funding stability. This article discusses results from a survey of financial management practitioners that provide insight into factors that both enable and detract from achieving funding stability. The author presents program stability as a myth in the real world environment where the "norm" is characterized by changing program requirements, technologies, and funding. He further hypothesizes that stability cannot occur without major change in the Planning, Programming, Budgeting and Execution, and Congressional Enactment processes.

Image designed by Diane Fleischer »

Program funding has always been the Achilles heel of acquisition programs during their development and production. There never seems to be enough precious funds available. On May 8, 2010, at the Eisenhower Library in Abilene, Kansas, then Secretary of Defense Robert M. Gates gave a speech centered on lowering program costs (Gates, 2010a). He said that he would be directing the military services, the joint staff, and others to examine how the DoD could reduce overhead costs and transfer those savings into force structure and weapon systems modernization gains.

Acquisition Leadership—Making the Hard Choices

Shortly thereafter, then Under Secretary of Defense for Acquisition, Technology and Logistics Ashton B. Carter generated a memorandum entitled "Better Buying Power: Mandate for Restoring Affordability and Productivity in Defense Spending" (Carter, 2010a). He provided more specific direction to acquisition professionals and emphasized the need to restore affordability to our programs and activities. On August 16, 2010, Gates sent a memorandum to the key department leaders entitled "Department of Defense (DoD) Efficiency Initiatives," directing a series of 20 initiatives to reduce duplication, overhead and excess, and instill a culture of savings and restraint across the DoD (Gates, 2010b).

On August 20, Gates followed up with another memorandum to key DoD leaders entitled, "Guidance on DoD Efficiency Initiatives with Immediate Application," directing five immediate actions to identify efficiencies and resultant savings (Gates, 2010c). Shortly thereafter, Carter released another memorandum for acquisition professionals (Carter, 2010b). On September 14, 2010, he outlined 23 specific actions organized into five broad-major areas and noted there would be continued *budget turbulence,* if the acquisition community chose not to pursue greater efficiencies. One of those actions was to "make production rates economical and hold them stable" (p. 4), implying some sort of *funding stability* to enable this initiative. Other funding stability-related actions in the memorandum were to "mandate affordability as a requirement" (p. 2), "set shorter program timelines and manage to them" (p. 4), "address schedule directly as an independent variable" (p. 5), and "Increase the use of Fixed-Price Incentive Firm Target (FPIF) contract type where appropriate using a 50/50 share line and 120 percent ceiling as a point of departure" (p. 6). To meet these objectives requires stable programs and stable funding.

To emphasize his support, Air Force Secretary Michael Donley, in a speech at the Air Force Association Conference on September 13, 2010, provided guidance to Air Force Leaders and reminded them "not to get 'over-extended'" with more programs and resource commitments than we can afford (Kreisher, 2010, para. 7). He encouraged them to seek sufficient funding to ensure success without leaving programs broken, underfunded, disconnected in the next budget cycle, and a bill payer for other programs. Donley summed up the guidance with "make the hard choices now" (para. 8).

General Ray Odierno, in July 2011 Senate confirmation hearings to be the next Army Chief of Staff, stated "carefully refined contract requirements, a sound program strategy, and stable funding," are necessary to get the procurement situation under control (Odierno, 2011).

And in Defense Acquisition University (DAU) President Katrina McFarland's Senate confirmation hearing to be the Assistant Secretary of Defense (Acquisition) on March 12, 2012, she responded to advance questions on Funding and Requirements Stability by stating, "Implementation of Affordability Targets at Milestone A, Affordability Requirements at Milestone B, and working to build realistic schedules and hold programs to them are recommended steps. Combined with

the Configuration Steering Board process, these steps as described in the Better Buying Power (BBP) will increase the program funding and requirements stability" (McFarland, 2012, p. 20) .

Interestingly enough, long before these most recent initiatives, congressional, administration, and industry leaders already declared program stability and funding stability a prerequisite for acquisition reform. In testimony before the House Armed Services Subcommittee on Defense Acquisition Reform in September 2009, Richard Sylvester, vice president, Acquisition Policy, Aerospace Industries Association , recommended that the government move to stabilize program requirements, budgets, and system configuration (The Department of Defense, 2009).

On September 1, 2009, OSD Director, Acquisition Resources and Analysis Nancy Spruill addressed questions on cost growth stating, "We have found that funding and requirements stability and greater technology maturity drive successful programs" (Spruill, 2009, p. 6). Later in that same article, when discussing strategic acquisition reform, she again stated the need to establish a fixed, stable investment budget. Findings from hundreds of acquisition reform initiatives over the years reflect the same conclusions.

So why is this so hard? For years, the acquisition community has been saying program and funding stability are essential to acquisition reform. To that end, the Department of Defense leadership has consistently directed and encouraged acquisition practitioners to ensure program and funding stability. And yet, after all the repeated emphasis, the acquisition community has not been able to meet this goal.

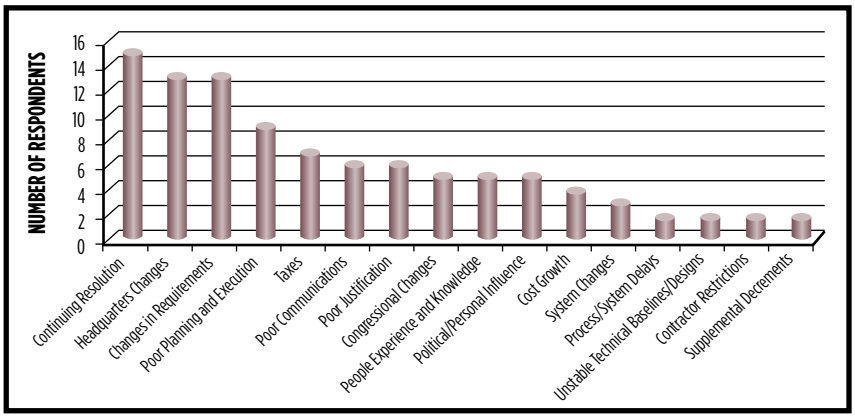
Survey Results—Detractors & Enablers

A survey of Financial Management professionals, which represents the basis of this article, offers some insight into why practitioners in the field believe funding stability is so problematic. The DAU survey was conducted by requesting the graduates of DAU resident courses BCF-205, BCF-211, and BCF-301 identify three detractors and three enablers to funding stability. The survey was sent to the graduates of 20 classes (approximately 400 Financial Management workforce personnel from all Services, from installations across the continental United States and outside the continental United States; all grades from GS-9 to GS-15, including program management offices and nonprogram management

offices). Forty students provided responses that were accumulated into the survey results. The author views this population as representative of the Financial Management community.

Table 1 shows the results from a DAU survey identifying detractors to stable funding. The top three and nine of 16 detractors identified by the survey results are actually caused by external agencies at a level above the program office's control.

TABLE 1. FUNDING STABILITY DETRACTORS



Top Detractor—Continuing Resolution

The top detractor, Continuing Resolution, occurs when Congress is unable to complete passage of Defense Appropriations bills by the end of the fiscal year. Congress routinely passes a continuing resolution to fund the government at some partial level based upon expenditure rates of the previous year or most recent congressional marks. In Fiscal Year (FY) 2011, the Federal Government was forced to operate under seven continuing resolutions (the first from October 1 to December 3, and the last expiring April 15, 2011). Continuing resolutions permit the government to continue to operate, but obviously at some constrained level of funding. New start programs are not permitted under a continuing resolution. On numerous occasions, Congress had to pass more than one continuing resolution before reaching an agreement on an appropriations bill or an all-encompassing omnibus funding bill. The resulting incremental funding of programs has caused significant funding instability for the acquisition community. In 18 of the last 20 years and 30 of the last 33 years, Congress had not passed a Defense Appropriations bill by October 1 and had to resort to a CRA, or Continuing Resolution Authority

(Streeter, 2011). The latest is the 6-month FY13 CRA funding programs at FY12 levels. As a financial necessity, operating under a CRA requires adjusting to this incremental flow of funding to projects. Obviously, this external agency (Congress) has the capacity to significantly impact a program office's ability to maintain any semblance of funding stability. Based on past history, continuing resolutions will almost certainly continue into future years, resulting in further program funding instability.

Second Top Detractor—Headquarters Changes

The second detractor, Headquarters Changes, is related to changes from higher headquarters, which are identified in the survey as having the most impact on program stability. These changes also make funding stability extremely problematic. Technology advancements constitute a significant portion of these changes. Technology is forever emerging to provide the warfighter with enhanced capability. Would we really want to ignore a technology that provides a significant increase in warfighting capability? In today's Information Technology (IT) systems, software enhancements in speed, storage capacity, or throughput volume undoubtedly provide greater capabilities to existing programs. Do we really want to minimize these changes and field obsolete technologies to obtain program and funding stability?

Improved optics, greater efficiencies in fuel consumption, lighter and stronger materials, and power generation technologies are all examples of technology advancements that could have dramatic impact on warfighting capability, and could be solutions to previously identified capability gaps. Perhaps, technology advancements in logistics could help reduce mortality rates of our soldiers and Marines moving Petroleum, Oil, and Lubricant convoys in Afghanistan. The Army recently completed a study showing .42 casualties per fuel convoy and .34 casualties per water convoy in Afghanistan (Army Environmental Policy Institute, 2009). Understandably, senior leaders at a higher headquarters would encourage and support requirements changes driven by technology improvements that save lives and improve capabilities. Inevitably, requirements and technology enhancements will continue to inhibit the likelihood of program stability and any concomitant funding stability.

Third Top Detractor—Changes In Requirements

The third most important detractor, Changes in Requirements, can be more easily managed. However, eliminating or reducing requirements changes, or the impact of such changes, has always been a challenge for the acquisition community, charged with finding a material solution to an existing system that no longer meets the warfighter's requirements. An extensive infrastructure exists to analyze existing warfighting capabilities against specific capability gaps identified by combatant commanders. These gaps sometimes take on a life all their own. As an illustration, if the capability exists to observe emplacement of Improvised Explosive Devices (IED) out to a maximum range of 6 kilometers, then the warfighter would ideally like to see beyond 6 kilometers. If an unmanned aerial drone can loiter for 10 hours, then the warfighter would ideally like the drone to loiter for more than 10 hours. The warfighter would surely want a troop carrier that provides greater protection at less weight, or a radio battery that lasts twice as long. And the list goes on. Seldom will Service leadership suppress a requirement that would give the warfighter this enhanced capability. Invariably, requirements changes will continue unabated. Consequently, funding instability related to these requirements changes will continue as long as this country has soldiers, sailors, Marines, airmen, and Coast Guard personnel operating in hostile environments.

The current Planning, Programming, Budgeting and Execution (PPBE) process seems to compound funding instability even more. Under current guidelines for Program Objective Memorandum (POM) development, Total Obligation Authority (TOA) controls are provided by the Office of the Secretary of Defense (OSD) to the military departments. As a POM is developed by the military departments, programs are prioritized and funded such that available TOA at that control number is allocated to programs. As that is done for each year in the Future Years Defense Plan (FYDP), the completed POM contains programs that consume all available TOA for all FYDP years. That POM is then forwarded to OSD for the joint Cost Assessment and Program Evaluation /Comptroller program and budget reviews. These reviews result in OSD-generated Resource Management Decisions (RMD) that promulgate senior OSD-level decisions to adjust the FYDP input accordingly in a zero sum construct. In other words, if additional program funding is added to one program in an RMD, then an associated offset is applied to other programs. At the end of the OSD/OMB reviews, decisions and

associated funding levels in the FYDP are rolled into the President's Budget (PB). Hence, the PB FYDP reflects programs that consume the total available TOA for each FYDP year.

The PB then traverses the Congressional Enactment Process, resulting in program adjustments via congressional marks and funds being appropriated. The apportionment/allocation/allotment process distributes appropriated funding for execution against these original program requirements. So acquisition program managers would now have the budget authority needed to execute their programs.

But wait, was the appropriation amount the number needed to execute the program? Did we not mention program adjustments were potentially made at all levels between the program office and the appropriation (Program Executive Office [PEO], Service Headquarters, OSD/OMB, two authorization committees and one authorization conference committee, two appropriation committees and the Appropriation Conference Committee, and maybe a major subordinate command included for good measure)? The result of all these adjustments could be the addition or deletion of funds to programs. So the resultant funding available for obligation may be significantly different than what was requested months before at the start of the budget process. These funding levels may force a technical adjustment and/or a restructure. Each one of the individual increases or decreases to a program budget request resulted in the program office responding with reclamas or appeals and program "what if" drills. At the end of the day, decisions are made at all levels to provide the most "bang for the buck" and to balance the books; many, many programs are impacted, some positively and some negatively. So what happened to program stability?

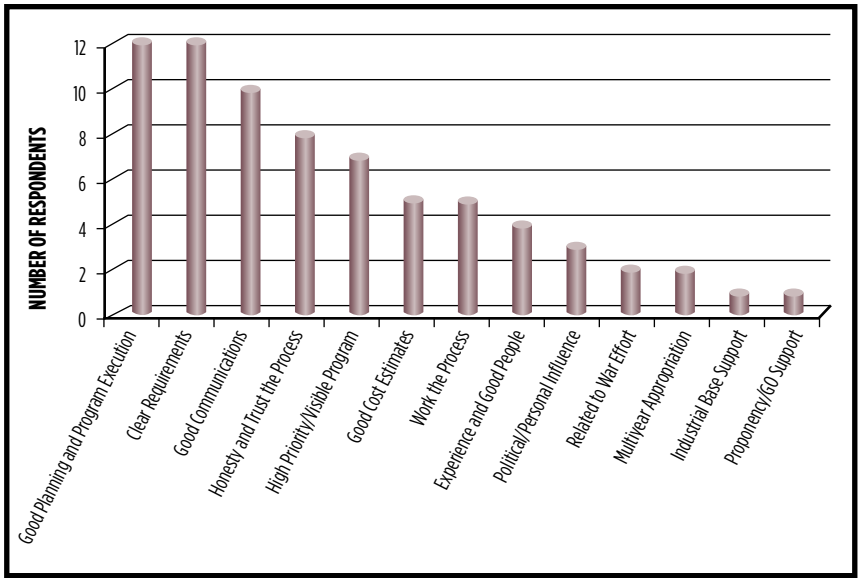
The program then enters the execution phase with its allocated funding. Concurrent with execution, the program's funding requirement is updated and the cycle starts again. Very few programs execute at the funding level provided in the appropriation. Real world events, unknown at the time of the program estimate or at the time of these incremental decisions, result in needed funding-level adjustments. Even if there were no changes at the program office level, all the intermediate levels may have adjustments to programs for which this program becomes a bill payer. Or most likely, a new requirement from the warfighter has been introduced, but there is no additional TOA provided by OSD for these new requirements. So the PEO, or the major subordinate command, or

the military department, or OSD/OMB, or the congressional committees will prioritize existing program needs along with new program(s) funding needs. If program requirements were not previously funded and now are of sufficient priority to require funding, other programs in a like amount of funding (remember we had TOA controls for each year in the previous FYDP that consumed the available funding) must move into the unfunded category. And that something might be a number of programs that are decremented to obtain the required funds for the new initiatives. Additionally, there could be a number of new warfighting requirements and/or technology enhancements introduced into this budget cycle, which would likewise be prioritized and potentially result in many more programs becoming full or partial bill payers.

So what happened to funding stability? In a process that allows and encourages technology changes, requirements changes, and funding changes, how can there ever be stable programs and stable funding? The author's hypothesis is that funding stability is simply not probable given the above arguments.

So let's again turn to the DAU survey results on what financial management practitioners believe would enable funding stability (Table 2).

TABLE 2. FUNDING STABILITY ENABLERS



Note. GO = General Officer

Two Top Enablers—Good Planning & Program Execution, Clear Requirements

We might expect to see stable requirements, better management of new technology, and a more efficient way to fund new requirements without impacting legacy or existing programs as key enablers to funding stability. However, the data suggest at the practitioner level that good planning and program execution, and a clear definition of requirements would go a long way to stabilizing funding. Program office personnel might consider external agency adjustments to their programs a direct result of poor planning and program execution. The plan is used to defend budget requirements; accordingly, a poor plan results in program reductions. The same can be said for program execution, as higher headquarters at all levels of oversight are watching financial execution to ensure its synchronization with the plan. When programs cannot execute in accordance with the plan, analysts at all levels will see the opportunity to realign funds to higher priority programs.

Third Top Enabler—Good Communications

Good Communications is directly linked to the first two enablers. As one develops the program plan for execution, constant and effective communication with oversight agencies enables a better understanding of the plan by all concerned. This allows program office personnel to strengthen that plan by documenting identified deficiencies and defending them against program adjustments. Direct communications between program financial personnel and internal program staff personnel will result in better justification materials as well as better reclamas (for adjustments from Service and OSD headquarters) and appeals (congressional adjustments) to proposed reductions. Good Communications between program office personnel and oversight personnel will facilitate more defensible justifications as well as a better understanding of program nuances by all the stakeholders.

Fourth Top Enabler—Honesty and Trust the Process

Honesty and Trust the Process as an enabler provides interesting insights into the perspective of many financial management professionals. The financial culture for many years has centered on protecting funding and an unwillingness to return funds to a higher headquarters for use against higher priority programs. In many cases, that culture results in funds being wasted or oversight personnel discovering disconnects between the plan and the execution, as well as reallocating those funds and exacerbating stability. Being honest with higher headquarters and

freeing up dollars do result in funding stability as this honesty will enable unneeded funds to be made available for higher priority needs of the Service. Releasing unneeded funds for higher priority programs enriches the enterprise by helping to fix other program problems, and creates an attitude of "you helped me with this program, I will help you when you need it." Program managers need to take an enterprise perspective and offer up unnecessary funds for high-priority programs, and headquarters managers need to support that culture with payback as required.

Obviously, high-priority programs and those with high levels of visibility generally are funded in accordance with their priority. These programs tend to be more stable, and funding issues are resolved quickly by senior leaders. Army Digitization was the number one priority program for a number of years in the late 1990s and could count on receiving the funding it needed. The Mine Resistant Ambush Protected (MRAP) vehicle has enjoyed that priority over the last few years. This enabler could be linked with political/personal influence. High-priority programs tend to have the visibility and a strong proponent to promote the program. Sometimes these proponents are powers in the political arena and sometimes they are simply key personnel in the decision-making community that usher the program through the system. A strong backer at the right level can do wonders for program stability. Often, senior leaders become supporters of programs and ensure they are properly resourced due to their position. As an example, some years ago the Vice Chief of Staff of the Army was a strong soldier system proponent and would ensure subordinate levels would not decrement soldier programs without his concurrence. At a later time, the same could be said for a Vice Chief who was a strong aviation program proponent. Years before that was an Army Digitization supporter. So obviously, having a key stakeholder in the right place at the right time in the process can minimize funding turbulence.

Programs with good cost estimates and good program execution consistent with those estimates would be more stable as internal shortfalls do not drive instability. However, external detractors would continue to impact such programs. The current focus on funding to the OSD Independent Cost Estimate (ICE) should assist in minimizing cost turbulence. More often than not, the ICE will result in a higher cost estimate than the Program Office Estimate.

Working the system provides another interesting insight. Program managers that understand the PPBE process as well as the Congressional Enactment Process are more inclined to be engaged throughout and make these systems and processes work for them. As an example, program managers who know when key management decisions are being made in these two processes, and are proactively involved in being available on short notice to provide needed data or information, seem to fare better than those who sit back and await the outcome of the process. Program managers who walk the halls in the Pentagon identifying the latest pending action on their programs can be extremely helpful in providing information to decision makers and their staffs. Knowledge of the Congressional Enactment Process as to when committee and subcommittee marks are taking place and responding with appeal information contributes enormously to program stability by reducing program adjustments.

The same can be said for knowledgeable and experienced people on the program management staff who can fight off these adjustments based upon their knowledge, understanding, and relationships with key stakeholders. Their knowledge of key system characteristics, the contracting and resourcing processes, and their technical competence can be enormously influential in successfully protecting programs.

A program that is directly related to the war effort should enjoy funding priority and program stability. Many programs support the war effort, but again, some are more critical than others. The MRAP program has entertained high priority as it saves lives and minimizes injury. Any program related to IED threat reduction will enjoy a high priority for funding. Again, soldier systems would fit into this category and enjoy minimal funding adjustments.

This author was quite surprised that multiyear procurements did not have a higher number of votes on the survey. Clearly, programs with approved multiyear procurements will enjoy stable funding due to the high termination costs associated with those programs. Multiyear Procurement is associated with Economic Order Quantity purchases where contractors are encouraged to buy in quantity or affect production efficiencies in exchange for a contract covering a number of years—normally 3 to 5. Decision makers are reluctant to decrement these programs as a commitment was made to fund them. The downside to multiyear

procurements is they reduce the flexibility of the Service, OSD/OMB, and Congress due to the large termination costs. This author would have expected this to be the number one enabler to stable funding.

Programs necessary to maintain an industrial base capability would tend to be exempt from program adjustments for the primary purpose of ensuring the nation has that capacity in time of need. The reason the survey had so few responses for this factor is most likely attributable to few programs fitting this situation. A follow-on survey identifying this as a potential enabler should result in many more identifying this factor as a significant funding stability enabler.

Program Stability and Information Technology

A report to Congress entitled, "A New Approach for Delivering Information Technology Capabilities in the Department of Defense" offers dramatic approaches to funding IT that might provide funding stability (DoD, 2010). The executive summary states that anticipated legislative changes will be required to fully implement the new acquisition process. It goes on to suggest a single appropriation of IT projects where research and development, procurement, and operations and maintenance will all be performed using this single appropriation.

Single Appropriation

This approach would certainly contribute to funding stability while providing enormous flexibility in managing programs. Obviously, all programs would enjoy a greater degree of funding stability under such a proposal. It will be interesting to see if Congress will support such a proposal in the PB for IT projects. Unfortunately, this author does not see Congress applying such a proposal to all programs as it significantly reduces their oversight responsibility.

Revolving Fund

The second IT approach is to create a revolving fund similar to the National Defense Sealift Fund. Funding would be deposited in a nonexpiring account with obligation authority for the purposes under the act. Again, this approach would provide funding stability for IT programs and has applicability to other programs as well. It will be interesting to see how Congress reacts to this approach if the Department of Defense tries to implement it in a future PB.

Stable Funding Through IT Funding Elements

Stable Funding through IT Funding Elements is the third approach, which would use a single funding element such as a program element (PE) or procurement line item to fund a portfolio of similar projects. "Funding for the combination of smaller IT projects may be best addressed by a stable budget defined by a single funding element" (DoD, 2010, p. 7). This funding element would support an IT capability in lieu of individual programs. Again, this will require congressional approval as the proposal reduces congressional approval and oversight for defense programs. The Army Digitization Office in the mid to late 1990s had such a funding line where Congress appropriated $100 million of Research, Development, Test and Evaluation funds for competing digitization programs. That program was examined in detail by numerous oversight agencies and was abandoned due to dissatisfaction with the rigor, which was extremely detailed, and the lack of congressional oversight.

These three approaches to IT programs could prove very effective in giving the department the necessary flexibility to meet the unique requirement related to maturing technologies that require near real-time reaction to fully implement. Those same flexibilities are necessary to provide funding stability to all programs.

Discussion and Recommendations

It is this author's opinion that funding stability in the real world environment where changing requirements, technologies, and program funding are the norm to meet warfighting needs is most likely a myth. It cannot occur without some major change in the PPBE and Congressional Enactment processes, both of which are unlikely. One could envision, albeit not easily, a military department reserving in the FYDP a portion of the TOA for future programs or for program adjustments. Doing that of course would expose that TOA for OSD/OMB use to be applied to other programs. The risk of losing those funds would most likely not be supported by the Service leadership. And of course, the military departments have many more requirements for funding than available TOA, so they would be required to defund programs to reserve this TOA. Highly unlikely!

Recent passage of the Budget Control Act of 2011 exacerbates this issue by requiring significant reductions to defense funding along with the potential for across the board reductions (sequestration) if Congress cannot reach agreement on further deficit reduction. Funding instability for many defense programs will most likely occur—whether there is an agreement or a lack of agreement.

So the acquisition community as well as oversight agencies will continue to study, suggest, recommend, and *talk about* the need to ensure program and funding stability. But real world implementation of these acquisition reform ideas will continue to elude the acquisition practitioner as the requirements generation and the resource allocation systems are simply not flexible enough to react to emerging changes while maintaining program stability.

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Keywords: *System Dynamics, Project Management, Defense Acquisition, Dynamic Modeling*

Dynamic Consequences of Cost, Schedule, and Performance Within DoD Project Management

Patrick R. Cantwell, Dr. Shahram Sarkani, and Dr. Thomas A. Mazzuchi

Project management has been a constant challenge for the U.S. Department of Defense (DoD) acquisition community. While most DoD projects are technologically advanced, the tools and methods to manage these projects are the same as for simple, repetitive projects. The authors argue that traditional approaches fail because they only evaluate the relationships between two of the three elements of cost, schedule, and performance. Instead, they have developed a system dynamics model that allows cost, schedule, and performance to interact and influence one another. This model is complementary to other research and intended to be usable by the practicing project manager. The results from model runs will provide consequences for three potential control alternatives in DoD project management.

Image designed by Diane Fleischer »

The search for the ideal form of DoD project management has existed since the dawn of DoD projects and is driven by a desire to reduce the DoD project failure rate. In fact, many external observers as well as quite a few DoD acquisition professionals would probably say that more DoD projects fail than succeed. Many researchers have explored the reasons for general project failure in great detail. They have developed many theories that withstand academic scrutiny, but the range of even simply understanding the nature of projects varies depending on project characteristics, the project industry, and where researchers decide to restrict their studies. Ultimately, no one solution makes DoD or any other domain of project management work. That the DoD project management industry has not had more research is somewhat surprising given the large number and size of DoD projects. However, this is a common problem in most project management domains (Love, Edwards, & Irani, 2008). Certainly, DoD could gain more appreciation and insight from an improved understanding of the way it conducts project management, which is different from other industries.

Background

According to the U.S. Government Accountability Office (GAO), half of the major defense acquisition programs are not meeting cost goals, and 80 percent have increasing unit costs (GAO, 2011). GAO further notes that between 2008 and 2010, the 98 major defense acquisition projects have grown in budget by 9 percent (GAO, 2011). In the Fiscal Year (FY) 2012 budget request, the U.S. Department of Defense (Comptroller) asked for $85.3 billion of its $553.1 billion budget, or approximately 15.4 percent for major defense acquisition projects (Comptroller, 2011).

Frequently, budget pressure, schedule pressure, or changing user demands are cited as the reasons for both commercial and DoD failures (Meier, 2010). However, these challenges have been present for as long as projects have been undertaken, and the trend within DoD is getting worse instead of better (GAO, 2011). The fact that many of these projects are developmental and have little or no basis for comparison is a fair excuse for why initial cost, schedule, and performance estimates prove to be incorrect. However, DoD project management needs to develop approaches to overcome the current trends. The first step to improvement is a solid understanding of how most DoD project management

works. The goal of the authors' research is to ultimately provide insight into the practical application of alternative decisions within DoD project management from the perspective of the government project manager.

Project management has existed since man began building things. However, many researchers define the beginnings of the formal discipline of project management with the U.S. Polaris missile development and use of critical path methods in the 1950s (Lyneis, Cooper, & Els, 2001; Pich, Loch, & De Meyer, 2002; Tishler, Dvir, Shenhar, & Lipovetsky, 1996; Williams, 2005). Therefore, a close connection exists between DoD projects and formal project management, but not all project management is the same. Tishler et al. (1996) note that defense projects are different from commercial projects due to a larger, more interdisciplinary design and higher technological risks. Despite this early bond between DoD and project management, many U.S. senior DoD leaders as well as the U.S. Congress have expressed the view that U.S. DoD project management needed improvement as early as 1970, and have since changed the acquisition policy guidance nine times (Ferrara, 1996).

Sorenson (2009) provides an in-depth overview of the history of U.S. DoD acquisition. He notes that the "current defense acquisition process is constructed on a foundation of distrust" (Sorenson, 2009). By this he means that the distribution of power as well as the extensive oversight is all in place to ensure that everyone is involved in doing the right thing, and to avoid the illegal and immoral past history of highly publicized procurement irregularities related to defense acquisition. He notes that there are variations in how projects are executed and decisions that are made on varying projects. Sorenson (2009) further comments that the Secretary of Defense has (though infrequently) terminated acquisition programs, but Congress never has. He highlights many of the problems with defense acquisition, from poor cost estimates to development delays to changing requirements to excessive oversight (Sorenson, 2009).

Other researchers have found that many DoD project managers underestimate cost and schedule due to the failure to understand complexities involved as well as seemingly futile efforts to correct an underperforming project, which often results in blaming exogenous variables as opposed to endogenous ones (Lyneis & Ford, 2007). They further add that a great deal of research exists noting general theories on the need to reduce elements of project management rework cycles, but domain-specific advice or research is limited (Lyneis & Ford, 2007).

Ford and Dillard (2009) address this deficiency using a system dynamics model of the JAVELIN missile development program that allowed them to evaluate the strengths and weaknesses of "evolutionary acquisition" by comparing two strategies for system development.

System dynamics also has a long history with DoD. One of the earliest uses of system dynamics within DoD was in the diagnosis and legal support for delay and disruption claims by Ingalls Shipbuilding against the U.S. Navy in the development of the amphibious assault ships in the 1970s (Cooper, 1980). This model was effective, but was taken from the perspective of the contractor in the 1970s. An extensive system dynamics model was used to evaluate the general field of software development (Abdel-Hamid & Madnick, 1991). Black and Repenning (2001) developed a generic system dynamics model based on a commercial manufacturing new product development to evaluate how early failure to apply appropriate resources to a project (or multiple projects) results in a "firefighting" phenomenon that results in poor project performance. Taylor and Ford (2006) further reinforce this research with the same phenomenon and additional "tipping point" analysis as applied to construction management. These research results are highly valuable, but focused on the commercial world that does differ from government project management in that government project management is more focused on managing a contractor who is doing the development. More recent uses of system dynamics models have been in the actual prosecution of combat operations in the areas of command and control, search and rescue, and irregular warfare (Coyle, Exelby, & Holt, 1999; DoD Announces, 2008). All of these models are valuable and insightful, but they do not provide practicing project managers much specific detail in ways to perform their jobs better.

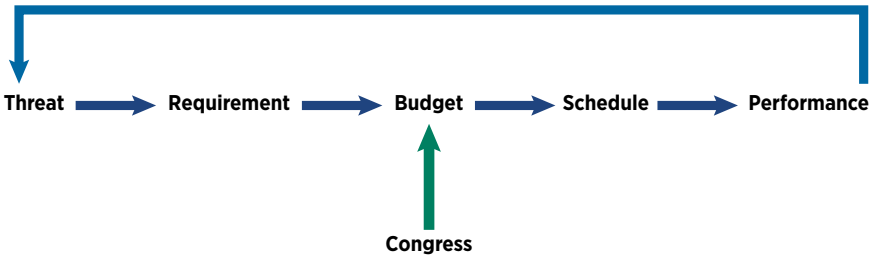
In the last 3 years, Ford and Dillard's JAVELIN system dynamics model is one of the most recent models and does provide good insight into varying acquisition approaches to a project. Both the current authors and they agree that a DoD project manager must still accomplish a single-block development even within the larger evolutionary acquisition; and attempting to document and model all external influences on DoD project management may be futile. Therefore, our approach is to develop a historically based, empirical model that produces the final cumulative cost, schedule, and performance results in a manner that allows us to evaluate the consequences of three simple control alternatives within any larger acquisition framework. Thus, our model could one day be incorporated into Ford and Dillard's to provide additional understanding

of the dynamics of DoD project management. We believe our research will help practicing DoD project managers better understand positive and negative consequences of simple project control alternatives that they may consider.

Dynamic Hypothesis

If you were to ask many DoD professionals to describe how acquisition truly works at the strategic level, they would describe a framework similar to that depicted in Figure 1. In this figure, one strategic activity is all or the vast majority of what influences the next downstream strategic activity. Therefore, a given threat (or change in threat) causes a new delivered requirement that changes a budget estimate, which causes the schedule estimate, and the end result is a performance expectation. At the budget event, Congress may intervene and adjust up or down the budget, which impacts the downstream activities. Eventually, the expected performance will have an impact on the threat. While this figure is relatively simple to understand, the problem is that it ignores the speed of change in many of these subactivities (i.e., budget development every 2 years while the requirements may change every year or less) and ignores other impacts of the subactivity interaction. It further assumes that a single change can be controlled or managed with "simple processes" such as through the monitoring of a work breakdown structure or earned value management. Previous research has shown these techniques may be effective if there are relatively few or no unknowns, but they prove inadequate when there are many unknowns or the true state of the variable may not be known for some time (Dvir & Lechler, 2004; Thomas & Mengel, 2008).

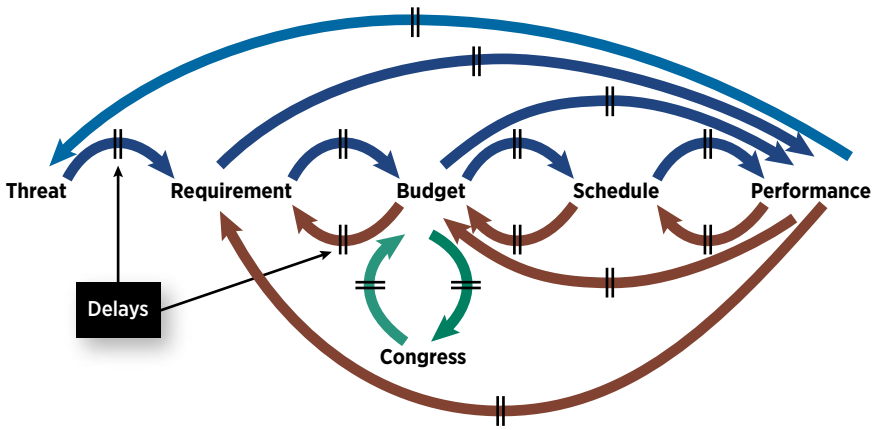
FIGURE 1. DOD ACQUISITION AT THE STRATEGIC LEVEL



As an alternative, the authors suggest that DoD professionals adopt a mental framework like that shown in Figure 2. In this figure, all of the same activities as Figure 1 are present. However, Figure 2 illustrates

that delays are present and every activity impacts every other activity. This means that an adjustment to the budget will impact schedule and performance over time. That this is a more accurate depiction of the real world is usually not in question, but the major issue is how we deal with this. The authors believe that a system dynamics model will serve as an effective tool to better understand what is going on and to propose an alternative for improved system response. In other words, we hope to find a better way to perform DoD project management for the practicing project manager.

FIGURE 2. MENTAL FRAMEWORK



Model Methodology

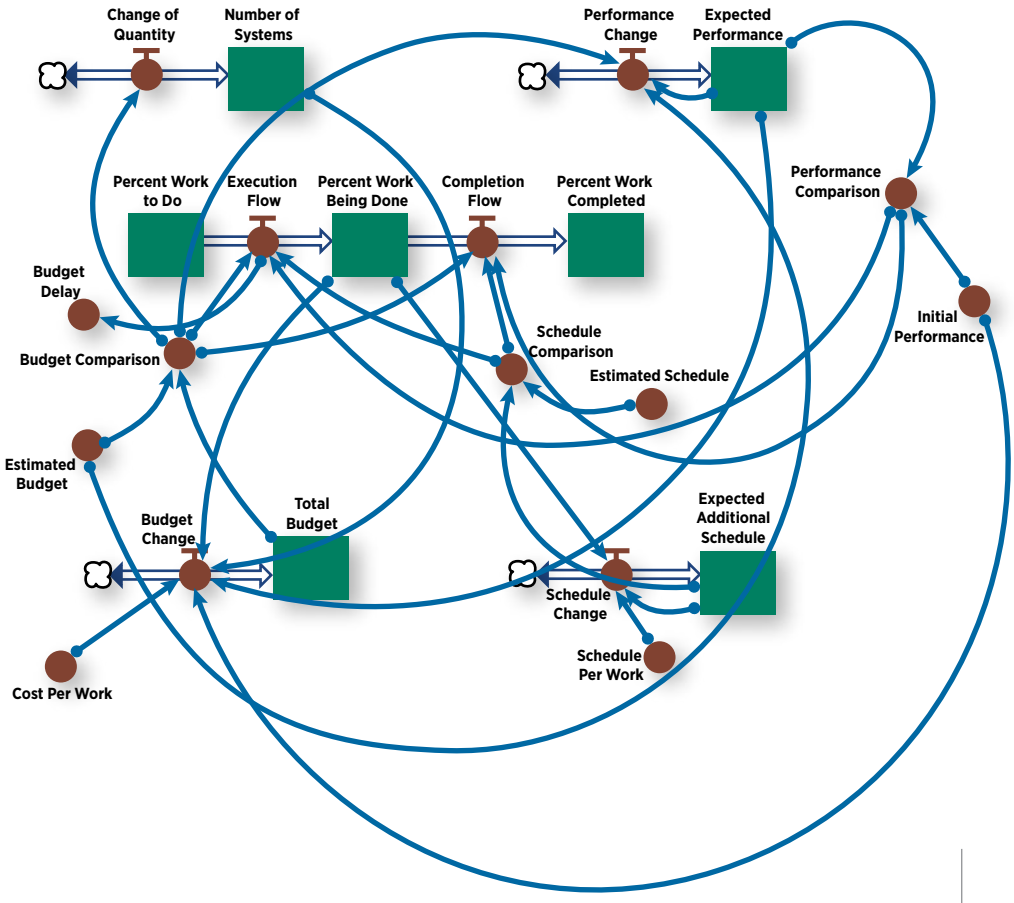
It is important to first note that the authors subscribe to the belief that DoD project management as a system is poorly understood. Therefore, our objective is to better understand the system and its responses through the use of an empirical model. Because of this objective, our model is relatively simple and strives to show several aspects of the system and its dynamic behavior over time that may help improve the overall results. The model is shown in Figure 3.

The foundation of our model is a work flow process surrounding system design/understanding. Our work flow process is very simple and defines system design/understanding project work of any kind as a percentage in one of three states: work to be done, work in progress, and work completed. The completion of all work would equate to a perfect understanding of the system being acquired, which should be the goal

of all projects. While we make a simplifying assumption that all work is equal in priority and execution, we believe that over the entire project life cycle, this is the ideal case and appropriate for our objective. With all other influences being removed, our work flow will complete all activities within 15 years, which is appropriate for most DoD projects. In our baseline model, no unknown work or rework is included. While this is certainly not accurate nor representative of the real world, our goal is to best understand the ideal case before moving to more intricate situations.

To allow for dynamic consequences, control of starting and completing work is done through a comparison of the projected or estimated budget, schedule, or performance to the actual budget, schedule, or performance. In the case of the budget comparison, we have incorporated a 2-year delay due to the DoD Planning, Programming, Budgeting

FIGURE 3. WORK FLOW PROCESS SURROUNDING SYSTEM DESIGN/UNDERSTANDING



and Execution process where a project budget is submitted, and about 2 years later the actual approved budget is delivered. (We use the terms "budget" and "cost" interchangeably in this model for simplicity, and are only focused on total system design and production costs, not the actual total life-cycle costs that include sustainment and disposal.) When the difference between the estimated budget, schedule, or performance and the actual budget, schedule, or performance is positive (i.e., the project is under cost and/or ahead of schedule and/or less capable than initially desired), then work is allowed to start and be completed at an accelerated rate corresponding to an increase in work execution. However, when the difference in the estimated budget, schedule, or performance and the actual budget, schedule, or performance is negative (i.e., the project is over cost and/or behind schedule and/or more capable than initially desired), then the work is slowed to a decelerated rate corresponding to a slowing of work execution or delaying of work. As an example, if the actual budget is 25 percent over the estimated budget, then the work initiation and completion rates are slowed by 12.5 percent due to the 2-year delay. In this model, budget and schedule are equally important and contribute the same to the work rates. Therefore, a situation with a 25 percent over budget and a 25 percent over schedule would result in a corresponding 37.5 percent reduction to the work rates.

5

Budget and schedule flows are based on the work in progress. The budget flow is the product of work in progress multiplied by a cost per work constant that is multiplied by the ratio of the number of systems to desired number of systems and the ratio of current performance to the desired performance. This assumes a cost reduction is associated with fewer quantities of systems and less system performance. The schedule flow is the product of the work in progress multiplied by a schedule per work constant. Either the budget or schedule flow can move in a positive or negative direction allowing for budget or schedule reductions, but it is important to note that because some amount of work is in progress at any given time, these flows will never be negative. It is also important to note that budget and schedule do not directly influence each other in this model. This is due to observations that a budget increase does not guarantee a reduction in schedule nor does a schedule increase guarantee a budget reduction (assuming all other factors are the same).

Previous project management research has addressed the interactions of cost, schedule, and work. Many earned value management and earned value schedule studies have evaluated cost, schedule, and work.

However, little to no previous research has enabled the interaction of cost, schedule, and work levels in addition to performance levels over time. Our research provides some insight into this interaction. We have incorporated performance in our model by evaluating it in two ways. First, the number of systems is another flow that impacts the total budget. As long as the project is under budget, then the number of systems will remain the same. Once the project goes above cost, then the number of systems will be reduced in an effort to reduce cost growth. This is a common behavior observed in DoD projects.

Second, performance is evaluated through a percentage of the initial desired performance. The desired performance begins at 100 percent and, like system quantity, as long as the project is under budget, will remain at its current level. Also like system quantity, once a project is over budget, the performance level will be reduced by a percentage in an effort to reduce the budget and schedule of the system development. Additionally, the amount of performance degradation could also be thought of as a quantifiable estimate of program risk, which may not be a problem or be tolerable to the project stakeholders. Both of these performance measures can be generically applied and are helpful in our gaining a basic understanding of how this model operates. While both of these performance measures impact the budget flow, only the performance level compared to the desired performance level impacts the work flow. This is due to the assumption that complete system understanding can be gained through one system and no further insight is gained from additional system production.

More detailed aspects such as rebaselining or evaluating which performance elements are reduced have been excluded so that the essential model behavior can be observed. Verification and validation of this model was done through two means. First, common system dynamics practices as referenced in Barlas (1996) were successfully conducted. Second, the authors have used a case study to validate the results of the model with actual system performance. The authors have chosen the U.S. Army's Future Combat System as the case study.

Case Study—The Army's Future Combat System

In 1999, the U.S. Army began designing the Future Combat System (FCS) as a means of preparing itself for what it expected to be the future of warfare. The Army expected to have the first unit equipped in 2011 and

the entire Army equipped by 2032. FCS involved multiple air and ground systems that were networked and interoperable. One key tenet of the FCS effort was that information could replace mass, and a second tenet was that FCS components could be deployed rapidly. The ultimate combination was a highly technical and revolutionary system-of-systems that sought to push technology and balance many competing priorities (GAO, 2008). FCS was officially terminated as a program in the summer of 2009.

While many unique and interesting dynamics surround this program, it is used as a means of verifying and validating our model. In our model, the key FCS inputs were the project cost and schedule estimates. These inputs were taken from the U.S. Congressional Budget Office (CBO, 2006) report on FCS. The model set 2005 as the base year, which was based on availability of fiscal information, and extends until 2025. Our model results of a total system cost in 2025 of $161 billion are consistent with the Congressional Budget Service (CBS) estimates of $160.6 billion. While the CBS may have been in error in its assessment, the fact that our model achieves similar results instills confidence in our approach. Additionally, our model estimates that when the project was killed in 2009, the number

of systems would be reduced to 14, with an estimated project completion date of 2021. These results are consistent with actual results of that time and provide the final validation of our model for general understanding.

Results

Using this model, we now turn to evaluating how varying responses impact the results. We have focused on project manager responses, and these results should hold true as long as DoD projects are evaluated against their initial (or current) estimates. The potential strategies evaluated are to Remove Controls, Ignore Schedule, Ignore Budget, and Improve Estimate. The reduction in total systems remains the same for all strategies so further discussion of it is excluded.

Remove Controls

One potential strategy to improve project success is to remove all project controls. While this model does not account for some of the uncertainties and unknowns that occur within the life of the project, it does help us evaluate a perfect-world scenario. In this perfect world with no reduction in work flow, the project completes all work by 2025, but only attains 67 percent of the desired capability. The total budget is $147 billion, which is a 9 percent cost reduction of the baseline.

Ignore Schedule

Another potential strategy to improve project success is to ignore the schedule comparison. This alternative operates on the principle that "if you need it bad enough, you will do anything to get it." Upon first look, this alternative achieves the lowest total cost at $141 billion (a 13 percent reduction of the baseline) with all work completed by 2014 and a performance drop of 21 percent of the initial desired capability.

Ignore Budget

Positive results were achieved by ignoring schedule comparison so the authors were interested in what would happen if the budget comparison is ignored. In this case, the total cost was $133 billion, which is an 18 percent reduction in baseline and looks very attractive. However, only 67 percent of the initial desired performance is achieved on system completion, which does not occur until 2032. While this strategy results in the best cost reduction, the performance and timeline are sacrificed.

Improve Estimate

Another seemingly simple strategy is to focus all efforts on knowing the true cost and schedule up front. This technique is in consonance with most systems engineering literature and does make sense with what every senior DoD acquisition leader advises. While not the focus of this research, it is another challenge entirely to determine how to accomplish this. However, this approach results in a total budget of $210 billion or 130 percent of the baseline, with 86 percent of the desired performance delivered.

	Total Cost	Performance Delivered	Work Completed by 2025	Work Completed by
Baseline	$161B	69 percent	100 percent	2021
Remove Controls	$147B	67 percent	100 percent	2025
Ignore Schedule	$141B	79 percent	100 percent	2014
Ignore Budget	$133B	67 percent	77 percent	2032
Improve Estimate	$210B	86 percent	100 percent	2022

Looking at this data reveals two general observations. First, in a perfect world potential opportunities for cost reductions abound, but, second, they come at the expense of performance level. The largest variation in strategies regarding cost is 30 percent, which could trigger a Nunn-McCurdy breach and require congressional reporting. However, the trade-off is clearly associated with the amount of performance delivered, which at most varies by 19 percent, and when that performance is delivered, which varies at most by over 18 years. Additional statistical analysis shows that no two factors are highly correlated, but that the most likely relationship is between total cost and performance delivered.

What these results mean to a DoD project manager is that no single strategy is likely to achieve cost, schedule, and performance optimization. Project managers need to evaluate the prioritized objectives of that project's stakeholders and develop their strategies to meet those priorities. For instance, if a project is needed quickly, then ignoring how the project is comparing to the initial schedule may be the best solution. If a project needs high performance, most likely a good strategy for the project manager is to ensure the systems engineering and analysis is performed early so that the best cost and schedule estimates can be made.

Future Research and Conclusions

While these results are interesting, they are certainly not to be considered rigid rules of DoD project management. In fact, many elements and influences have been excluded in this model in an effort to gain an initial understanding of the total system behavior. The dynamics of how DoD project work is prioritized and executed, the dynamics of varying design and evaluation methods, and the dynamics and value of the three-milestone DoD acquisition gate process are all work-related influences that should be further studied. Another potential future area of study is the combination of this model into Ford and Dillard's evolutionary acquisition comparison to see if even simple control alternatives affect the results of the research. The dynamics of varying budget delays as well as the impact of congressional budget action should also be further studied. Finally, the dynamics of system quantity changes to the actual system cost is an area that can also be expanded to provide better fidelity in this model.

All of these future areas of study require significant investigation and study, and likely vary from project to project. This further supports the authors' theory that DoD project management is a highly contextual process that requires dynamic understanding of influences that sometimes do not make themselves known for some time. A system dynamics model such as the one discussed in this article could be used to best identify and predict total project behavior so that varying strategies could be evaluated for the best one in a given situation. The model could certainly be expanded and complemented, and the DoD would do well to invest more resources in exploring why projects fail (or succeed), documenting the circumstances and influences, and distributing them for widespread use in the project management arena. However, a single or even several causal factors should be avoided to explain all projects as every project is unique and must be evaluated in its unique context.

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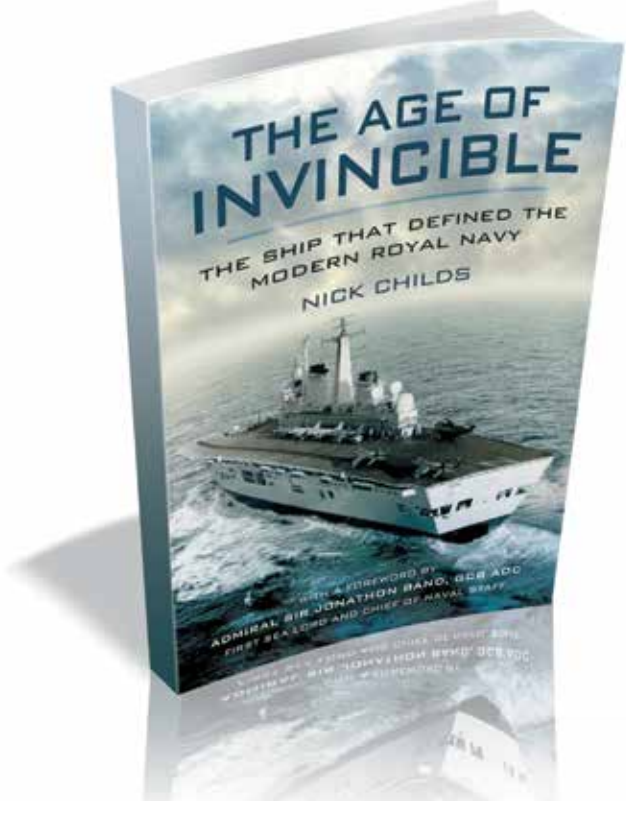

Featured Book

The Age of Invincible: The Ship That Defined the Modern Royal Navy

Author(s):
Nick Childs

Publisher:
Pen & Sword Maritime

Copyright Date:
2009

ISBN:
978-1844158577

Hard/Softcover:
Hardcover, 208 pages

Reviewed by:
Professor David Andrews, FREng, RCNC, Professor of Engineering Design, Department of Mechanical Engineering, University College London, and former Project Director, Defence Procurement Agency, United Kingdom, Ministry of Defence

Review:

This book has a foreword by then First Sea Lord Admiral Jonathan Band, which nicely summarizes it: "this excellent and very readable account of the life [of the ship]... and the worlds from which it sprang and into which she emerged." The book also describes the politics that led to the current build program of much larger Carrier Vessel Future (CVF) vessels. Initially, the sorry story is told of the cancellation of the CVA-01, lead ship of the first post-war carrier class. Louis Rydill, as the design manager, is quoted as feeling he was on the rack trying to achieve the capability of a Forrestal design within a displacement of 53,000 tons and a necessary, but daunting level of innovation. Meanwhile, there was ineptitude by the Royal Navy's hierarchy in the corridors of power (contrasted later with the "A Team" 16 years on, which won the Falklands Campaign). Following the demise of British naval aviation, there was the subsequent slow and painful climb back to a fleet led by three "Through-Deck Cruisers"—only "carriers" in a limited sense once the short take off and vertical landing (STOVL) provision was incorporated.

Next, *Invincible* and her design intent is described (familiar to those involved, including this reviewer, who contributed to Nick Childs' research, as well as coauthored the definitive technical paper in 1980 on the design—more appropriate for those who would like something technically detailed rather than this essentially strategic and personalities-focused history). Childs has caught the essentially innovative nature of this quite new concept—based on Rydill's early helicopter cruiser studies and then Tony Austin's coherent through-deck and all gas turbine propelled design, developed without any previous ship on which to base it (Honnor & Andrews, 1982). The book then covers the Harrier ramp story well, if un-technically—there was a lot more to it than being "just welded on to the forward end of the runway."

The nadir was reached with the early Thatcher government's defense cutting regime with a chapter entitled "For Sale," yet followed—mercifully, for the Navy—with the Falklands redemption of maritime capability and a chapter on "*Invincible* at War." This should be the key chapter of the book, but is a mere 10 pages covering the immediate perspective of the Commanding Officer (then) Captain Jeremy Black, and little on how well the ship and its embarked aircraft performed. The subsequent chapter "What Lessons" focuses on the strategic rather than the tactical- or design-related lessons.

The last part of the book addresses post-Cold War peacekeeping, where the ability of carriers to project power ashore was shown to be limited with the *Invincibles* and thus made the case for the two big (65,000-ton)

carriers. On the vexing question of naval ship costs, despite the fact that it dominates the whole fleet acquisition process, Childs does not ask why the Queen Elizabeth Class (QEC) carriers, which are large but slow and minimally armed, have been subject to ever rising costs. Clearly, each major program has been, successively, the only significant United Kingdom shipbuilding program, and therefore had to shoulder the added burden of sustaining that national capability. However, this writer believes the cost escalation is also due to the persistent but false belief by politicians and wider government (including the naval hierarchy) that "value-for-money" could be delivered by giving industry the responsibility for designing and project managing naval shipbuilding, instead of leaving both in-house.

However, none of the above is addressed in Childs' book, which largely focuses on the contributions of a succession of senior naval officers. It is a fascinating, if dispiriting, story of sacrificing the size of the rest of the fleet to keep carrier aviation alive. The uphill nature of this struggle seems consistent with the sense of a nation that has collectively lost sight of its maritime raison d'être. However, this is only part of the story that Childs could have addressed, as his story has a worrying lack of engagement with the underpinning engineering narrative. Could that be coincidental?

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RECOGNITION OF REVIEWERS FOR PRINT YEAR 2012

We would like to express our appreciation to all of the subject matter experts who volunteered to participate in the *Defense Acquisition Research Journal* peer review process. The assistance of these individuals provided impartial evaluation of the articles published during the 2012 print year. We would also like to acknowledge those referees who wished to remain anonymous. Your continued support is greatly appreciated, and we look forward to working with many of you again in print year 2013.

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