IT'S TIME TO TAKE THE CHILL OUT OF COST CONTAINMENT AND RE-ENERGIZE A KEY ACQUISITION PRACTICE

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Unless program managers (PM) tackle cost containment head-on, future weapon system acquisition successes may be jeopardized, resulting in fewer products and services to equip the nation's warfighters. The United States can ill afford any decrease in its preparedness when the nation is currently waging war on two fronts. This research examines cost containment in the context of Total Life Cycle Cost Management. A more thorough understanding and aggressive application of cost-containment strategies could conceivably shift acquisition outcomes to a more cost-effective posture. Responding to a survey conducted as part of this research, 887 Department of Defense (DoD) acquisition professionals provided input on cost containment, including tool types and associated processes. Of those 887 respondents, 543 were current or former DoD PMs.

Keywords: *Life Cycle Cost Management (LCCM), Cost Containment, Cost as an Independent Variable (CAIV), Performance Based Logistics (PBL), Cost Analysis Requirements Description (CARD), Earned Value Management (EVM), Technology Readiness Level (TRL)*

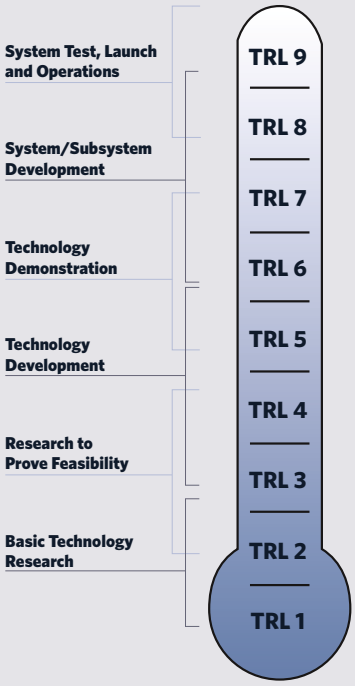
image designed by Harambee Dennis »


Materiel Solution Analysis
A
Technology Development
B
Engineering and Manufacturing Development
C
Production & Deployment
Operations & Support

Is there a superior acquisition development decision aid that can assure more program successes and help contain costs? Interestingly enough, some of the most basic tools currently at our disposal in the Department of Defense (DoD) are already ideally suited to help achieve acquisition excellence. They can also have a significant impact on fiscal outcomes. For some time, program managers (PMs) have had access to these in the form of a customized Tool Kit that outlines and characterizes a wide array of helpful decision aids and measures (Defense Acquisition University [DAU], 2009a), including:

- *Technology Readiness Level (TRL)*. Tempers technology insertion by measuring technology maturity; ensures technology properly finds its way into development efforts, while accounting for any associated risks; and considers performance and life-cycle factors before a technology solution is finalized (Figure 1)

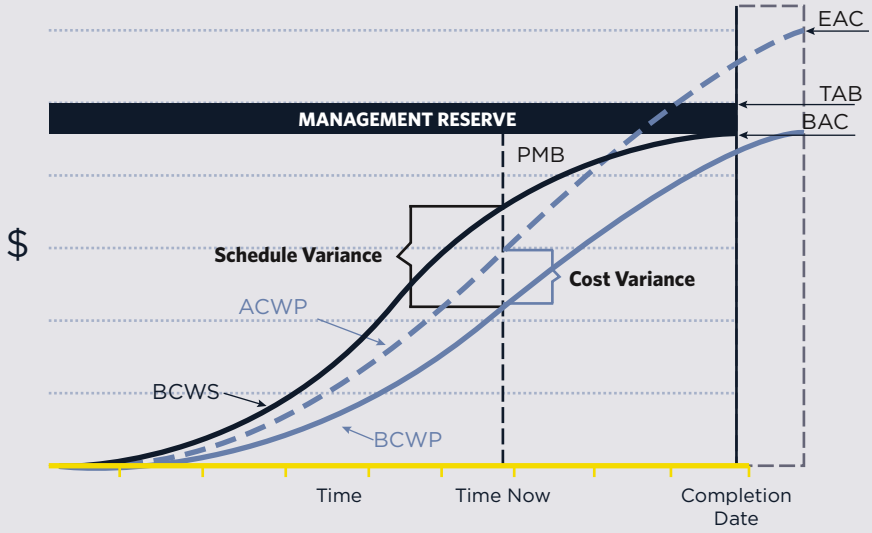
FIGURE 1. TECHNOLOGY READINESS LEVEL SCALE



(Source: Labay, 2009)

- *Earned Value Management (EVM)*. Predicts cost and schedule perturbations, provides early warning, and serves as a forecasting tool that ties itself to traceable physical work packages (under an overall Work Breakdown Structure [WBS]) (Figure 2)

FIGURE 2. EARNED VALUE MANAGEMENT (EVM) GRAPH



Note. BCWS=Budgeted Cost For Work Scheduled; BCWP=Budgeted Cost for Work Performed; ACWP=Actual Cost of Work Performed; EAC=Estimate At Completion; TAB=Total Allocated Budget; BAC=Budget At Completion
(Source: DAU, 2009b)

FIGURE 3. COST ANALYSIS REQUIREMENTS DESCRIPTION (CARD)

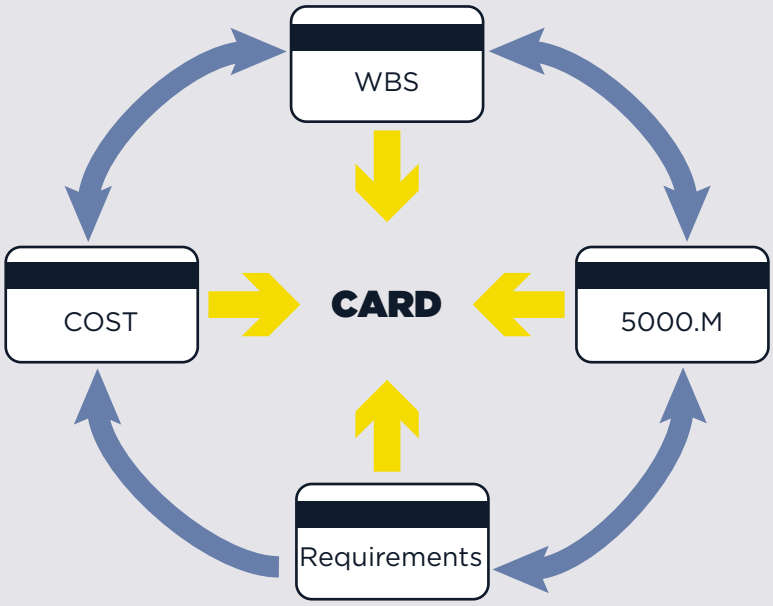


FIGURE 4. TECHNICAL AND MANAGEMENT PROCESSES

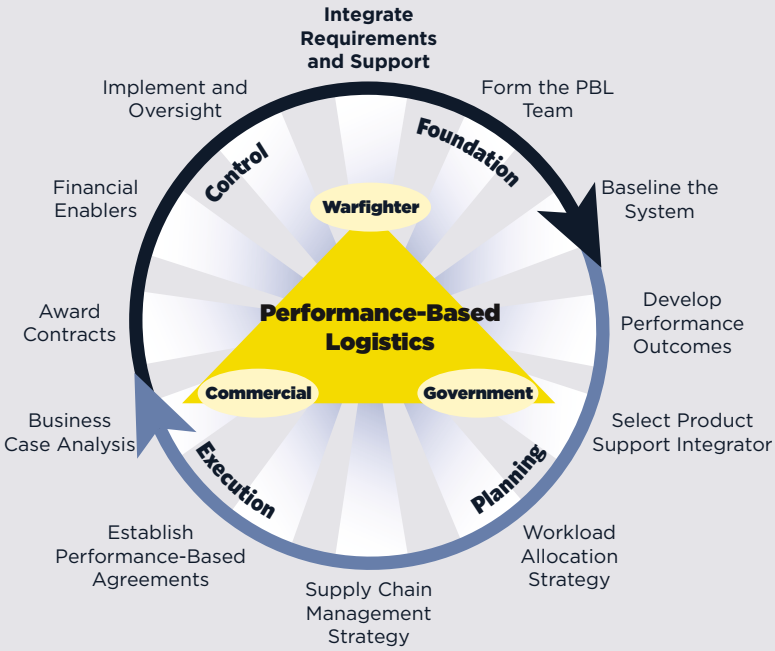
Technical Processes	Technical Management Processes
Top-Down Processes (include requirements development, logical analysis, and design solution)	Technical Planning
	Technical Assessment
Bottom-Up Realization Processes (include implementation, integration, verification, validation, and transition)	Decision Analysis
	Technical Control Processes (include requirements management, risk management, configuration management, and technical data management)

(Source: Tremaine, 2009)

- *Cost Analysis Requirements Description (CARD)*. Provides comprehensive and detailed descriptions of acquisition programs; supports Program Office Estimates (POE), Component Cost Analyses (CCA), and independent Life Cycle Cost Estimates (LCCE) (Figure 3)
- Technical and Management Processes. Ensure products properly evolve from concept to deployment; set the stage for the selection of a wide range of alternative design approaches through an integrated superset of design, assessment, and control processes (Figure 4)
- *Performance-Based Logistics (PBL)*. "Provides a means for the resource-constrained program management office to develop, implement, and manage the sustainment of a system over its life cycle" (Fowler, 2009) (Figure 5)
- *Cost as an Independent Variable (CAIV)*. Weighs affordable performance capabilities and scheduling based on cost goals that can be realized by a set of decisions that balances programmatic risks (Rush, 1997). Also serves as a trade-off tool to achieve Reduced Total Ownership Costs (Pallas & Novak, 2000) (Figure 6).

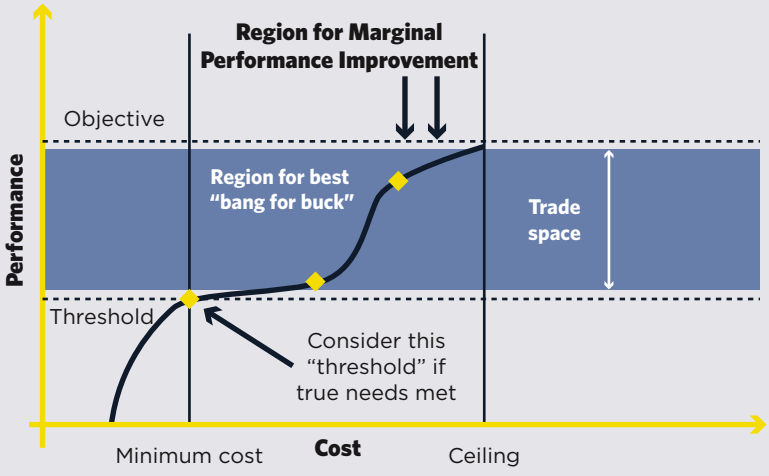
Taken together, these tools can give PMs the power to overcome many of the looming programmatic hurdles that continue to surface as often as the weather changes. Many other helpful decision aids are available and designed specifically to combat the challenges PMs face every day. Considering this wide and diverse array of decision aids, what is missing? What have we actually failed to characterize that ostensibly

FIGURE 5. PERFORMANCE-BASED LOGISTICS 12-STEP PROCESS MODEL



(Source: PBL, n.d.)

FIGURE 6. CAIV FOCUSES ON THE "KNEE OF THE CURVE"



(Source: Criscimagna, n.d.)

fuels cost growth? Why do examples keep surfacing like the MV-22 Osprey, where costs per flight hour—currently at $11,000—are expected to more than double the target estimate (Clark, 2009)? If so many variable costs can fluctuate, can they be properly tracked and addressed in time to contain costs?

One methodology in particular was expected to give truthful predictions of total costs. But, its value has presumably diminished in the face of the very dynamic and complex processes normally associated with acquisition programs in the DoD. It goes by the name *Life Cycle Cost Management (LCCM)*. Up to now, it has been used to understand both the wide array of system costs that start with a program's initial baseline and run all the way through disposal.

Discussion

Conceptually, LCCM is not new. As early as 1936, T. P. Wright had already created cost estimating equations to predict the cost of airplanes over long production runs (Hamaker, 1994). Oddly enough, many are still in use today. In varying degrees, support for LCCM continued to grow ever since. In 1975, an Air Force working group recommended five required actions to effectively institute LCCM capabilities in program offices. They recommended:

- Program offices be provided with a source of personnel familiar with analytical techniques
- Engineers and analysts be given general guidance on how to develop, adapt, and use life-cycle cost models for specific applications
- Program office and supporting personnel have access to a short course in the subject of development and application of LCC models and methods
- Periodic life-cycle cost methods workshops be held
- Program office personnel be provided with a central focus of expertise where lessons learned in each new life-cycle application are integrated with existing LCC models and methods (McKenzie, 1978).

LCCM is certainly not an underdeveloped concept, either. Over the years, a number of LCC models have surfaced to help programs fashion their overall funding profiles. Each model takes into account the broad range of a system's true costs, including its economic life, inflation rates, discount rates, total number of cost elements that comprise the system, magnitude of cost elements, and salvage value, etc. But to this day, when asked about their experience with LCC models, their applicability, usefulness, ease of

TABLE 1. VALUE OF LIFE CYCLE COST MANAGEMENT: VIEWS OF ACAT I PROGRAM MANAGERS

	ACAT I Program Managers with over 11 years of experience			
	No Experience with Model	Thoughts based on Experience with Model		
LCCM Models	Not Familiar or Not Used	Not Useful	Useful	One of the Best
ACARA	87%	2%	10%	1%
CASA	78%	2%	18%	2%
EDCAS	90%	2%	7%	1%
MAAP	89%	2%	7%	2%
FLEX	91%	3%	4%	2%
LCCA	72%	3%	22%	4%
LCCH	74%	2%	21%	3%
PRICE	73%	2%	23%	3%
ZCORE	92%	2%	3%	0%
ACEIT	70%	2%	24%	4%

Note. This table represents an opinion survey conducted for purposes of this research; the percentages represent input from 887 survey respondents, 543 of whom were current or former DoD PMs.

use, and limitations are viewed as questionable by many, including DoD's most experienced program managers (Table 1). Confidence in these models appears to have waned.

Sentiments like those expressed by the National Aeronautics and Space Administration (NASA, 2008) are common among many acquisition professionals with comparable years of experience on the subject of developing/relying upon the accuracy of LCC estimates that models like these provide.

> It involves using incomplete, inaccurate, and changing data for an outmoded & ineffective space system to derive the precise cost of purchasing an unknown quantity of an undefined new space system to satisfy an overly exaggerated and unvalidated requirement at some time in the future, under uncertain conditions, with a minimum of funds. (p. 17)

Whatever model or methodology is selected, carefully (and frequently) applying it can have a lasting effect on *cost containment*. Of

primary importance is the selection of the most suitable LCC model(s). Each characterizes a number of important variables a little differently. Nonetheless, each LCC model also has the capacity to magnify cost drivers, early and often. Regrettably, Booz Allen-Hamilton reported that the "real issue is one of obtaining the data in a timely manner and of reducing the redundant data collection effort needed every time a cost-effectiveness question arises in the decision-making arena" (Leggitt, 1981, p. 13). However, unless PMs alter their views on their usefulness and frequency of use, these models/methodologies will likely have less influence on key decisions.

Fundamentally, LCCM is actually an extraordinary concept, which is generally described through two manifestations. The first, LCC, accounts for research and development costs, investment costs, operating and support costs, and disposal costs over the system's entire Life Cycle. The LCC includes not only the direct costs of the acquisition program, but also includes indirect costs that would be logically attributed to the program. The second, Total Ownership Cost (TOC), consists of LCC elements as well as other infrastructure or business process costs not necessarily attributable to the program (DoD, 2008). Understanding all the costs and all the implications associated with LCCM may seem intimidating. So many unknowns and so many combinations and permutations come into play that can easily vary, making it difficult to quantify any system's total costs, especially when it matters most—during the birth of a program.

In 2006, to raise more awareness, DoD elevated the ranking of ownership costs to a Key System Attribute (KSA) in anticipation of drawing more attention early on (Kobren, 2009). Have we given LCCM enough attention to have an impact though? Probably not. And if not, how can we garner even more attention and emphasis on this KSA? Perhaps we should just call it what it is—Aggregate Management. After all, it aggregates everything that could possibly affect the cost of materializing anything that actually gets built and eventually fielded in the DoD.

Investment budgets are shrinking, and without additional attention, initial concepts designed to meet some requirement might take a lot longer to materialize or cost a whole lot more to produce and sustain—both problematic scenarios that we as a nation can ill afford. LCCM needs to be somehow re-energized. Increasing its use would trigger the robust part of the LCCM challenge—encouraging deeper thinking, acting more critically, and pursuing more creative methods to contain overall costs. Years earlier, Lt Gen James T. Stewart, USAF (Ret.), indicated one of the threats to cost containment and described it as "yo-yo funding" (Dapore & Bryant, 1984, p. 312) that persists even today in the DoD's Planning, Programming, Budgeting, and Execution (PPBE) process.

Exchange with Subject Matter Experts (SMEs)

The authors conducted two focus sessions with a handful of acquisition experts who teach the art and science of LCCM and cost estimating. Their experiences, combined with frequent contact with acquisition colleagues inside and outside the classroom, highlighted specific cost-containment issues that PMs face every day.

Their first meeting was with the Logistics SMEs. Each SME confirmed that LCCM issues persist. They noted LCCM considerations continue to be minimized up front where they could have the most significant impact. They also stressed any discussion on LCCM tends to be short-lived, especially further down the acquisition continuum and after initial modeling (R.Burroughs, personal communication, September 17, 2009).

To amplify the importance of LCCM, the SMEs recommended instituting an LCC breach construct (similar to the intent behind Nunn-McCurdy breaches). For example, if a program exceeded its LCC baseline by a fixed cost percentage similar to the construct established by Nunn-McCurdy, PMs would have to report any infringement to Congress. They also indicated it would be beneficial to establish a formulary similar to TRLs where a program could not proceed to the next phase until it demonstrated some minimum level of achievement (M. Sherman, personal communication, September 17, 2009). Currently, DoD expects LCC reassessments after an initial one is developed, but do these subsequent updates give enough attention to cost containment? Not explicitly.

The logistics SMEs emphasized both the lack in LCCM discipline and the absence of cross communication in programs that generally need it the most throughout a program's life cycle. They accentuated that funding allocations and key decisions typically seem to be focused on development and not sustainment. And, without a tool to respond to the dynamic nature of LCC that accounts for all costs, including Operations and Support (O&S), there will be little forewarning a sustainment breach might be close at hand (M. Sherman, personal communication, September 17, 2009).

A widely recognized tenet of DoD program management is that O&S costs constitute the majority of a program's total costs—a widely recognized tenet in DoD program management. As recently as March 2007, the Cost Analysis Improvement Group (CAIG) reaffirmed that "projected O&S costs average 60-65 percent of projected life-cycle costs after reviewing 34 Major Defense Acquisition Programs, or MDAPs (CAIG, 2007). Just as strikingly, at the end of a program's research and development effort and just prior to production or operations, 95 percent of the cumulative LCC has already been committed (DOE, 1997). So, is the lack of attention actually warranted in subsequent life-cycle phases given the questionable ability to influence O&S costs? The authors suspected so, but were anxious to hear and consider divergent views from the Budget, Cost, and Financial Management experts.

The authors next met with four Budget, Cost Estimating, and Financial Management (BCEFM) SMEs. This group echoed the same sentiment voiced by the Logistics SMEs: Sustainment tends to get minimized early in the development phase. However, they added that the "ilities" are generally not well-defined. They stated LCCM typically suffers from a lack of sufficient cost detail to adequately address sustainment costs that predominate once systems find their way into operations (R. Morig, personal communication, September 22, 2009).

The BCEFM SMEs quickly reached a consensus on one of the major obstacles to cost containment. They stated funding instability makes cost containment an insurmountable prospect. Already faced with many other daily programmatic challenges, they asserted that funding instability, typically manifested by perpetual budget cuts, creates a gyrating funding baseline on top of other strategic concerns including:

- Industry partners who are not necessarily motivated by cost containment
- Frequent changes in requirements
- Internal staffing shortfalls that are sometimes tough to fill
- Lack of certain key functional experience in program offices
- Cultural realities that emphasize program survival over program affordability.

The BCEFM SMEs also affirmed if PMs found a cost metric that had a strong influence in controlling costs well after the "truthful predictions," it would be widely used and could perhaps help contain costs (J. Rego, personal communication, September 22, 2009). EVM satisfies the forecasting piece of the equation, but without specific and practical motivational methods that help contain costs, its usefulness is questionable. So, do those specific methods exist today? The answer is yes. Contract incentive strategies are one of many tools available, and have been used extensively in DoD to help curb some of the escalating technical risks and associated costs. However, they have tended to provide more short-term gains than the ones needed for longer term, and more enduring outcomes in the past few years, especially when technology maturity is so fluid (GAO, 2005).

LCC IN PRACTICE TODAY

Today, in the context of containing costs in acquisition programs in the DoD, PMs are compelled to address LCCM across their program's life cycle. As mentioned earlier though, well before a PM's arrival much of the projected life-cycle costs for future systems or products is rooted in decisions made during the early phases of advanced planning and conceptual design (Blanchard, 1992). Consequently, initial LCC assessments

have always been a key component of a program's "go/no go" decision process since they address a program's affordability, and are ultimately dependent on the military department's (or agency's) ability to secure the necessary funding. Each military department and agency gives LCCM a lot of attention at the beginning of a system's life cycle. However, in addition to LCCM concerns, military departments and agencies must balance today's operational needs with future requirements, and not neglect more capable systems still in various stages of development—designed to either boost current system performance or meet new warfighter/user requirements.

LCC projections are not expected to be dormant once PMs take charge. Title 10 of the United States Code § 2434 requires the Secretary of Defense to consider an independent Life Cycle Cost Estimate (LCCE) before approving Engineering and Manufacturing Development (EMD), or Production and Deployment (P&D) of an MDAP. In practice, LCC gets looked at closely via an assortment of predictive analyses (probabilistic and deterministic) that sometimes can be difficult to absorb. So much so, that it is generally left to the experts to decipher. Very few PMs ever find themselves digging into LCC parameters. Besides, they have the experts in their respective program offices who analyze and weigh the output. Even so, many variables make it sometimes difficult for even the experts to fully quantify. The experts, who generally populate the models with key assumptions, do their best to leverage the behavior of analogous systems. Still, quantifying all the assumptions is a daunting task when so many parameters are so variable or have not been captured or qualified. Ultimately, the responsibility resides with the PM to embrace LCC estimates, but do they and their staffs revalidate these estimates on a more routine basis? Do they dive deeper into the basis of the original LCC estimate and make any necessary adjustment(s) to contain costs?

PMs recognize that LCC generally starts out with an "inferred" cost-containment element before their programs leave the initial approval process gate. What happens later is a combination of art and science mixed with some uneasiness. PMs are expected to quantify the anticipated costs of their development system across the Future Years Defense Program (FYDP). For ACAT IC and ID programs, LCC is carefully revisited by Congress in the context of Program Acquisition Unit Cost (PAUC) when costs escalate by at least 15 percent or more of the current baseline, or 30 percent or more over the original baseline (DAU, 2009a, p. 31). While operational costs can be extrapolated as a derivative, they seem to be temporarily suspended from the equation since operational costs cannot yet be easily reconciled. What happens further down the acquisition trail for most programs does not necessarily force PMs to either necessarily challenge the assumptions that were part of the original LCC equation or consider that LCC is such a dynamic process.

After Milestone B (formal initiation of an acquisition program), PMs tend to narrow their focus on managing their programs day-to-day. This

day-to-day strategy is about program survival. PMs dwell on cost, schedule, and performance parameters in the face of too little funding, too little schedule flexibility, and too many technology hurdles. If LCC models are seen as an initial forecasting apparatus only to give a reasonable grounding of all known costs—but not necessarily designed to contain costs—how could cost, schedule, and performance become more tightly integrated into the overall LCCM equation? And, what about CAIV? Where does it fit in? As originally envisioned, CAIV was designed to give PMs the flexibility to balance all the factors that could help contain costs—but has it? What do PMs have to say about CAIV? How are LCC and CAIV related? Are they related? What do PMs think about these questions? Their perspectives follow.

Survey Findings

The objective data generated by this opinion survey confirmed what some earlier studies found in LCCM. In addition, the data offered quite a few other interesting perspectives as well, especially in the way PMs view LCCM and CAIV regarding cost-containment principles. The survey also reinforced how PMs unevenly apply LCCM principles and cost-containment strategies across their programs.

Even though the opinions expressed in this survey were based on fundamental beliefs, opinions invariably drive decisions since they are inextricably linked to "experiences"—an imperative in the DoD's acquisition enterprise, and one of the key factors designed to help meet the certification requirements of the acquisition corps. In other words, opinions matter in the acquisition profession when such opinions are steeped in years of acquisition experience. Burrowing into the invaluable experiences that have shaped DoD's current PM workforce can also be a very meaningful bellwether. In this particular survey, PMs provided specific narrative comments that acknowledged certain cost-containment hurdles. The survey also found a couple of misconceptions regarding the use and usefulness of some of these cost-containment tools in the Tool Kit. The discussion that follows addresses noteworthy findings.

LCC MODEL FAMILIARITY AND EXPERIENCE

When 887 PMs were asked to rate the LCC models that they had previously used, many were simply unfamiliar with the models. Provided below are representative comments from the opinion survey results (Table 1).

> Sorry, just not that familiar with the models. Somebody else uses them and provides data to me.

As a PM, I have not been involved with the detailed execution of the specific model used to derive cost estimates. In many instances, costs and cost estimates were derived from legacy numbers of the previous program.

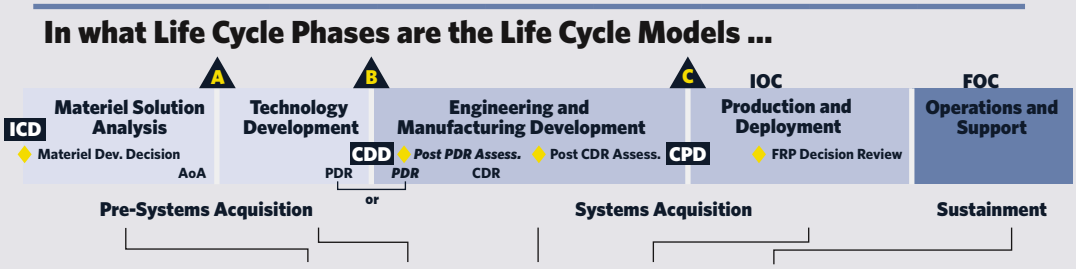
To be honest, not my field of expertise, and I am only familiar with the tools to the extent my team uses them.

I have no first-hand knowledge of any of these systems/models.

USEFULNESS OF LCC MODELS

PMs believed that the P&D and O&S phases are better predictors of costs, while the Technology Development (TD) and EMD phases are generally the most influential in driving decisions. Contrary to what the DoD would prefer, they did not believe the pre-acquisition phases (Materiel

TABLE 2. LIFE CYCLE PHASES WHERE LIFE CYCLE COST MODELS MADE AN IMPACT: VIEWS OF ACAT I PROGRAM MANAGERS



	MSA	TD	EMD	P&D	O&S	None	DK
a good cost predictor?	14	19	59	68	67	45	31
most influential in driving decisions?	45	66	91	41	34	20	28
suitable for cost containment?	15	28	52	64	48	56	33
significantly underestimated?	65	82	107	58	60	18	32

Note. MSA=Materiel Solution Analysis; TD=Technology Development; EMD=Engineering and Manufacturing Development; P&D=Production and Deployment; O&S=Operations and Support; None=No Model is a Good Predictor; DK= Don't Know Which Model is a Good Predictor.

Solution Analysis and TD) are suitable for cost containment given their inability to qualify let alone quantify some of the major "unknowns." More importantly, by the time their programs entered EMD, a large number of PMs declared that LCC models have significantly underestimated costs. PMs also stated these models need more precision in the early stages of program initiation since they drive so many future decisions (Table 2). Organizations like the CAIG recommended that PMs should seek more research that focused on "scrubbing development and procurement, more detailed analysis of sustainment profiles, and identification of causal factors" (CAIG, 2007).

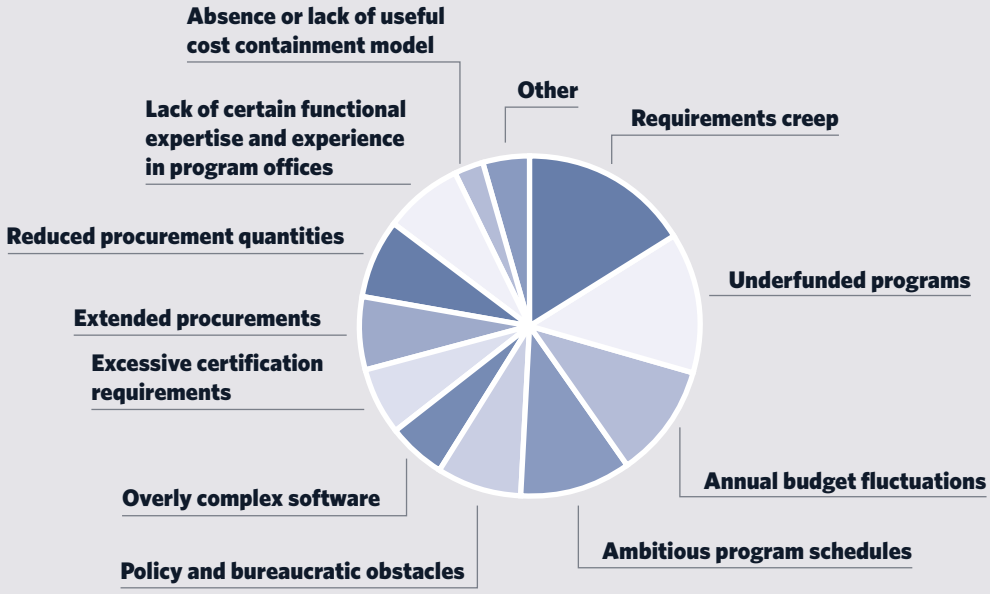
Representative Narrative Comments. A sampling of comments on the way PMs view LCCM and its cost-containment principles follows.

> Most models have many assumptions, and those assumptions are not monitored over time; and risks are not addressed to keep the assumptions valid, so the models are not valuable when decision makers really need the information.
>
> LCC for O&S appears to be generally unrealistic.
>
> As programs proceed along their life cycle, LCC doesn't seem to be appropriately updated.
>
> LCCM never captures changes allowed/forced on programs, and fails to "predict" well. Models are used early on, but eventually lose influence as "inertia" takes over and programs enter "make the best of it mode."
>
> Overly optimistic estimates.
>
> No one seems to put the thought and time into a thorough estimate of determining LCC.
>
> No one seems to update LCC and use it as a yardstick.

MAJOR OBSTACLES TO COST CONTAINMENT

Of the many typical challenges that PMs face, five obstacles accounted for a noticeable majority of the reasons that made cost containment difficult to overcome. Those five standing in the way included requirements creep, underfunded programs, annual budget fluctuations, ambitious program schedules, and too many policy and bureaucratic obstacles (Figure 7).

FIGURE 7. PROGRAMMATIC OBSTACLES THAT MAKE COST CONTAINMENT DIFFICULT TO OVERCOME: VIEWS OF ACAT I PROGRAM MANAGERS

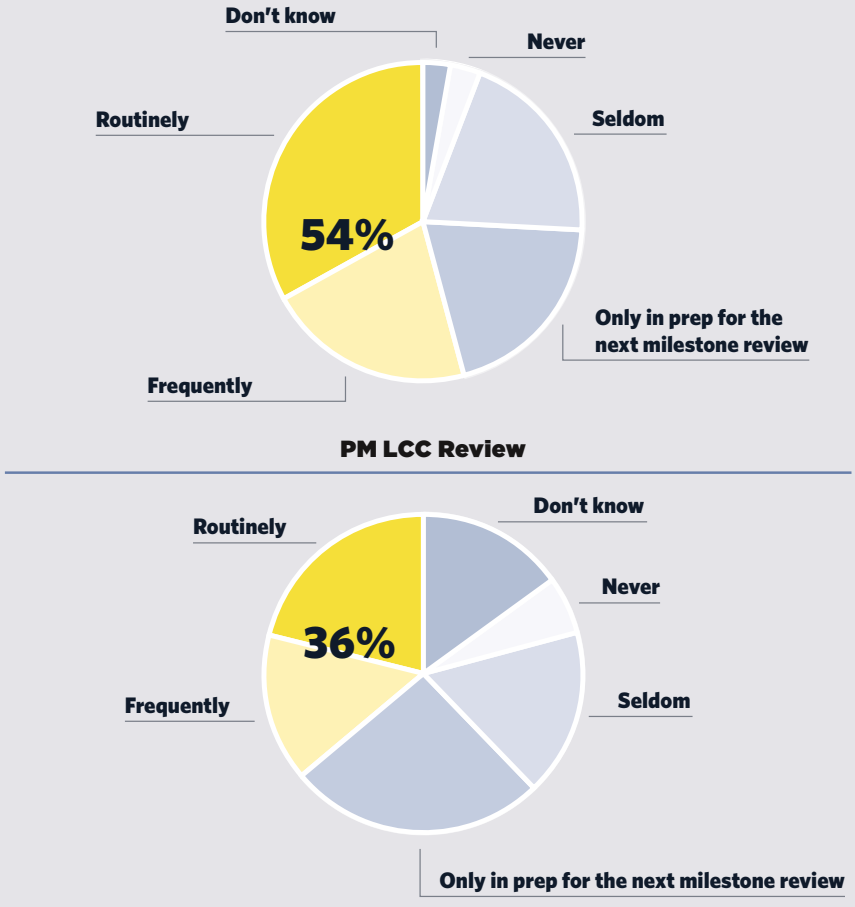


REVISIT RATES FOR LCC ESTIMATES

Despite whether revisiting LCC estimates was viewed as a burden or resource constraint, about half of the PMs routinely or frequently reviewed their program's LCCs unless in preparation for an upcoming milestone review (Figure 8). While a great forcing function, performing LCC updates only in preparation for the next milestone is probably too late to significantly influence cost containment. However, PEOs and/or senior managers showed even less interest in LCC estimates other than preparation for the next milestone (Figure 8). Without more frequent and intensive reviews by either PMs or PEOs, the ability to make cost adjustments becomes more difficult to defend.

Representative Narrative Comments. A sampling of comments on revisiting LCC highlights this seemingly low level of interest in LCC estimates other than for milestone reviews.

FIGURE 8. REVISITING LIFE CYCLE COST ESTIMATES: VIEWS OF ACAT I PROGRAM MANAGERS



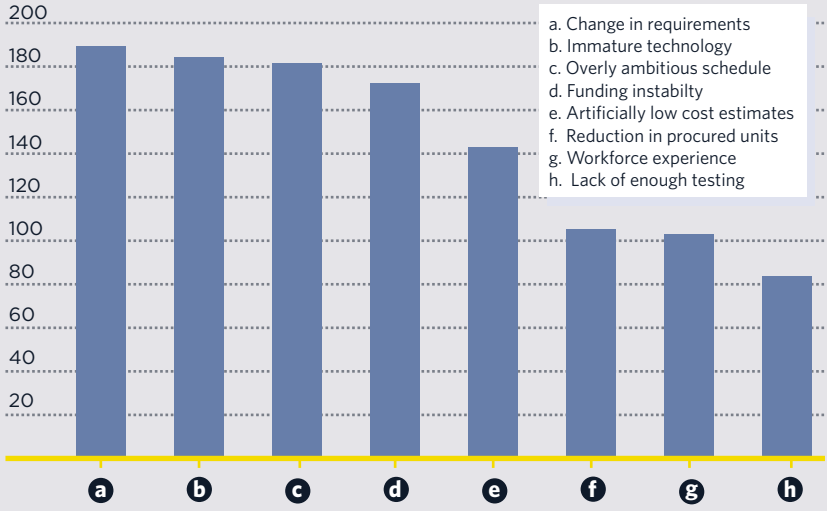
The costs that are of the most concern to me are those in the immediate execution year. I have considered out-year costs but not as much as I should have.

My focus is on providing most capability within budget, not on future life-cycle costs.

General knowledge on cost containment among all program office personnel is very low.

Many of the cost growths are based on not really understanding the requirements and instead based on assumptions on both sides.

FIGURE 9. HOW COST DRIVERS RANK IN ORDER OF SIGNIFICANCE: VIEWS OF ACAT I PROGRAM MANAGERS



SIGNIFICANT COST DRIVERS

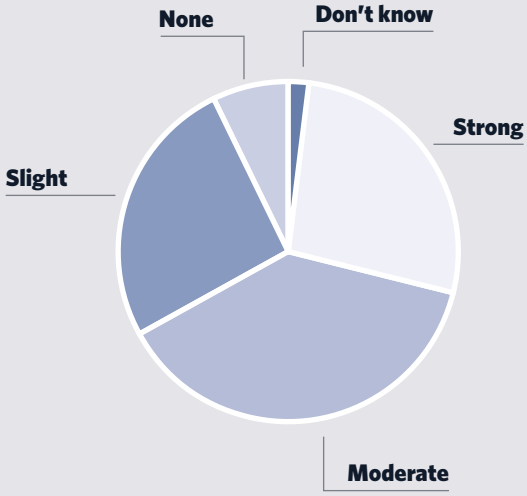
Identifying and knowing the significance of key cost drivers are paramount. Otherwise, the ability to contain costs could easily weaken. When asked how they would rate the significance of many of the classic cost drivers, PMs expressed that immature technology, funding instability, changing requirements, artificially low cost estimates, and overly ambitious schedules were the most significant (Figure 9). With the addition of artificially low cost estimates and too many policy and bureaucratic obstacles, these were the same obstacles that made cost containment difficult to overcome when an even wider selection of survey choices was posed to PMs in an earlier question (Figure 1).

CONNECTION BETWEEN CAIV AND LCC

CAIV is another key tool available to help contain costs as previously discussed. It gives PMs a flexible instrument to help quantify the undeniable relationship(s) between certain performance requirements and realistic cost constraints. However, only 65 percent of the PMs acknowledged either a "strong" or "moderate" connection to LCC (Figure 10). Subsequently, PMs might see CAIV as a quick fix only and not fully appreciate the extent of the long-term gain; not believe there is a long-term gain; or perhaps not fully believe in the concept as a whole.

Representative Narrative Comments. A sampling of comments on the relationship

FIGURE 10. STRENGTH OF CONNECTION BETWEEN CAIV AND LCC: VIEWS OF ACAT I PROGRAM MANAGERS



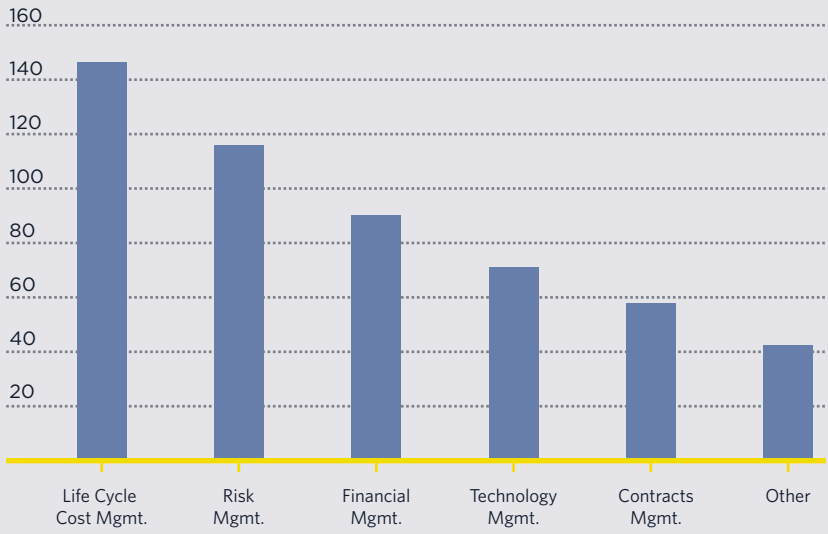
between CAIV and LCC shows a program management community less comfortable with CAIV as a cost control tool.

> Strong in theory but weak in practice.
>
> I think the relationship between LCC and CAIV has been diminished.
>
> I've never seen CAIV used to contain costs on a program.
>
> I don't believe CAIV has anything to do with CAIV. It's an artificial constraint that prevents the PM from meeting the requirements.
>
> I didn't see CAIV used in any organized way because hardly anyone on the PM team has enough practical experience.
>
> Unfortunately, the CAIV tool of last resort became common to overcome cost overruns due to funding stability and poor execution.
>
> CAIV trades are rarely supported by the requirements community. The requirements community is 99 percent focused on capability and mildly interested in long-term O&S cost-reduction efforts.

TRAINING CHALLENGES

PMs stated a need for additional training, primarily LCCM and Risk Management training, to help them better contain costs (Figure 11).

FIGURE 11. ADDITIONAL TRAINING NEEDED TO BETTER CONTAIN COSTS: VIEWS OF ACAT I PROGRAM MANAGERS



Recommendations

To reconcile some of the shortcomings of LCC and, just as importantly, better prepare PMs to contain costs and achieve more successful acquisition outcomes, the authors of this research recommend the following:

- Take the chill out of cost containment and re-energize LCCM. Make it everyone's business. Even though PMs cannot serve as LCC experts, they and their teammates should know the basis of their own LCC estimates throughout their program's life cycle, and not wait until the next milestone to make any necessary adjustment(s).
- Elevate LCC to a KPP (Key Performance Parameter)—it will compel more PMs and senior personnel to rigorously exercise LCCM principles. Establishing LCC as a KSA is not enough.
- Continuously challenge assumptions.
- Base cost decisions on programmatic realities and more current data since these influence LCC outcomes.
- Establish an LCC Continuous Learning Model (CLM) that amplifies the objectives and characteristics of an LCC model, and identifies the family of LCC models that best apply where, how, and when.

- Add an LCC best practice link to each functional Community of Practice (CoP) where PMs can learn from others.
- Establish LCCM trip wires throughout a program's life cycle, and do not penalize PMs for reporting unfavorable but essentially accurate program information to seniors or higher headquarters.
- Reward and incentivize PMs for containing and/or lowering costs.
- Develop cost-containment strategies that are carefully evaluated and painless to execute.
- Embrace innovation and dismiss mundane strategies that guarantee less-than-optimal outcomes.
- Promote more CAIV. Conceptually, CAIV was placed into the acquisition arsenal to give PMs a little more latitude with performance versus cost trade-offs. As ADM Mike Mullen, USN, Chairman of the Joint Chiefs of Staff, recently said at the Program Executive Officer/Systems Command Commanders' Conference at Fort Belvoir, Virginia, on November 4, 2009, "The acquisition community and the warfighter will have to jointly accept the 80 percent solution…we have to be realistic with what we can afford." (Mullen, 2009).
- Let PMs lead. PMs have the knowledge, skill, and ability to carefully guide their programs in the face of a complex and difficult environment.

Conclusions

This research reinforced the many contrasting perspectives that PMs possess with respect to cost containment and their ability to influence and/or control it. As originally conceived, understanding the usefulness and criticality of LCCM can have a major impact on weapons systems developments by keeping a lid on rising costs—a growing necessity. The acquisition environment will invariably change. Budgets will shrink; fewer new systems will be built and fielded; more pressure will be exerted on extending and sustaining current systems; and more pressure can be expected on containing costs—*much* more pressure. The remaining weapons systems under development will come under political fire. As external scrutiny swells, programmatic decisions will be challenged since there will be so much more information immediately available about emerging systems. So, how can PMs once and for all silence the skeptics and achieve positive acquisition outcomes? For starters, they can shock the critics by challenging the programmatic "cost status quo" at every juncture and not

just the major milestones. They can no longer "kid themselves" about what something is going to cost, as Under Secretary of Defense for Acquisition, Technology and Logistics Ashton Carter recently stated (Carter, 2009). They can increase programmatic "cost accuracy" by better understanding and re-energizing one key cost-containment practice that has seen less action or become ineffective in recent years—LCCM. Inarguably, yo-yo funding will continue. Poor outcomes need not. DoD cannot afford more of the same. Changes to DoD 5000.02 that now call for Preliminary Design Reviews (PDR) prior to Milestone B, and earlier measured prototyping to lower out-year costs will go a long way. Warfighters need every penny applied to capability, not cost overruns. Ultimately, PMs and their staffs must be more introspective and tightly integrate the art and the science of containing costs in the face of global economic changes. It's time to take the chill out of containing costs. DoD depends on it; our nation depends on it; and the warfighters need to count on it.

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APPENDIX

List of Abbreviations and Acronyms

AoA	Analysis of Alternatives
ACAT	Acquisition Category
ACWP	Actual Cost of Work Performed
ADM	Admiral
BAC	Budget at Completion
BCEFM	Business, Cost Estimating, and Financial Management
BCWP	Budget Cost for Work Performed
BCWS	Budget Cost for Work Scheduled
CAIG	Cost Analysis Improvement Group
CAIV	Cost as an Independent Variable
CARD	Cost Analysis Requirements Description
CDR	Critical Design Review
EAC	Estimate at Completion
DAU	Defense Acquisition University
CDD	Capability Development Document
CPD	Capability Production Document
DoD	Department of Defense
DOE	Department of Energy
EMD	Engineering and Manufacturing Development
EVM	Earned Value Management
FOC	Full Operational Capability
FRP	Full Rate Production
FYDP	Future Years Defense Program
GAO	Government Accountability Office
ICD	Initial Capabilities Document
IOC	Initial Operational Capability
KPP	Key Performance Parameter
KSA	Key System Attribute
LCC	Life Cycle Cost
LCCE	Life Cycle Cost Estimate
LCCM	Life Cycle Cost Management

Lt Gen	Lieutenant General
NASA	National Aeronautics & Space Administration
O&S	Operations and Support
PAUC	Program Acquisition Unit Cost
PBL	Performance-Based Logistics
PDR	Preliminary Design Review
PM	Program Manager
POE	Program Office Estimate
MDAP	Major Defense Acquisition Program
P&D	Production and Deployment
PEO	Program Executive Office
PPBE	Planning, Programming, Budgeting, and Execution
Ret.	Retired
SME	Subject Matter Expert
SYSCOM	Systems Command
TAB	Total Allocated Budget
TD	Technology Development
TOC	Total Ownership Cost
TRL	Technology Readiness Level
USAF	United States Air Force
USN	United States Navy
WBS	Work Breakdown Structure