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COST AS A MILITARY REQUIREMENT

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The Center for Public Policy and Private Enterprise at the University of Maryland's School of Public Policy provides the strategic linkage between the public and private sector to develop and improve solutions to increasingly complex problems associated with the delivery of public services—a responsibility increasingly shared by both sectors. Operating at the nexus of public and private interests, the Center researches, develops, and promotes best practices; develops policy recommendations; and strives to influence senior decision-makers toward improved government and industry results.

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Executive Summary

In 1916, Frederick Lanchester theorized that the power of a military force is proportional to the square of the number of its units. Despite technological advances in military weaponry, Lanchester's basic observation—that quantity is essential to military success—remains true today. Yet weapons system performance is frequently prioritized over affordability during the development process. As a result, Department of Defense (DoD) programs must often reduce planned quantities in order to stay within budget. Ironically, the expensive, yet marginal increases in system performance that result, measured in terms of their contribution to overall military effectiveness, could have been achieved by acquiring a greater number of less capable systems.

Today, new and frequent mission changes are fueling the increasing costs for both goods and services. At the same time, there is little doubt that the DoD will see significant budget cuts in the coming years. Given these conditions, the DoD must reorient its priorities so that it is able to acquire essential systems in the required quantities.

In a resource-constrained environment, the unit cost determines the quantity of systems that can be acquired. We contend that the DoD should make unit cost a contract requirement and, therefore, a critical design requirement. Moreover, we believe that, in addition to schedule and performance, cost should be explicitly represented within the trade space; rather than merely designing to cost, program leadership would have the flexibility to trade higher performance for lower costs provided that the objectives of the program were maintained.

Establishing the cost for a product prior to its development is not a new idea. In the commercial sector, this approach, known as *target costing*, was first introduced in Japan in the early 1960s. Today, it is widely used by firms throughout the developed world. Whereas cost traditionally has been considered an outcome of product development, target costing treats it as an input. The target cost for a product is determined using a simple formula: Target Cost = Estimated Selling Price - Desired Profit. Target costing promotes creativity and new ways of thinking to increase performance while discouraging the inclusion of non-value-added functions. As a result, today's

customers are able to purchase lower cost, higher quality products that meet their needs (e.g., personal computers, smart phones, and automobiles).

Admittedly, there are significant challenges that must be overcome in order for a cost requirement to be viable. In the commercial sector, product development is market driven. Firms spend considerable sums in order to better understand what the customer is willing to pay for a product; thus, a firm that adds extraneous features of little added value to the customer are punished in the market.

The defense market, however, is characterized by very few firms (in most sectors, simply an oligopoly of suppliers) and only one customer (i.e., a monopsony). Because weapons systems are contracted for in advance of their production, the contractor is generally not incentivized to translate the diffuse desires of the customer—in this case, the DoD—into an effective and efficient product. Rather, the DoD specifies requirements upfront, and in great detail, for fear that they may never be developed. In fact, there is frequently a perverse incentive to "gold-plate" products by adding every desired feature, to include some of little marginal value. This is especially true within the context of complex product developments, where neither the DoD nor the contractor have full knowledge of the attributes and capabilities of the end product.

Despite these challenges, the DoD must strive to approximate the approaches to cost management that are used by commercial firms. Too often, the perceived uniqueness of the defense market is used to justify relaxed policies with regard to cost control. However, the commercial sector's experience indicates that holding fixed the required cost of a product is not only a possibility but a preferable strategy in today's competitive market.

In its effort to control the cost of weapon systems, the DoD has recently implemented a number of strategies, including, most notably, Cost as an Independent Variable (CAIV) and, more recently, Should Cost/Will Cost. These initiatives have aimed to replicate the success of commercial practices but have stopped short of imposing a cost requirement.

Developed in the 1990s, CAIV strives to elevate the importance of cost within the trade space (i.e., the region within which modifications to achieve the maximum balance between cost, performance, and schedule resides). The goal of CAIV was to shift this emphasis from performance to cost, allowing variance in performance and schedule so that cost can be better maintained (Kaye, Sobota, Graham, & Gotwald, 2000). However, CAIV has had little discernible impact on program cost growth.

Under the second strategy, Should Cost/Will Cost, two separate cost estimates are developed: a non-advocate *will-cost* estimate, which provides the official basis for budgeting and programming and a *should-cost* estimate for program management execution (Davies & Woods, 2011). The official budget baseline for the program is based on the non-advocate will-cost estimate, which is typically developed by the Office of the Secretary of Defense's (OSD) Cost Assessment and Program Evaluation office, or CAPE. CAPE estimates are typically derived by taking into account the costs of analogous (historic) programs. In contrast, the should-cost estimate is based on what the program manager believes is possible within "the context of creative, innovative, and disciplined measures to increase productivity" (Sledge, 2012, p. 1). In preparing their should-cost estimate, managers are encouraged to identify cost savings without relying on previous templates; rather, a should-cost review "attempts to break the cycle of historical-based cost estimation by challenging existing cost structures" (Sledge, 2012, p. 2).

Unfortunately, it does not appear that Should Cost/Will Cost provides managers with much incentive to build cost savings into their programs. On the one hand, program managers are required to budget to the historically based, and higher, will-cost figure; on the other hand, they must drive their suppliers to the lower should-cost estimate. Retired Army Colonel Nathanial Sledge (2012) writes that the new approach "reduces their management trade space, making it more challenging to demonstrate year-over-year progress" (p. 2). In other words, a program manager who works "to achieve a baseline of should-cost initiatives is shooting himself or herself in the foot" (Sledge, 2012, p. 3).

Currently, the DoD has little recourse should the unit cost of a weapon system exceed initial estimates. Typically, in such cases, the DoD is already heavily invested in the product; often, walking away is deemed more costly than paying the additional costs. In order to hold fixed the unit cost of a weapon system, cost must be defined as a key performance parameter (KPP), or an "attribute or characteristic of a system that is considered critical or essential to the development of an effective military capability" (DoD, 2011). Often, a KPP has a threshold, which represents the required value, and an objective, which represents the desired value. Typically, the DoD writes contracts so that the delivery of KPPs is a binding requirement.

However, in order for Cost as a Military Requirement to be effective, there are additional steps that must be taken. The success of target costing in the commercial sector relies on a series of proven practices, including (1) reliance on cross-functional development teams; (2) adherence to incremental product development; and (3) the use of pre-manufactured components and subcomponents. These practices, and the structures that enable them, exist within the DoD. However, they are often used inconsistently.

Typically, the DoD does not implement a cost requirement. However, there have been some notable exceptions, such as the Joint Direct Attack Munitions (JDAM) program and the Global Hawk. In the case of the JDAM, a price ceiling of $40,000 per unit was one of the program's seven KPPs. In the case of the Global Hawk, the cost requirement of $10 million per unit was expressed as a mere objective.

Adopting a cost requirement proved essential to the JDAM program's successful outcome. The contractor's system was priced at just over $14,000 per unit, a savings of 67%, or $2.9 billion (Grasso, 1996). Moreover, its success makes clear the benefits of certain practices, namely, the effective use of competition, a minimal requirements regime, the use of commercial off-the-shelf (COTS) components, and cross-functional integrated product teams (IPTs). Today, the average per-unit production cost, adjusted for inflation, remains about the same (GlobalSecurity.org, 2011).

In the case of the Global Hawk, the program was designed to undergo multiple blocks of development; the most important goal of each block was to remain within the cost requirement of $10 million per unit and to keep the program on schedule. Following the operational success of the first iteration (i.e., the RQ-4A), the Air Force decided to design a new, larger, and more capable variant of the Global Hawk, known as the RQ-4B. Originally, the RQ-4B components were to be 90% compatible with the A model. Desiring even more capability, the Air Force altered the requirements to produce a significantly larger B variant. Ultimately, the B variant as designed, when compared to the A, would carry a 50% larger payload, fly for two hours longer, and retain the approximate 10,000 nm range. While these were marginal requirement shifts from the original design, the deviations necessitated major reengineering. The development of the RQ-4B project was to be funded with the original budget for the 4A; however, the Air Force removed cost as a requirement, relegating it to a consideration. Many independent commentators have regarded the Global Hawk RQ-4A program as a great success. However, the restructured Global Hawk program has faced significant cost and schedule difficulties.

Based on our review of target costing and our examination of two defense programs that relied on fixed cost ceilings, we have developed the following recommendations.

- **The DoD must reorient its priorities such that cost (with militarily acceptable performance) takes precedence over higher performance at all costs.**
  According to Cooper and Chew (1996), in the commercial sector, "all design-team members, whatever their functional specialty, must regard the overall final cost target as an unalterable commitment" (p. 96).

- **The Under Secretary of Defense for Acquisition, Technology, and Logistics (USD[AT&L]) should designate a series of pilot programs that define cost as a KPP**.
  Pilot programs would demonstrate the effectiveness of Cost as a Military Requirement while helping to identify challenges and barriers. Cost as a Military Requirement should then be expanded accordingly. In conjunction with the pilot programs, the USD(AT&L) should institute an expedited process for the Federal Acquisition Regulations (FAR) and Defense Federal Acquisition Regulation Supplement (DFARS) waivers in order to maximize program trade space and program flexibility and to promote localized decision-making.

- **DoD programs should expand the use of cost-focused IPTs to all program phases.**
  A key factor in the success of target costing in the commercial sector is the use of cross-functional teams. These teams work to ensure that the required performance is achieved

within the cost target. DoD policy should continue to emphasize the importance of IPTs in meeting program objectives by ensuring that teams include representatives with a user perspective as well as those with a cost versus performance understanding. Accordingly, under Cost as a Military Requirement, the IPT works to ensure that the cost KPP is met and, thus, that the required quantities can be procured.

- **DoD programs should rely on competition in order to constrain life-cycle costs.**
  In order to meet a product's target cost, contractors may be tempted to pay less attention to the impact of product design (especially with regard to reliability and maintainability) on life-cycle costs. To promote product efficiency (e.g., reduced maintenance costs, reduced fuel consumption) the DoD should promote competition during the design phase in order to minimize built-in costs. Moreover, the JDAM case demonstrated the effectiveness of inserting government personnel into competing contractor IPTs during multi-stage proposal preparations. Trusting relationships were built early on, and decisions could be made quickly. In the end, JDAM program officials were able to choose between two efficient system designs that were priced well below the established target. Finally, competition should be maintained during the production phase in order to ensure that the contractor continues to meet cost, schedule, and performance requirements.

- **DoD programs should require contracts to include warranties in order to promote product reliability.**
  The use of warranties, particularly in a competitive environment, incentivizes the contractor to build reliable, quality products and helps to ensure that when trade-offs are made, quality will not be sacrificed to satisfy the cost requirement. Warranties will also incentivize continuous process improvement, as the contractor seeks to minimize their costs providing warranty support.

- **DoD programs should assign threshold requirements (from minimally acceptable to highly desired) for performance.**

> By promoting threshold requirements, DoD programs will maximize their trade space and ensure that they are not chasing what Norman Augustine (1997) referred to as the last 10% of performance (which he contended generated one third of the cost and two-thirds of the problems). When the DoD uses this approach in conjunction with incremental development, system performance can be improved over time. And, by stressing continuous improvement (a key underpinning of the commercial sector’s target costing process), increases in performance can actually be achieved at lower cost.

Today, the military is often unable to acquire weapons systems in the intended quantities because of program cost growth. The DoD has reduced its orders of F-22s and F-35s by hundreds of aircraft. Reductions of this sort will lead some to believe that our military is underprepared to face threats to our national security or, perhaps, that the need for the specified capability was exaggerated to begin with. Cost as a Military Requirement not only helps to solve the cost growth problem but also ensures that the military is able to acquire sufficient quantities of essential systems, thus improving public opinion and enabling our men and women in uniform to successfully carry out their missions.

I. Introduction

The rising cost of new weapons systems beyond their initial estimates has long been a concern for the Department of Defense (DoD). In 1982, it was reported that average weapons systems' cost growth (adjusted for inflation) was 5-6% per year during the 1970s (Singer, 1982). In 1993, RAND found that since the 1960s, there was no substantial reduction in the rate of cost growth, despite numerous initiatives to address the issue (Drezner, Jarvaisse, Hess, Norton, & Hough, 1993). In a more recent RAND report, published in 2007, Arena, Leonard, Murray, and Younossi (2006) examined 46 completed weapons systems programs over the course of three decades, between 1970 and 2000. The study compared the costs at major acquisition decision milestones with their initial cost estimates. Arena et al. (2006) found that the average adjusted total cost for a completed program grew (i.e., exceeded the initial estimate) by 46%. Arena et al. (2006) then examined the extent of cost growth by decade and concluded that among completed and ongoing programs, each decade saw similar increases in program cost.

This persistent cost growth can be traced to numerous factors, including over-optimism, estimating errors, unrecognized technical issues, requirements creep, a lack of incentives to control cost, quantity changes, and schedule extensions. And, although these challenges have been studied and understood for decades, government initiatives have not been able to control costs. One need only look to the F-35 (Joint Strike Fighter), the DoD's most important aircraft program. The program acquisition unit cost for the F-35 (i.e., the cost of development and procurement amortized across the expected production run) has skyrocketed from the initial estimate of $50 million per aircraft, to over $161 million today (Government Accountability Office [GAO], 2012).

Perhaps an even greater challenge is the unit cost of DoD weapon systems, which has also increased significantly over time. Take, for example, the unit cost of high-performance aircraft programs, which has grown at an exponential rate. In 1984, Norman Augustine made an intriguing, if not alarming, prediction:

> In the year 2054, the entire defense budget will purchase just one aircraft. This aircraft will have to be shared by the Air Force and Navy 3½ days each per week

> except for leap year, when it will be made available to the Marines for the extra day. (p. 12)

Indeed, the DoD's spending on aircraft, past and present, is in line with this prediction (see Figure 1). Augustine's 16th law casts into sharp relief the rather simple notion that as the cost of a given system increases, fewer can be acquired. And yet, military leaders often prioritize performance over cost. Often, if a technology that can enhance a system's performance is within reach (or even on the distant horizon), program leaders opt to include it, believing that the added performance justifies the cost.

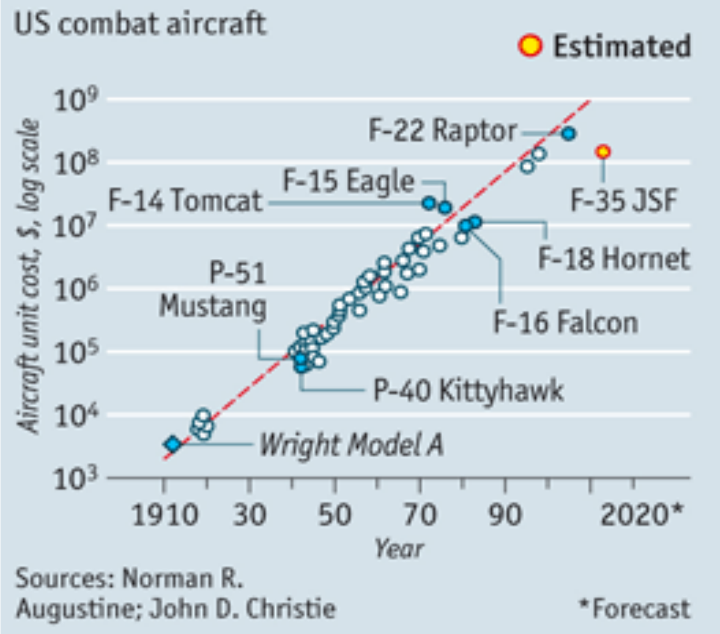


Figure 1. Augustine's 16th Law
("Defence Spending in a Time of Austerity," 2010).

However, when it comes to cost-performance trade-offs, the calculus is not so straightforward. In 1916, Frederick Lanchester (1916) theorized that the power of a military force is proportional to the square of the number of its units. In theory, then, a force of 15 pieces of artillery will have a nine-fold advantage (in terms of relative effectiveness) over a force consisting of five pieces. Even within the context of modern warfare, technical superiority cannot compensate for an insufficient quantity of weapon systems. Or, as Vladimir Lenin is reported to have said, “quantity has a quality all of its own” (Dunnigan, 2003).

Yet, because affordability is not typically given adequate attention during the design and development process, DoD programs often must reduce planned quantities in order to stay within their planned budgets. The Air Force’s air superiority fighter, the F-22 Raptor, suffered this fate. As costs increased, quantities were reduced, causing program costs (adjusted for quantity) to increase, which, in turn, triggered further reductions in quantity. Originally, the Air Force planned to order 750 F-22s at a cost of $26.2 billion (Williams, 2002). Beginning in 1991, the Air Force reduced its order to 650 aircraft, then to 438 in 1994, and finally down to 183 in 2011. As late as 2006, the costs continued to climb from $361 million per aircraft, to $412 million per aircraft in 2012 (GAO, 2011). In the end, the F-22 was not procured in the numbers required to replace the F-15s. Moreover, the F-22, although praised by DoD officials and pilots alike, included far fewer capabilities than originally planned.

New and frequent mission changes are fueling a greater diversity of acquisitions. At the same time, there is little doubt that the DoD will see significant cuts in the coming years. As the DoD adjusts to these reduced budgets, it will operate within a global security environment that continues to present a wide range of threats. Not only must the DoD continue with its operational commitments (e.g., currently in Afghanistan), but there are other instabilities caused by the continued evolution of transnational terrorism, the proliferation of weapons of mass destruction, the growing cyber threat, as well as potential regional threats.

In order to acquire essential systems in the required quantities, the DoD must control both a system’s unit cost as well as its life-cycle costs. Some past DoD initiatives have attempted to reduce costs through indirect means. For example, Cost as an Independent Variable (CAIV) is an approach to reducing costs by allowing program personnel to balance schedule and performance trade-offs in order to meet cost goals (Boudreau, 2006). CAIV helps ensure that the *trade space*—i.e., the region within which modifications to achieve the maximum balance between cost, performance, and schedule resides—is the foundation for decision-making (Frittman & Edson, 2010). In principle, this approach seems promising. We agree that flexibility with regard to schedule and performance should be built into a contract so that trade-offs can be made as development progresses. At the same time, we contend that the DoD should consider taking this approach a step further by making unit cost a contract requirement.

Report Approach

The DoD continues to struggle to contain the costs of its weapons programs. We believe that placing upper limits on per-unit costs while injecting flexibility into the decision-making process could allow the DoD to bring costs under control. In this report, we examine the potential for elevating unit cost to a contract requirement. In the next section, we examine the commercial sector's approach to establishing product costs prior to development. We also describe past DoD strategies to control costs. Next, in Part III, we describe the supporting practices that can be used in conjunction with a cost requirement. In Part IV, we examine two DoD programs, the Joint Direct Attack Munition and the Global Hawk, in order to gain insight into how, and in what contexts, cost as a requirement can be effectively used to achieve savings. In Part V, we discuss implementation strategies. Finally, in Part VI, we provide our recommendations and concluding remarks.

II. Background

Establishing the cost for a product prior to its development is not a new idea. In the commercial sector, this approach, known as *target costing*, was first introduced in Japan in the early 1960s. Today, it is widely used by firms throughout the developed world.

Whereas cost traditionally has been considered an outcome of product development, target costing treats it as an input. The target cost for a product is determined using a simple formula: Target Cost = Estimated Selling Price – Desired Profit. However, target costing is not merely the imposition of a cost ceiling. As Zengin and Ada (2010) pointed out, "manufacturers cannot make a trade-off between cost, quality, and functionality of the product with only cost considerations in mind" (p. 5594). Indeed, in today's competitive global markets, a business that pursued such a strategy would quickly fold. Rather, target costing, as a strategy, promotes creativity and new ways of thinking to increase performance while discouraging the inclusion of non-value-added functions. As a result, today's customers are able to purchase lower cost, higher quality products that meet their needs. Cooper and Chew (1996) described the logic behind target costing as follows: "Looking at today's marketplace, the organization maps customer segments and targets the most attractive ones…and then determine[s] what level of quality and functionality will succeed within each segment, given a fixed target price, volume, and launch date" (p. 1). Gordon (2000) noted that many firms use target costing "as a way to focus on managing costs, rather than recovering costs through some form of cost-plus pricing mechanism" (p. 169).

After the target cost is determined, it must be apportioned among the many internal cost centers, including marketing, manufacturing, general and administrative, logistics, distribution, as well as the price of purchased items (Ellram, 2006). Following this high-level allocation to features or functions, costs are further apportioned at the level of the individual component, material, or service.

Mihm (2010) observed that "target costing does *not* require perfect knowledge about the component" (p. 1334). Fairly accurate component cost estimates can be developed via systematic value analyses of comparable existing parts (Mihm, 2010). And whereas the target cost of the product remains firm throughout the development process, component cost estimates are permitted to fluctuate as product development evolves. Typically, each product feature is ranked in terms of its relative importance. Some firms may go as far as to assign specific numeric weights to each feature. These weights are then used to determine where the firm can adjust costs while maintaining, or even enhancing, the product's value (Ellram, 2006). In order to ensure the inclusion of the most valuable features, the target cost of one component may be increased while that of another is reduced. The most successful firms continually rely on their sense of customer value as the basis for their cost-allocation decisions (Cooper & Chew, 1996). Indeed, even after the product is released, firms strive to increase the product value and incorporate any improvements into future iterations. Even within a single iteration, firms work to improve the manufacturing and other processes in order to reduce costs. The target costing process is summarized in Figure 2.

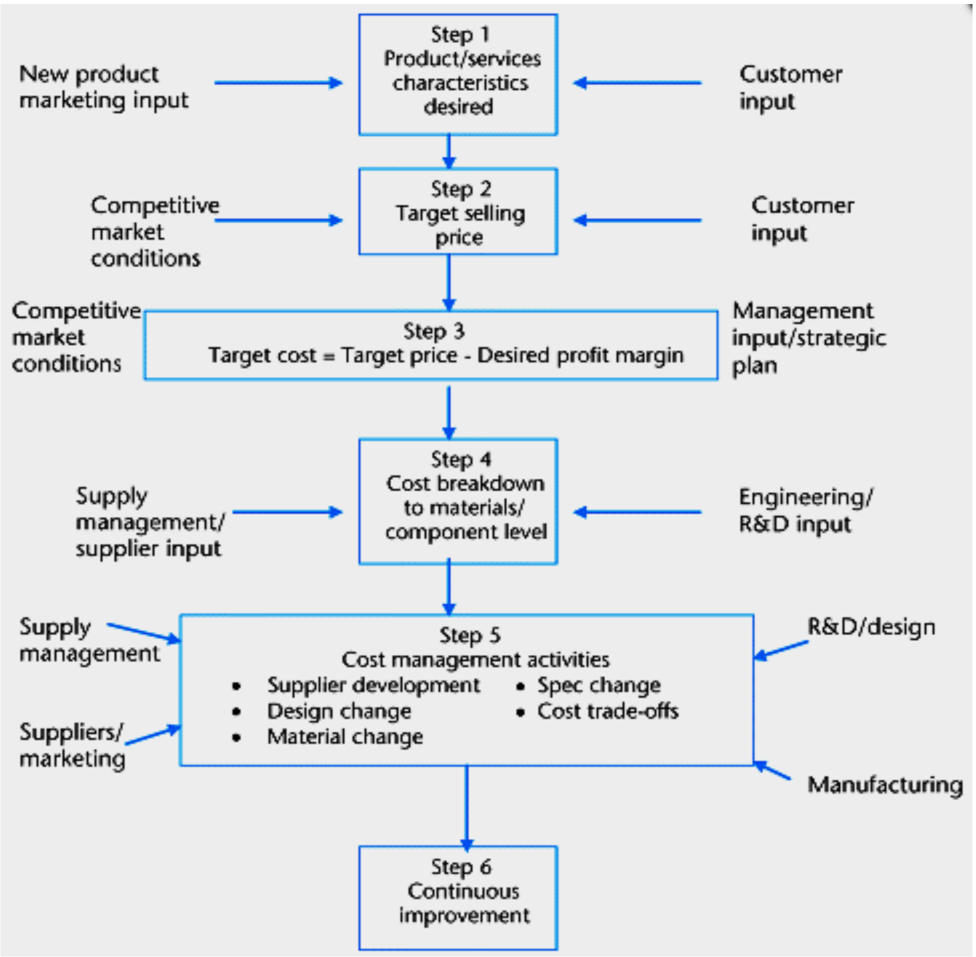


Figure 2. Target Costing Process
(Ellram, 2006)

The automobile industry illustrates the benefits of target costing. With relatively few new manufacturers gaining ground in the market, reliability, cost, and performance are all major contributors to the quantity of vehicles a manufacturer sells. Accordingly, components and potential material solutions are stringently analyzed in terms of their cost and value to the customer. It is no mystery that the Japanese firm Toyota has had considerable, prolonged success, largely on account of its costing approach. Indeed, when asked why Toyota is a top-selling car company, everyday Americans readily respond that it offers customers higher quality at lower cost.

Today, virtually every successful commercial firm employs a cost-driven approach to product development. For a variety of reasons, the DoD has been reluctant to do the same. But given current and impending budgetary constraints, it may soon have little choice in the matter. Admittedly, there are significant challenges that must be overcome in order for a cost requirement to be viable. In the commercial sector, not only is product development cost-driven, but it is also market driven. Firms spend considerable sums in order to better understand what the customer is willing to pay for; a firm that adds extraneous features of little added value to the customer is punished in the market.

The defense market, however, is characterized by very few firms and only one customer (a monopsony). Because weapon systems are contracted for in advance of their production, the contractor is generally not incentivized to translate the diffuse desires of the customer—in this case, the DoD—into an effective and efficient product. Rather, the DoD specifies requirements upfront, and in great detail, for fear that they may never be developed. In fact, there is frequently a perverse incentive to “gold-plate” products by adding every desired feature, including some of little marginal value. This is especially true within the context of complex product development, where neither the DoD nor the contractor fully understands the attributes and capabilities of the end product.

Even though product marketing input is less of a determinant in the cost of DoD systems, the DoD’s input can play a large role. Indeed, Figure 2 suggests that both types of input—product marketing and customer input—are essential. In the commercial sector, large retailers such as Wal-Mart have significant control over their supply bases because they have considerable buying power. Ellram (2006) noted that even in the manufacturing sector, large firms like Dell might be able to dictate pricing to companies like Intel. In the same way, the DoD must use all available strategies (e.g., competitive dual-sourcing) to leverage its size and buying power and exert downward pressure on the cost of weapons systems.

The pace of technological innovation is another example of market forces at work within the commercial sector. The accelerating rate at which new personal computers, smartphones, and MP3 players appear on store shelves is as much a function of new technology (creating the demand for new capabilities) as it is the accumulation by industry of users' feedback and desires, the essential core of which is reflected in the design of the product. Once the two processes—user input and technological innovation—merge, an uninterrupted loop spurs ever increasing gains in efficiency and performance. Because development is incremental, commercial firms are typically well positioned to estimate costs.

Firms can further refine the accuracy of these estimates by relying on standardized components that are manufactured by other firms (Rush, 1997). Carmakers, for instance, often use standardized components because they are cheaper than built-to-order parts and generally come with a warranty, which reduces the manufacturer's cost of long-term operations and support while maintaining the reliability of their products.

For the DoD, it is often more challenging to pursue an incremental approach to development because the customer base for each product is relatively small and systems have relatively long life cycles. It can also be more challenging to incorporate COTS components into defense systems; barriers to their use include proprietary interfaces, stringent military environmental requirements, and continued cultural resistance.

These challenges notwithstanding, the DoD must strive to approximate the approaches to cost management that are used by commercial firms. Too often, the perceived uniqueness of the defense market is used to justify relaxed policies with regard to cost control. However, the commercial sector's experience indicates that holding fixed the unit cost of a product is not only a possibility but also a preferable strategy in today's competitive market. Although competition within the defense market is less fierce in some respects, the cost constraints faced by the DoD are no less significant. Following, we examine two of the DoD's previous initiatives to control cost. Both initiatives incorporate some recognized commercial-sector strategies; however, neither approach establishes cost prior to development.

Previous DoD Initiatives

In its effort to control the cost of weapon systems, the DoD has recently implemented a number of strategies, including, most notably, Cost as an Independent Variable (CAIV), and, more recently, Should Cost/Will Cost. We describe these two strategies in the following sections.

Cost as an Independent Variable

Developed in the 1990s, CAIV strives to elevate the importance of cost within the trade space. All acquisitions are assessed based on their cost, schedule, and performance. Collectively, these three parameters make up the trade space. Historically, performance has received the most emphasis and is often considered the independent variable. The other two parameters (i.e., the dependent variables) were varied as the program progressed in order to maintain the desired performance. The goal of CAIV was to shift this emphasis from performance to cost, allowing variance in performance and schedule so that cost can be better maintained (Kaye, Sobota, Graham, & Gotwald, 2000). In short, this strategy attempted to create a cost-saving environment by emphasizing the importance of cost as well as flexibility with regard to performance and schedule.

Under Design to Cost (DTC), the predecessor to CAIV, the primary focus centered on meeting the projected average unit procurement costs. It has been argued that DTC led managers to focus on reducing near-term production costs, to the exclusion of system life-cycle costs. However, under CAIV, program managers take into account the estimated complete life-cycle cost of the program and adjust cost and performance accordingly. Moreover, there is specific recognition that the best time to reduce life-cycle costs is early in the acquisition process (Land, 1997, p. 27; see Figure 3). In fact, according to Newnes et al. (2008), "50-70% of the avoidable costs of a product are in-built within the concept design stage" (p. 100). Similarly, research by Kluge (1997) suggested that most of the complexity in a product (and, thus, its cost) is generated by its design and not by customer demand. According to Kluge (1997), "Complexity can, therefore, often be reduced without customers noticing much difference in the finished item … for instance, by standardizing parts and subassemblies" (p. 214). CAIV encourages program managers to, when appropriate, spend more money upfront in an effort to reduce production or operations and support costs.

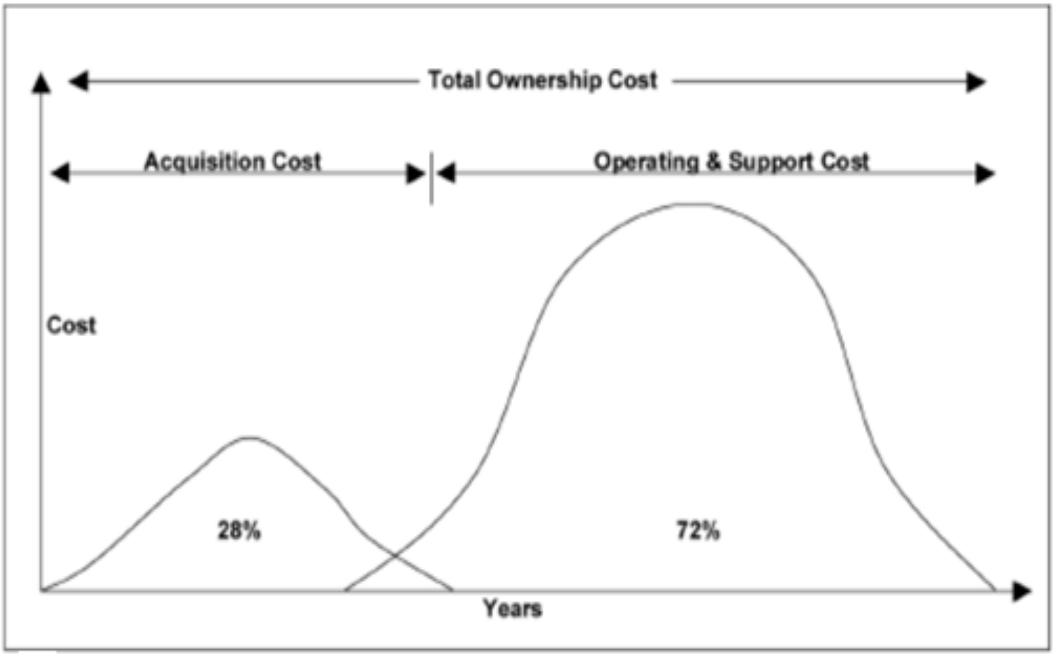


Figure 3. Acquisition Cost Versus Operating & Support Costs
(DoD, 2011)

The key tenets of CAIV, according to the DoD's *Defense Acquisition Deskbook* (1999), are as follows:

- Requirements are stated in terms of capabilities and may be exchanged, substituted, or adjusted for the sake of another. Capabilities should be established at the system level and not at lower levels.
- Early and continuous customer/warfighter participation in setting and adjusting program goals throughout the program is imperative.
- Trade space (i.e., cost gradient with respect to performance) around the cost objective is encouraged.

- Realistic but aggressive cost objectives are set early and updated for each phase of an acquisition program.
  (p. 37)

In 2002, then Under Secretary of Defense for Acquisition, Technology, and Logistics (USD[AT&L]) Edward "Pete" C. Aldridge Jr. required that all Acquisition Category (ACAT) 1 programs use CAIV in order to control costs. In retrospect, however, it does not appear that use of the CAIV approach has achieved the desired results. To the contrary, a number of programs that relied on CAIV experienced, and continue to experience, major cost overruns. In the early 1990s, the DoD selected eight programs to serve as CAIV flagships. These programs, it was believed, would demonstrate how this initiative could contain costs. In 1999, the GAO identified additional program offices that were "leaders" in the application of various acquisition best practices, one of which was the CAIV approach (p. 22).

Selected Acquisition Reports (SARs) from 2010 featured five of the original flagship programs mentioned previously: the AIM-9X Sidewinder missile, the MIDS communications terminal, the JASSM cruise missile, the F-35 Joint Strike Fighter, and the SBIRS satellite program. The SARs also featured two of the programs that the GAO identified in 1999: the Advanced Amphibious Assault Vehicle (which is now known as the Expeditionary Fighting Vehicle, or EFV), and the Advanced Medium-Range Air-to-Air Missile (AMRAAM). The changes in quantity and the percentage change in cost (adjusted for quantity) for each of these programs are provided in Table 1.

Program	**Change in Quantity**	**Percent Change in Program Cost (adjusted for quantity)**
AIM-9X	+93	+12.7%
MIDS	+1,666	+11.5
SBIRS	+1	+151.4%
JASSM	-429	+64%
JSF	-409	+58%
EFV	-432	+169.3%
AMRAAM	+2390	+40.6%

Table 1. CAIV Programs Cost Growth
(*Note*. The information in this table is from GAO, 1999, and Selected Acquisition Reports from 2010.)

None of the programs is below the initial estimated cost. In fact, among the seven programs, costs have grown by 47.6% on average—just slightly over the historic statistic (46%) cited in the 2007 RAND report referenced previously. Based on the wide range of percentages in Figure 3, one is led to conclude that the CAIV initiative is having little discernible impact, positive or negative, on program cost growth. Moreover, it is clear that CAIV does not enable the acquisition of planned quantities. In fact, if the JASSM, JSF, and EFV programs were to revert to their initial planned quantities, the percent change in cost would be significantly higher. Minimizing restrictions within the trade space by treating cost as an independent variable is a good first step. However, in practice, it appears that this approach did not go far enough.

Should Cost/Will Cost

Implemented by then-USD(AT&L) Ashton Carter in 2011, the Should Cost/Will Cost approach was devised in response to anticipated national budgetary constraints identified by Congress. As of 2011, all ACAT I, II, and III programs use this approach. Simply put, Should Cost/Will Cost identifies low-value, high-cost elements of a program and seeks to increase value or decrease costs.

Under this approach, two separate cost estimates are developed: a non-advocate *will-cost* estimate, which provides the official basis for budgeting and programming, and a *should-cost* estimate for program management execution (Davies & Woods, 2011). The official budget baseline for the program is based on the non-advocate will-cost estimate, which is typically developed by the Office of the Secretary of Defense's (OSD) Cost Assessment and Program Evaluation office, or CAPE. CAPE estimates are typically derived by taking into account the costs of analogous programs. In contrast, the should-cost estimate is based on what the program manager believes is possible within "the context of creative, innovative, and disciplined measures to increase productivity" (Sledge, 2012, p. 1). In preparing their should-cost estimate, managers are encouraged to identify cost savings without relying on previous templates; rather, a should-cost review "attempts to break the cycle of historical-based cost estimation by challenging existing cost structures" (Sledge, 2012, p. 2). Accordingly, a should-cost estimate can include alternative material solutions, the trading of subcomponents, or reductions in performance expectations (Carter, 2011). Under Should Cost/Will Cost, program managers pay close attention to the difference between the should-cost and will-cost estimate. At every milestone decision, the difference is calculated and used as a criterion by which to evaluate the program.

According to a 1972 report by the Army Safeguard Office, "cost growth, the positive difference between ultimate cost and initial cost, is a function of the prevailing incentive systems, and incentive systems can be changed" (p. 3). Unfortunately, it does not appear that Should-Cost/Will Cost provides managers with much incentive to build cost savings into their programs. On the one hand, program managers are required to budget to the historically based and higher will-cost figure; on the other hand, they must drive their suppliers to the lower should-cost estimate. Retired Army Colonel Nathanial Sledge (2012) writes that the new approach "reduces their management trade space, making it more challenging to demonstrate year-over-year progress" (p. 2). In other words, a program manager who works "to achieve a baseline of should-cost initiatives is shooting himself or herself in the foot" (Sledge, 2012, p. 3).

Should Cost/Will Cost has other disadvantages. For instance, the will-cost estimate is created early in the program and is therefore prone to inaccuracy for a multitude of reasons, including unstable requirements and unknown sourcing. Because program "savings" under Should Cost/Will Cost are expressed as the difference between the two estimates, an inaccurate will-cost estimate can make achieving cost savings impossible, or even too easy. Either way, one cannot help but think that the outcome is somewhat artificial.

Finally, because system requirements are fixed but cost is not, it is virtually impossible to trade higher performance for lower costs. Just as it has in the past, this limitation will lead to the initiative's eventual demise.

Cost as a Military Requirement

The disappointing realization of the two initiatives described earlier can be attributed to the same underlying cause: individual and agency goals are not always aligned with those of the DoD. Often, over-budget or underperforming programs are allocated more resources because it is assumed, perhaps correctly, that the program costs were estimated improperly or that the technology was less mature than originally believed. Either way, it is difficult to hold program personnel accountable because it is typically impossible to parse the factors that account for the success or failure of a program. Accordingly, program personnel may be more concerned with reducing personal risk, or justifying their position within the program, than with reducing costs. A binding cost requirement may be the only way to effectively reduce the costs of complex acquisitions. In any case, it is clear that simple appeals to "cost culture" will have little to no impact on the bottom line (Mihm, 2010, p. 1334).

Currently, the DoD has little recourse should the unit cost of a weapon system exceed initial estimates. Typically, in such cases, the DoD is already heavily invested in the program; often, walking away is deemed more costly than increasing program funding. In order to hold fixed the unit cost of a weapon system, cost must be defined as a KPP, or an "attribute or characteristic of a system that is considered critical or essential to the development of an effective military capability" (DoD, 2011). Often, a KPP has a threshold, which represents the required value, and an objective, which represents the desired value. Typically, the DoD writes contracts so that the delivery of KPPs is a binding requirement.

According to Augustine's 15th law, "the last 10% of performance generates one third of the cost and two-thirds of the problems" (Augustine, 1997, p. 54). Attempting to incorporate higher performance also leads to delays because once a certain level of performance is thought possible, an even higher level is deemed desirable. In order to break this cycle, Cost as a Military Requirement not only imposes a price ceiling but also demands that cost be explicitly represented in the trade space. In other words, developers may trade higher performance for lower cost provided that the prescribed initial system capabilities are maintained.

However, in order for Cost as a Military Requirement to be effective, there are additional steps that must be taken. Some of these steps can be accomplished by simply incorporating features of the previous DoD initiatives, which, when combined with a cost requirement, have the potential to be successful. Of foremost importance, the DoD must define the operational requirements of a system in terms of required performance capability, as opposed to a detailed set of specifications. In other words, the DoD should refrain from detailing *how* to achieve critical performance requirements. This affords contractors more flexibility with regard to design, materials, and sourcing. Moreover, defining requirements in this way incorporates the creativity and bottom-up approach envisioned by the Should Cost/Will Cost initiative. Second, as with CAIV, the DoD must seek to develop realistic cost estimates that take into account post-production costs. Given the complexity and unprecedented nature of defense projects, this will no doubt be challenging. Before tackling the challenges that are unique to the DoD and the defense market, we examine some of the proven commercial-sector practices that facilitate the target costing approach.

III. Supporting Practices

The success of target costing in the commercial sector relies on a series of proven practices, including (1) reliance on cross-functional development teams; (2) adherence to incremental product development; and (3) the use of pre-manufactured components and subcomponents. These practices, and the structures that enable them, exist within the DoD. However, they are used inconsistently. In the following sections we examine these three commercial-sector practices as well as their analogs within the DoD.

Cross-Functional Teams

The literature on target costing strongly advocates the use of cross-functional teams for development efforts. Ibusuki and Kaminski (2005) state that it is important to establish a team-based organization that integrates essential disciplines such as marketing, engineering, manufacturing, purchase, and finance in order to develop a quality product that meets cost and performance requirements. Ramanan (2000) wrote that target costing "requires that all the key players, such as design engineers, process planning engineers, market personnel, and management accountants have early involvement with a product" (p. 403). He also noted that team members of various backgrounds must come together to provide information about products [based on] incomplete design data" (p. 403). Similarly, Ellram (2006) asserted that in order to most effectively resolve any gaps between target cost and actual cost, companies should rely on cross-functional teams. More broadly, Ramanan (2000) asserted that target costing is most appropriate in an organization "where cross-departmental communication is easily facilitated" (p. 403).

In the 1990s, the DoD also began to rely on cross-functional teams in the form of integrated product teams (IPTs). The *DoD Integrated Product and Process Development Handbook* defined an IPT as "a multidisciplinary group of people who are collectively responsible for delivering a defined product or process" (OUSD[AT&L], 1996, ch. 10.3). According to the *Handbook*, the IPT is composed of people who plan, execute, and implement life-cycle decisions for the system being acquired (OUSD[AT&L], 1996). This group can include contractors, stakeholders, and other empowered representatives from all of the functional areas of the product, including those involved with the design, manufacturing, test and evaluation (T&E), and logistics personnel. The customer should generally also be included. The *Handbook* states that "because the activities relative to a system's acquisition change and evolve over its life cycle, the roles of various IPTs and IPT members evolve" (OUSD[AT&L], 1996, ch. 10.3). Moreover, "when the team is dealing with an area that requires a specific expertise, the role of the member with that expertise will predominate; however, other team members' input should be integrated into the overall life-cycle design of the product" (OUSD[AT&L], 1996, ch. 10.3). Some teams may assemble, often in ad hoc fashion, to address a specific problem and then become inactive or even disband after accomplishing the task in question. An example of a program management office IPT structure used to acquire a military vehicle is provided in Figure 4.

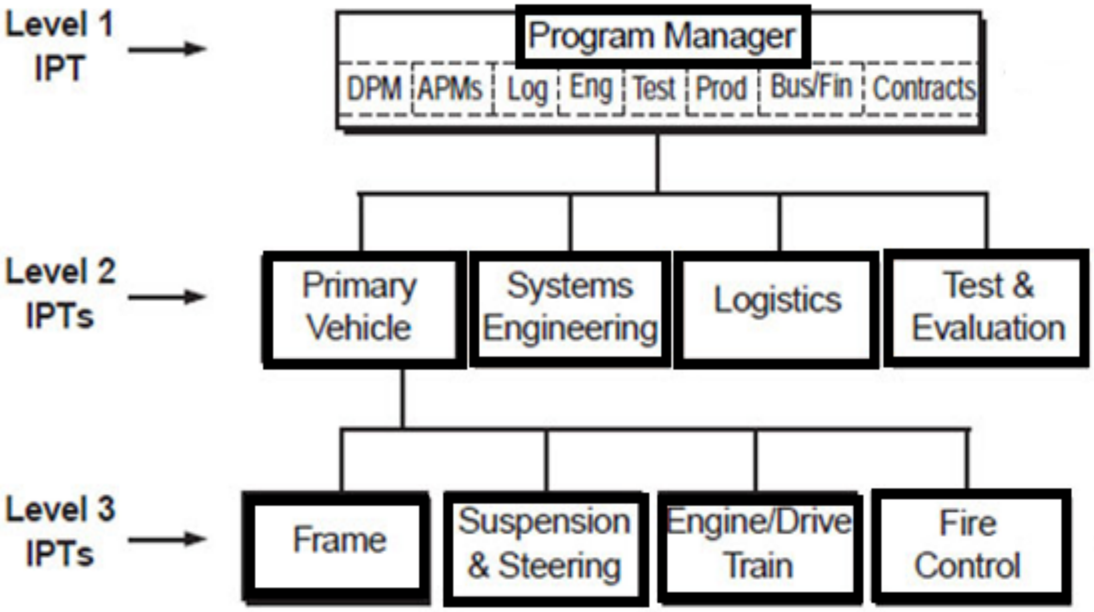


Figure 4. Example of a Program Management Office IPT Structure
(DAU, 2011)

As Dillard (2008) pointed out, the IPT philosophy has also come to inform command and control tactics, with emphasis being placed on transmitting essential information to the tactical edge. Both on and off the battlefield, the DoD has begun to recognize the advantage of empowering lower level personnel in order to "transfer knowledge and power to the point of an organization's interaction with its environment" (Dillard, 2008, p. 261). Research in organization theory (e.g., Engwall, 2003; Thomas & Buckle, 2004) supports the DoD's move to decentralize control via the empowerment of lower level entities.

Incremental Development

One major reason that target costing is effective in the commercial sector is because firms can incorporate user feedback, mature technology, and new innovations into their products. And they are able to do so because their products are developed and released incrementally. In the private sector, progressively more sophisticated versions of, for example, the iPhone are released by Apple in response to near-continuous consumer demand. Incremental development, then, is as much a consequence of commercial market demand as it is a good business strategy.

Tom Gilb (1976) was among the first to discuss and promote incremental development, which he referred to as "evolutionary." He described the process in his book, *Software Metrics*. Although he was discussing the development of software, the same process is relevant to the development of other types of products. Gilb (1976) wrote:

> "Evolution" is a technique for producing the appearance of stability. A complex system will be most successful if it is implemented in small steps and if each step has a clear measure of successful achievement as well as a "retreat" possibility to a previous successful step upon failure. You have the opportunity of receiving some feedback from the real world before throwing in all resources intended for a system, and you can correct possible design errors. (p. 28)

Incremental development is naturally resistant to requirements creep (i.e., the addition of new features without increases in resources, schedule, or budget) because firms face constant pressure to release a new iteration of a product before their competitors. Similarly, firms resist incorporating new technology into their designs because their engineers face firm schedule constraints. According to Gomory (1989), "engineers need new ideas that snap into the skills they already have" (p. 102). Gomory went on to state that "Perhaps the hardest kind of knowledge for engineers to absorb is work done at research universities—work that is potentially useful but that appears to them at an early stage of development or that simply is packaged in a form alien to the product team" (p. 102). Gomory (1989) characterized incremental—or, to use his word, "cyclic"—development as follows:

> There is no brand new product here, no revolutionary technology. Cyclic development is a competition among ordinary engineers in bringing established products to market. The contest is between my car and your car, not my car and your helicopter. Another way of saying this is that production is a relentless race, not a collegial puzzle. The company works assiduously to refine the product, customize it for more and more consumer segments, make it more reliable, or get it to market more cheaply. (p. 101)

Obviously, a product can only be refined to a point; eventually, a new product relying on a new technology will come to replace the older one. Incremental development, then, is a double-edged sword. On the one hand, it facilitates target costing because it relies on mature technologies that have established costs, and it is resistant to requirements creep and gold-plating. On the other hand, there is the potential for an "innovation death spiral," which, according to Allen (2011), occurs when "a company gets stuck throwing all its resources at incremental innovation" (p. 2).

In biology, gradualism—the theory that evolution occurs uniformly by steady transformation—is often contrasted against punctuated equilibrium, according to which species will exhibit little evolutionary change for most of their geological history. When significant evolutionary change does occur, the theory asserts that it is restricted to rare and rapid events of speciation. These two theories track closely to innovation and product development in the commercial sector, where both types of evolution occur.

The DoD, for its part, has made several efforts to rebalance its acquisition strategy to reflect the steady transformation that characterizes much of the commercial sector. Prior to 2008, the DoD relied on two, somewhat different approaches: spiral development and incremental development. These two approaches were part of a larger strategy, referred to as *evolutionary acquisition*, which, for several years, has been the preferred DoD strategy for rapid acquisition of mature technology for the user.

Within the context of Cost as a Military Requirement, the difference between spiral and incremental development is significant. Under the spiral development approach, end requirements—even for the initial increment, or spiral—were not typically known at program inception. Because the end state of the program was not known, it was unclear which technologies would be used in the future, how much they would cost, or if they could be readily integrated into the original platform. As a result, cost analyses and budgeting activities typically focused on the first spiral of development, often at the expense of other phases of the program (Lorell, Lowell, & Younossi, 2006). Incremental development, on the other hand, generally relies on well-defined requirements for the initial and subsequent increments, with the end-requirements being met over time.

In the commercial sector, manufacturers and design engineers work hand-in-hand, often in the form of cross-functional teams, in order to meet the target cost by simplifying the manufacturing process. This might include reducing the number of different parts or using the same type of fasteners to connect all the components of a system. Needless to say, it is difficult to tie the manufacturing process to a particular product design if future increments' requirements are not at least partially defined. Moreover, the inability to determine per-unit costs, let alone future program and life-cycle costs, suggests that spiral development is not well suited to Cost as a Military Requirement.

In fact, spiral development has fallen out of favor across the DoD. In 2008, the DoD abandoned this approach altogether and adopted incremental development as a stand-alone strategy, referred to simply as *evolutionary acquisition* and described in DoD Instruction (DoDI) 5000.02 as follows:

> An evolutionary approach delivers capability in increments, recognizing up front the need for future capability improvements. Each increment is a militarily useful and supportable operational capability that can be developed, produced, deployed, and sustained. Block upgrades, pre-planned product improvements, and similar efforts that provide a significant increase in operational capability and meet an acquisition category threshold as specified by DoDI 5000.02 are managed as separate increments. (OUSD[AT&L], 2008)

Note the emphasis on early requirements definition (e.g., pre-planned product improvements and recognition of the up-front need for future capabilities). The DoD's focus on incremental development using mature technology (over spiral development and unbounded requirements) should facilitate the implementation of Cost as a Military Requirement.

However, because evolutionary acquisition is an imposed process, rather than a by-product of the market as it is in the commercial sector, there is still a greater potential for requirements creep and gold-plating. Moreover, within the DoD, there is often significant pressure to provide the troops with the best capability. Of course, the irony is that as a result, a significant period of time passes during which nothing new is fielded. Or, according to Smallwood (2012), "the way to get nothing is to insist on waiting for everything" (p. 1).

To effectively implement evolutionary acquisition across the DoD, users must allow more flexibility with regard to requirements so that developers can make the needed cost, performance, and schedule trade-offs, deferring some requirements to later releases. These revisions may change the outcome of a specific increment—but not that of the final required capability. Current DoD programs do not generally demonstrate this adaptability until budget overruns require action. Users must also trust that the programs will continue as planned, be willing to accept less capable systems earlier (i.e., the 80% solution), and then evolve the desired capability in later increments.

This is not to suggest that evolutionary acquisition is necessarily plodding or unresponsive. Rather, programs can incorporate innovations that arise during development. Because the base architecture does not change, evolutionary acquisition can add functionality to a system's existing capabilities at a quick, even standardized, pace.Development teams can also leverage what they have learned from each of the previous iterations and adjust specifications and capabilities as needed to increase program and system efficiency.

Evolutionary acquisition is relatively low-risk, thus permitting the delegation of decision-making authority, which enables more timely decisions by people who are directly involved in the program. Hence, evolutionary acquisition enables the use of IPTs, which are in the best position to accelerate, redirect, or cancel an increment's release. Unfortunately, even though DoDI 5000.02 (OUSD[AT&L], 2008) mandates the use of evolutionary acquisition, it is often not implemented.

Pre-Manufactured Components

Kluge (1997) asserted that “successful companies reduce the cost of goods sold by increasing outsourcing” (p. 214). In competitive industries, such as the auto industry, it is essential to outsource any in-house activity that, according to Kluge (1997), “falls short of world standards” (p. 214). Today, the major automotive firms outsource the manufacture of roughly 70% of components. Component outsourcing serves three essential purposes. First, because the manufacturer specializes in a narrow range of components, it not only has developed a high level of expertise but benefits from economies of scale. Consequently, at each price point, components are typically of the highest quality available. Second, the price of components is known prior to development and can be factored into the target cost. Third, components and subcomponents are often accompanied by a warranty to ensure against defects.

The current policy calls for the DoD to use commercially available products (which it refers to as COTS products) to the greatest extent possible. Furthermore, with the advent of the information revolution, the commercial marketplace—not the DoD—drives the direction and rate of innovation and development of many technologies that are critical to modern weapon systems and business systems. Within the context of DoD weapon systems, COTS products are not acquired as stand-alone items but as components that will be integrated into a larger system. In many cases, if the DoD is to deploy state-of-the-art weapon systems, DoD programs must use these commercial systems. Because of their rapid availability, lower costs, and low risk, COTS products must be considered as alternatives to in-house, government-funded developments. However, current acquisition policy, color-of-money issues, and cultural resistance, in addition to some legislative and regulatory barriers (e.g., export controls and specialized cost accounting), have limited the DoD’s use of COTS products.

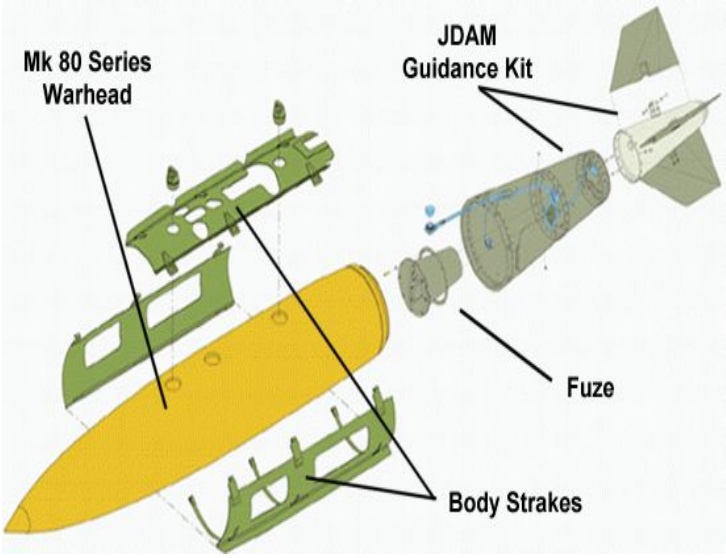
To gain the greatest benefits from COTS implementations requires the end users to maintain flexibility in their requirements and specifications. This will allow the greatest number of solutions to be considered. Depending on the circumstances, the DoD and its contractors should allow commercial components to inform the final system configuration, or even consider commercial items as the mainstays of the program, around which other features will be designed.

Accordingly, the use of COTS is fully compatible with a cost requirement in that flexibility with regard to requirements is a prerequisite.

IV. Examples

In the following sections we examine two DoD programs that relied on a cost requirement: the JDAM program and the Global Hawk. In the case of the JDAM, a price ceiling of $40,000 per unit was one of the program's seven KPP. In the case of the Global Hawk, the cost requirement of $10 million per unit was expressed as an objective. We examine how these designations (i.e., KPP versus objective) may have impacted the programs' outcomes. We also examine the extent to which each program implemented the supporting practices described in the previous section.

The Joint Direct Attack Munitions Program



In an effort to reap the benefits of the so-called peace divided, military budgets were sharply reduced following the end of the Cold War. As a result, the DoD began to explore new ways to decrease the cost of major acquisitions. In the early 1990s, Congress authorized the DoD to launch a small number of pilot programs that, to the extent possible, would rely on standard business practices. These programs were known as Defense Acquisition Pilot Programs (DAPP). Program managers were afforded considerable autonomy and were able to bypass several of the more lengthy documentation and reporting requirements prescribed by the Federal Acquisition Regulations (FAR) and Defense Federal Acquisition Regulations (DFAR), as well as provisions established in DoDI 5000.01 (OUSD[AT&L)], 2007) and DoD Directive (DoDD) 5000.02 (OUSD[AT&L], 2008). The JDAM program was among the first of these pilot programs.

During this time frame, the DoD was maintaining a surplus of conventional munitions in their stockpiles. Procured over the course of 30 years, many of these munitions were gravity bombs that were unguided and were collectively known as *dumb bombs*. In the aftermath of Operation Desert Storm in 1991, the Air Force and Navy's demand for precision-guided munitions skyrocketed (GlobalSecurity.org, 2011). To address that need, the DoD initiated the JDAM program in 1993. The JDAM system is not a stand-alone weapon; rather, it was designed as an attachment to these older gravity bombs and enabled them to use laser and GPS guidance, providing a precision capability (Ingols & Brem, 1998). These new JDAM-equipped bombs have a range of roughly 15 nautical miles when dropped from high altitudes (Lorell & Graser, 2001).

It has been widely reported that in the beginning stages of the program, the Air Force Chief of Staff provided a handwritten note to program personnel outlining his top three priorities: the per-unit cost of the system should not exceed $40,000; the system should work; and the system should hit the target. This level of simplicity was reflected in the requirements themselves. The original operational requirements document included only seven KPPs (Lorell & Graser, 2001), the first six of which were considered critical performance requirements. These requirements were as follows:

- target impact accuracy of 13 meters;
- accuracy unaffected by weather conditions;
- in-flight retargeting capability (before release);
- warhead compatibility;
- carrier suitability; and
- primary aircraft compatibility. (Ingols & Brem, 1998)

The seventh KPP was the imposition of an average unit procurement price ceiling of $40,000. Note that this price ceiling represents a significant departure from earlier estimates. In 1993, the average unit procurement price was estimated at $68,000. However, Air Force officials believed that the JDAM could not be acquired in sufficient quantities at this price and thus established the $40,000 figure, which was non-negotiable and non-tradable.

Note that some of these were absolute requirements, whereas others were written as minimum threshold performance requirements with greater trade flexibility once the minimum threshold was achieved (Lorell & Graser, 2001). For example, JDAM had to work with three specific types of bomb. However, compatibility was a threshold requirement. JDAM had to be compatible with four types of aircraft—the F-22, B-52H, F/A-18C/D, and AV-8B. However, compatibility with nine additional aircraft was listed as an objective and thus subject to trade-off analysis with cost, schedule, and other factors. At present, JDAM is compatible with eight types of aircraft.

Bids were received from six contractors, providing ample competition and thus incentive to design the most efficient system possible (Ingols & Brem, 1998). The Air Force narrowed their choice to two firms, McDonnell Douglas and Lockheed Martin. Over the course of 18 months, the two contractors developed their versions of the system in the hope of winning the production contract.

The Air Force established IPTs, inserting government engineers into each of the contractor's development teams, which facilitated open and trusting relationships early on between the program office and industry. On account of the minimal requirements regime, the contractor had more freedom with regard to the design specifications, as long as they met system-level capabilities. Moreover, under the provisions of the pilot program initiative, contractors had greater flexibility with regard to component and subcomponent sourcing (see Table 2). As a result, many of the system requirements developed by the contracting teams were designed to facilitate the use of commercial products. For instance, a temperature range of -55°C to +125°C is the military standard specification for electronic parts. However, a new baseline standard was established for JDAM, which set the high temperature at +85°C in order to accommodate the use of COTS industrial- or automotive-grade components. Components were tested and screened in order to ensure that they could function at the lower extreme (Lorell & Graser, 2001).

The IPTs proved essential in that they were able to quickly provide certification of these source selections, rather than go through the protracted government approval process. The use of IPTs also reduced the need for lengthy program reviews and the delivery of data items since problems were addressed by the IPTs as they surfaced (Brink, 1997). Table 2 lists the planned sources of components for the designs of the two competing contractors during the final competition phase.

Both contractor/government teams were evaluated three times throughout the system's development (by a separate government team). The teams were graded on their effort, capabilities performance, and cost management. Brink (1997) noted that this was a radical departure from traditional evaluation practices, stating that “traditionally, the government was not allowed to grade the contractor or give him feedback during the competitive phase of a program, [which often resulted] in the contractor continuing on an erroneous course of action and all too often a flawed design” (Brink, 1997, p. 26). By providing feedback to the two IPTs, the Air Force was able to ensure the development of two system designs that were of more or less the same quality. In the end, the choice of contractor would come down to cost.

Component	McDonnell Douglas	Lockheed Martin
Integration/assembly	Commercial	Military
IMU	Military	Military
GPS	Military	Commercial
Mission Computer	Commercial	N/A
Circuit Cards	Commercial	N/A
Connector	Commercial	N/A
Actuators	Commercial	Military
Power Supply/Distribution	Military	Commercial
Thermal	Military	Military
Container	Commercial	Military/Commercial
Fin	Commercial	Commercial
Tail	Military	Military/Commercial
Hardback/nose	Commercial	Military/Commercial

Table 2. Mix of Commercial and Military Components and Tasks
(Lorell & Graser, 2001)

In addition to establishing the unit price for initial production, both contractors submitted production price commitment curves (PPCCs) where price per unit was expressed as a function of the quantity ordered. The PPCCs, although not binding, carried significant incentives for the contractors. If the contractor offered prices at or below the PPCC, it would retain full configuration control and would receive an incentive fee if the accuracy and reliability of the units exceeded specifications. Moreover, the contractor would not need to submit any type of cost or technical data to the government, nor would there be any in-plant government oversight or inspection of the contractor or subcontractors (Lorell & Graser, 2001).

At the conclusion of the development competition, the JDAM contract for 40,000 units was awarded to McDonnell Douglas. It is clear that the firm price ceiling, the accelerated acquisition plan, and the use of off-the-shelf components and other commercial practices resulted in significant cost savings. Both Lockheed Martin and McDonnell Douglas designed systems whose price tags were far below the $40,000 requirement. McDonnell Douglas' system was priced at just over $14,000 per unit, a savings of 67%, or $2.9 billion (Grasso, 1996), while Lockheed Martin's was priced at just over $16,000 per unit and provided a comparable capability (Ingols & Brem, 1998).

The Air Force used a firm-fixed-price contract to acquire the initial 40,000 JDAM units, as well as for all subsequent units bought under the program (Ingols & Brem, 1998). In addition, a 20-year warranty was included in the unit price, which, seemingly, has paid off: e.g., during the testing and evaluation cycle, each JDAM unit operated successfully (GlobalSecurity.org, 2011), and, as noted in the following paragraph, its operational reliability and accuracy have been outstanding.

The production contract required only that the contractor satisfy the KPPs. In other words, if a design change were required, the contractor would not have to submit a change proposal and then await government approval, which had traditionally been the case. As a result, all 40,000 units were delivered on time and at the agreed-upon price.

Adopting a cost requirement proved critical to the outcome of this program. Moreover, its success makes clear the benefits of certain practices, namely, the use of competition, a minimal requirements regime, and cross-functional IPTs. In addition, providing contractors with greater control over the technical data package and sourcing decisions proved highly effective in reducing costs while improving quality. Some of the positive program outcomes are listed in Table 3.

Metric	Baseline (Pre-DAPP)	Realized
Statement of Work	137 Pages	2 Statements of Objectives
Warranty Length	5 Years	20 Years
Development Time	46 Months	40 Months
Production Time	15 Years	11 Years
Source Selection	3 Months	6 Weeks

Table 3. JDAM Metrics
(*Note*. The information in this table is from Ingols & Brem, 1998)

In 1999, during Operation Allied Force (NATO operations in Yugoslavia), U.S. bombers launched over 600 JDAMs with 96% reliability, hitting 87% of intended targets (Myers, 2002). Over time, as technology improved, the Air Force and Navy acquired updated versions with enhanced guidance technology that could be used on newer aircraft. Today, the average per-unit production cost, adjusted for inflation, remains about the same (GlobalSecurity.org, 2011).

The Global Hawk

As the mission of the U.S. armed forces continues to evolve in the post–Cold War era, the military has relied more heavily upon the use of Command, Control, Communications, Computers and Intelligence (C4I) to act as a force multiplier. An important component of C4I is the unmanned aerial vehicle (UAV).

The Global Hawk RQ-4A and B variants are fully autonomous reconnaissance UAVs that have been heavily used in both Iraq and Afghanistan, with C (Block 30) and D (Block 40) versions planned. The military chose the Global Hawk as one of the test beds to assess the feasibility of the spiral development process in light of the military's historic difficulty in developing UAVs.

As noted by one study, “the United States has seen a three-decade-long history of poor outcomes in unmanned aerial vehicle (UAV) development efforts. UAV and tactical surveillance / reconnaissance programs have a history of failure involving inadequate integration of sensor, platform, and ground elements, together with unit costs far exceeding what operators have been willing to pay” (Drezner & Leonard 2002b). In the case of the Global Hawk, the military envisioned the development of a feasible concept vehicle that could be delivered quickly and affordably. The DoD established a “flyaway cost” objective of $10 million per unit. Typically, the unit flyaway cost includes the costs of procuring the airframes, engines, avionics, armaments, engineering change orders, and other nonrecurring costs divided by the procurement quantity. Research and development, support costs, and training costs are not included.

The Global Hawk RQ-4A, also identified early on as the Conventional High Altitude Endurance (CONV HAE) or Tier II+ UAV, was the DoD’s attempt to build an unmanned, fully autonomous, reconnaissance air vehicle. Global Hawk was envisioned as the primary platform for missions requiring long-range deployment, wide-area surveillance, and a long sensor dwell-time over the target area. Global Hawk was to be deployable from outside the theater of operation, and to immediately provide extended on-station time in low to moderate-risk environments, in order to provide imagery of high-threat locations using electro-optical (EO), infra-red (IR), and synthetic aperture radar (SAR) sensors. Unlike prior UAVs, the Global Hawk was outfitted with a variety of survivability features, including the capability to operate at high altitudes, and built-in self-defense measures (The Defense Airborne Reconnaissance Office, 1997).

The Global Hawk was initially a Defense Advanced Research Projects Agency (DARPA) Advanced Concept Technology Demonstration (ACTD) program. As an ACTD system, the primary purpose of the program was to leverage technology that had been demonstrated successful in real-world situations to evaluate its viability as a full-fledged military acquisition program. Because this program was designed to undergo multiple blocks of development, an important goal of each block was to remain within the cost requirement of $10 million per unit and keep the program on schedule. The plan was to use the first block (Block 10) to provide a baseline capability while using additional blocks (20, 30, and 40) to insert additional capabilities into production, when ready. To accomplish these goals, the program office was willing to allow competing firms to trade all other performance goals as necessary in order to meet cost and schedule parameters (Drezner & Leonard, 2002a; Johnson & Johnson, 2002).

The DARPA released the solicitation for this UAV project in April 1994 and awarded the Teledyne Ryan team the contract in May 1995. The first Global Hawk RQ-4A prototype completed its first flight on February 28, 1998. After initial flight testing, a second Global Hawk was produced in November 1998 that included a sensor payload. Trials for its military application began in 1999. The rest of that year saw several setbacks for the Global Hawk program: the second prototype was lost due to "an erroneous *flight termination* test signal that had been sent from Nellis AFB, Nevada; while a high-speed taxi accident at Edwards AFB set back AV-3 in September 1999" (Roberts, 2006). Despite these setbacks, the Global Hawk maintained its initial development schedule and was able to stay within the cost requirement (see Figure 4).

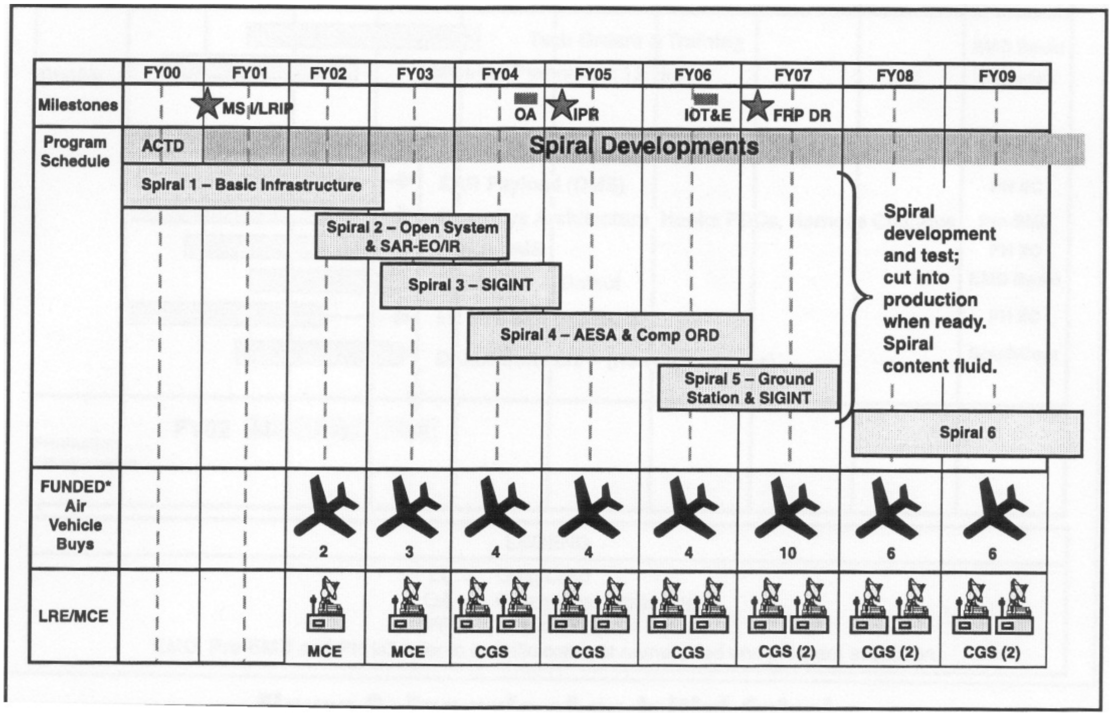


Figure 4. Global Hawk's Initial Development Schedule

In March 2001, based on the successful demonstrations and operational deployments of prototype aircraft, the DoD approved the Global Hawk for a concurrent start of system development and low-rate initial production of six air vehicles. At that time, the Air Force planned to use spiral development to develop more advanced capabilities and acquire a total of 63 air vehicles (GAO, 2004).

Following 9/11, the existing fleet of Global Hawks was hurried into operational service for the initiation of Operation Enduring Freedom (OEF). It would also be used extensively in Operation Iraqi Freedom (OIF). While still in the development phase, the Global Hawk would go on to log over 3,000 flight hours, a majority of that number being operational missions in support of OEF and OIF. The Global Hawk platform has been in continuous service since its initial operational status and continues to serve in both Iraq and Afghanistan. Overall, the Global Hawk took little more than six years to develop from initial solicitation to first operational fielding of the system.

During its service in combat operations, the Global Hawk RQ-4A provided the military with an extensive amount of real-time intelligence.

> With just one air vehicle deployed, the system was credited with identifying 38 percent of Iraq's armor and 55 percent of the time-sensitive air defense targets using electro-optical (EO), infrared (IR), and synthetic aperture radar (SAR) images to target Iraqi forces. These early combat deployments demonstrated the effectiveness of carrying multiple sensor capabilities on the same platform. (Coale & Guerra, 2006)

Following the RQ-4A's operational success, the Air Force decided to design a new, larger, and more capable variant of the Global Hawk, known as the RQ-4B. Originally, the RQ-4B components were to be 90% compatible with the A model. Desiring even more capability, the Air Force altered the requirements to produce a significantly larger B variant. Ultimately, the B variant as designed, when compared to the A, would carry a 50% larger payload, fly for two hours longer, and retain the approximate 10,000 nm range. While these were marginal requirement shifts from the original design, the deviations necessitated major reengineering. The development of the RQ-4B project was to be funded with the original budget for the 4A; however, the Air Force removed cost as a requirement, relegating it to a consideration.

As the focus of Global Hawk acquisition shifted from Block 10 to Block 20, the program was restructured in March 2002. The new strategy included 51 air vehicles, and of these 51 air vehicles, seven were to be constructed as RQ-4As and 44 were to be built as RQ-4Bs (GAO, 2004). The development period was extended from seven years to 12 years while the procurement period was shortened from 20 to 11 years. As a result, the funding profile changed dramatically—the research, develop, test, and evaluation (RDT&E) funding requirements increased and were spread over a longer development time line. Conversely, in order to accommodate a shorter procurement period, the procurement funding requirements were compressed radically (Henning & Walter, 2005). In December 2002, the program was again restructured as a result of the Air Force's request to change the Global Hawk's mission configuration; instead of buying all RQ-4Bs with multiple intelligence capability, the RQ-4Bs would now have a mix of multi-mission and single-mission capabilities (GAO, 2004).

Many independent commentators have regarded the Global Hawk RQ-4A program as a great success. It is the first automated air vehicle to receive the Federal Aviation Administration's National Certificate of Authorization, allowing it to fly anywhere in U.S. airspaces without prior authorization. The vehicle is also the "first unmanned aerial vehicle to achieve a military airworthiness certification" (Northrop Grumman Global Hawk Program, 2006, p. 4). The Global Hawk RQ-4A was the first UAV to fly across the Atlantic Ocean and later became the first UAV to fly across the Pacific Ocean. Finally, the RQ-4A was able to meet its mission-critical performance requirements while also meeting its cost requirement.

However, the restructured Global Hawk program has faced significant cost and schedule difficulties. The program's problems stemmed principally from two sources: an unrealistically low initial estimate of cost for Blocks 20, 30, and 40 and major levels of requirements creep for Block 20 on. The first problem arose because no technical surveys were undertaken to understand the true costs and time line needed for the capabilities requested. The costs for the program were, in large part, based on what the Air Force was willing to pay for the Global Hawk's theoretical capabilities. While this is one potential method of establishing a cost requirement, it was only attainable for the Block 10 systems. With new requirements added, and cost then becoming but a consideration, the ability to enforce desired procurement costs was lost.

As mentioned previously, under spiral development, neither the end-state requirements nor their costs are necessarily known at program initiation. However, the cost of incorporating future technology into later increments must be reflected in the program's unit cost requirement in order for it to be attainable. According to a report by the Institute of Defense Analysis (IDA), the rebaselined Global Hawk program "inherited the flexible approach to requirements management that had characterized the spiral development phase" even though the program had, for all intents and purposes, transitioned to the concurrent development of multiple aircraft variants (Fox, Kodzwa, Tate, & Bronson, 2011, p. 31). In other words, the program scope, cost, and schedule estimates continued to treat difficult or unfunded requirements as if they were not part of the program. According to the IDA, this led to the "understatement of eventual program costs at every stage" (Fox et al., 2011, p. 31).

Recently, the DoD, in a move backed by Congress, has begun reducing the Block 30 and 40 purchases. Because the average procurement unit cost (APUC) has increased steadily for these systems, fewer systems are being procured. At the same time, in order to meet performance requirements on the remaining Block 30 and 40 systems, more RDT&E dollars are required but will be spread over fewer systems, making each system more costly. Further complicating issues is the fact that the Global Hawk program relies on cost-plus contracting to a sole-source contractor, meaning that these additional costs will be passed directly to the DoD.

More problematic still, the current Block 30 systems that have proceeded into T&E have been unable to meet certain performance requirements. In fact, recent estimates suggest that Block 30 systems are able to meet only 40% of the required capability (Butler, 2012). As of February 26, 2012, procurement of the remaining 26 Block 30 systems has been suspended while Block 40 systems face likely cancellation, in that they are estimated to be more costly than the current U-2 systems that the Global Hawk was designed to replace (Butler, 2012).

V. Implementation Strategies

Based on our review of target costing and our examination of two defense programs that relied on firm cost ceilings, we believe that Cost as a Military Requirement warrants further consideration by the DoD. In Part III, we examined commercial-sector practices commonly used in conjunction with target costing, as well as their analogs within the DoD. However, the defense market is unique in many respects and, as mentioned previously, the potential for requirements creep, inefficient product design, and gold-plating may be more likely to occur in the defense market compared to the commercial market. In the following sections, we discuss four additional strategies that could be used to facilitate the imposition of a cost requirement: (1) using threshold requirements; (2) relying on fixed-price contracts; (3) expanding the inclusion of contractor warranties; and (4) spurring competition among contractors to develop alternative designs.

Threshold Requirements

Target costing will be of limited value with regard to products that rely on new or immature technology. After all, target costing is used in order to determine the selling price that customers are willing to pay for a specific level of product quality; it is a reverse costing methodology (Zengin & Ada, 2009). If the technology is unprecedented, new, or immature, then it will be challenging for development firms to estimate costs accurately. And it may be even more difficult to gauge the product's value from a prospective customer's point of view. Target costing, then, can only be used when a design's technology, components, and subcomponents can be assigned costs with a reasonable degree of accuracy.

With regard to weapon systems, even when the technology is mature, the defense market cannot typically determine in advance a price continuum for specific levels of product quality and functionality because there are so few sellers and only one customer. Additionally, the overall resource constraint (set by the budgets), and the critical need for quantity (to achieve mission need), also represents uniqueness for the defense market. Given this fundamental difference between the commercial and defense markets—and the necessity to, at times, rely on highly complex technology—the DoD should assign threshold requirements (from minimally acceptable to highly desired) for performance in order to promote trade space maximization and constrain unit cost growth.

Fixed-Price Contracts

Under Cost as a Military Requirement, the unit cost will be determined early on or even prior to a program's official initiation. For this unit cost to be enforceable over the long term, the DoD should rely on firm-fixed-price production contracts. Establishing a firm, enforceable unit production cost will also serve to constrain a program's development costs. That is, the contractors will be more likely to use mature technologies, COTS components, incremental development, and other cost-efficient practices in order to reduce production costs and meet the unit cost requirement.

According to FAR 16.202, fixed-price contracts should be used "when the risk involved is minimal or can be predicted with an accepted degree of certainty." History has shown that this type of arrangement can lead to poor outcomes, especially when applied in the development phase of the program. However, many past programs (e.g., the C-5 and F-111) were required to meet detailed technical specifications and/or relied on immature or unprecedented technologies (Gansler, Lucyshyn, & Rigilano, 2012). Under Cost as a Military Requirement, neither of these conditions is true. First, in order for target costing to be applicable in the first place, the technology must be mature to the point where development costs can be estimated with a reasonable degree of accuracy. Second, because Cost as a Military Requirement relies on threshold requirements (as opposed to detailed specifications), there is less risk of the contractor being unable to deliver. Because development risk is constrained by the imposition of a unit cost requirement, fixed-price contracts may, on occasion, be used for development as well. However, if used at all, these contracts should be incentive-type (as opposed to firm-fixed contracts), written to include a target cost, a target profit, a price ceiling, and a profit adjustment formula in order to incentivize contractor performance. This strategy would shift more of the risk to the contractor but also provides the contractor with greater flexibility to meet the cost requirement as well as greater incentive to exceed DoD expectations.

Of course, depending on the nature of the program, a cost-reimbursement contract may be preferable. If the technology is highly complex, then increasing the contractor's flexibility to design the optimal low-cost solution may reduce overall program costs in the long run. The bottom line is that establishing an enforceable unit cost (via firm-fixed-price production contracts) reduces risk, allowing the DoD to choose the most appropriate contract for system development.

Warranties

In order to effectively constrain the true cost of acquisitions, per-unit cost must be controlled, but not at the expense of increased life-cycle costs. However, because Cost as a Military Requirement focuses on unit cost, developers—military personnel and contractors alike—must also continue to focus on the product's reliability and its sustainment costs. It is important to note that even when an acquisition program's specifications are prescribed in detail by the government agency, the average procurement costs of a program typically represent only 30% of the total cost, with the other 70% incurred after production. It seems likely, then, that Cost as a Military Requirement, which is predicated on a minimal requirements regime, could lead to significantly increased life-cycle costs.

In commercial markets, where there is a high level of asymmetric information (e.g., it is difficult for a consumer to judge the quality of a major appliance), warranties have proven very successful in communicating product reliability to the customer by providing a signal of the quality of their products. Warranties signal product quality: to offer a warranty for a poor-quality product would be more costly than to offer the same warranty for a high-quality item (Pindyck & Rubinfeld, 1998). When used in conjunction with target costing, warranties provide a mechanism to signal that the quality of the product or component has not been sacrificed to meet the cost targets.

The simplicity of the JDAM requirements—that the system work, hit the target, and cost under $40,000 per unit—although invitingly simple, does not tell the whole story. An essential component of the contract was the 20-year warranty, included in the unit price, which incentivized developers to focus on system quality and reliability. To the extent possible, the DoD should promote the inclusion of contractor warranties in order to minimize life-cycle costs.

Of course, the inclusion of a single warranty may not be practical in all situations. JDAM was a relatively simple product, and ongoing support costs were negligible. Compared to aircraft, tanks, and ships, each JDAM unit had a short life cycle and was used only once, and a warranty was virtually all that was needed to reduce/eliminate post-production costs. When it comes to more complex systems, the DoD should develop a strategy wherein the original equipment manufacturer provides a product warranty (which will presumably require that the component manufacturers include warranties) in order to ensure that quality is not sacrificed to meet the cost objective.

Competition

As important as warranties are, they cannot compensate for an inefficient product design. As noted previously, the majority of a system's costs are built in early on in the development phase. Moreover, many of these costs (e.g., fuel usage, regular maintenance, personnel requirements) cannot be reduced through the inclusion of warranties. Once the product enters the engineering and manufacturing phase, cost reduction strategies are only marginally effective. Ibusuki and Kaminski (2005) wrote that "the greatest opportunities for cost reduction lie in the multiple alternatives of product concept and design" (p. 461). They went on to state that these opportunities can be seized when there is "creative consideration of alternatives" along with "structures analysis and decision-making" (Ibusuki & Kaminski, 2005, p. 461).

Along with warranties, spurring competition among contractors to develop alternative designs is the best way to ensure product reliability and lower life-cycle costs. The JDAM program suggests that competition among just two competitors can have dramatic outcomes. Obviously, ensuring that the defense industry remains vibrant, even in times of national budgetary reductions, is essential. The creative consideration of alternatives is encouraged under current initiatives (e.g., Should Cost/Will Cost). Under Cost as a Military Requirement, this emphasis must remain strong.

In fact, there is no reason to limit competition to the development phase. Rather, competition can also be used during the production phase in order to speed delivery, reduce costs, and encourage further innovation (Gansler, Lucyshyn, & Arendt, 2009). In the absence of competition, production efforts can often last for decades, with little incentive to increase efficiency.

VI. Recommendations and Conclusion

There is little doubt that the DoD will face a period of shrinking budgets. At the same time, the force structure will need to be modernized and transformed. Accordingly, in addition to technological superiority, the DoD must address the issue of affordability so that weapon systems can be procured in sufficient quantities. Based on our review of target costing and commercial-sector practices—and the JDAM and Global Hawk programs—we believe that making cost a requirement has the potential to be highly effective in controlling the cost of military weapons programs. In the next section, we provide recommendations going forward.

Recommendations

- **The DoD must reorient its priorities such that cost (with militarily acceptable performance) takes precedence over higher performance at all costs.**
  According to Cooper and Chew (1996), in the commercial sector, "all design-team members, whatever their functional specialty, must regard the overall final cost target as an unalterable commitment" (p. 96). The Global Hawk case suggests that early program gains are lost once the cost requirement is eliminated. The DoD must work to change the culture of the acquisition workforce, elevating the importance of cost throughout the acquisition process.

- **The USD(AT&L) should designate a series of pilot programs that define cost as a KPP**.
  Pilot programs would demonstrate the effectiveness of Cost as a Military Requirement while helping to identify challenges and barriers. The program should then be expanded accordingly. In conjunction with the pilot programs, the USD(AT&L) should institute an expedited process for FAR/DFAR waivers in order to maximize program trade space and program flexibility and promote localized decision-making.

- **DoD programs should expand the use of cost-focused IPTs to all program phases.** A key factor in the success of target costing in the commercial sector is the use of cross-functional teams. These teams work to ensure that the required performance is achieved within the cost target. DoD policy should continue to emphasize the importance of IPTs in meeting program objectives by ensuring that teams include representatives with a user perspective as well as those with a cost versus performance understanding. Accordingly, under Cost as a Military Requirement, the IPT works to ensure that the cost KPP is met and, thus, that the required quantities can be procured.

- **DoD programs should rely on competition in order to constrain life-cycle costs.** In order to meet a product's target cost, contractors may be tempted to pay less attention to the impact of product design (especially with regard to reliability and maintainability) on life-cycle costs. To promote product efficiency (e.g., reduced maintenance costs, reduced fuel consumption), the DoD should promote competition during the design phase in order to minimize built-in costs. Moreover, the JDAM case demonstrated the effectiveness of inserting government personnel into competing contractor IPTs during multi-stage proposal preparations. Trusting relationships were built early on, and decisions could be made quickly. In the end, JDAM program officials were able to choose between two efficient system designs that were priced well below the established target. Finally, competition should be maintained during the production phase in order to ensure that the contractor continues to meet cost, schedule, and performance requirements.

- **DoD programs should require contracts to include warranties in order to promote product reliability.** The use of warranties, particularly in a competitive environment, incentivizes the contractor to build reliable, quality products and helps to ensure that when trade-offs are made, quality will not be sacrificed to satisfy the cost requirement. Warranties will also incentivize continuous process improvement, as the contractor seeks to minimize their costs providing warranty support.

- **DoD programs should assign threshold requirements (from minimally acceptable to highly desired) for performance.**
  By promoting threshold requirements, DoD programs will maximize their trade space and ensure that they are not chasing what Norman Augustine (1997) referred to as the last 10% of performance (which he contended generated one third of the cost and two-thirds of the problems). When this approach is used in conjunction with incremental development, system performance can be improved over time. And, by stressing continuous improvement (a key underpinning of the commercial sector's target costing process), increases in performance can actually be achieved at lower cost.

Conclusion

Despite various attempts to curb cost growth, the cost of DoD programs continues to grow at a fairly consistent rate. These trends have been compensated for historically through increased budgets (most recently, with the sharply increased budgets and supplemental funding supporting operations in Iraq and Afghanistan).

Weapons system cost growth can be attributed to a litany of different factors, including over-optimism, estimating errors, unrecognized technical issues, and schedule changes. Public opinion, however, is less forgiving. A major poll by the Center for Public Integrity and the Stimson Center revealed that 80% of Americans believe that there is "a lot of waste" in the defense budget (Mehta, 2012, p. 1). Another recent poll by Reuters and Ipsos revealed that the majority of Americans prefer cutting defense spending to reduce the federal deficit, as opposed to taking money from public retirement and health programs (Smith, 2011). Justified or not, current defense spending is at a record level and, in light of current budgetary conditions, is unsustainable.

Today, the military is often unable to acquire weapons systems in the intended quantities because of program cost growth. The DoD has reduced its orders of F-22s and F-35s by hundreds of aircraft. Reductions of this sort will lead some to believe that our military is underprepared to face threats to our national security or, perhaps, that the need for the specified capability was exaggerated to begin with. Given the current polling data, it appears that many are likely to believe that the need was exaggerated, which increases perceptions of waste and ineptitude and, in turn, exerts greater downward pressure on the defense budget. Sooner or later, this sequence of events will leave our military without the adequate resources to counter serious threats. Cost as a Military Requirement not only helps to solve the cost growth problem but also ensures that the military is able to acquire sufficient quantities of essential systems, improving public opinion and enabling our men and women in uniform to successfully carry out their missions.

As the DoD seeks to transform itself to meet the challenges of the 21st century, it must embrace affordability in order to ensure that weapons systems will be available in the numbers required. We believe that making cost a military requirement has demonstrated its effectiveness in controlling cost growth in the private sector and, where attempted, in the DoD. Indeed, no other approach has worked.

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