Commercial Item Acquisition: Considerations and Lessons Learned

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1. Introduction

Expanding the use of commercial items[1] in Department of Defense (DoD) systems offers the DoD opportunities for reduced cycle time, faster insertion of new technology, lower life cycle costs, greater reliability and availability, and support from a more robust industrial base. It is a fact that for many of the technologies that are critical to military systems, the commercial marketplace—and not the DoD—now drives the pace of innovation and development. The increasing priority on the use of commercial items[2] in DoD systems is reflected in DoD Directive 5000.1, which states that the use of commercial items in DoD systems is the preferred approach for meeting operational requirements. Simply put, if the DoD intends to field state-of-the-art systems in a cost-effective manner, then it must incorporate commercial items into these systems.

Major DoD programs have been successful in building systems that realized the benefits of using commercial items. These programs found that the use of commercial items required a reemphasis of some traditional DoD business, management, and engineering practices, as well as a number of changes to other practices. Successful programs embraced these changes by building systems that were conceived, acquired, and sustained with an understanding of the imperatives of the commercial marketplace.

This document provides guidance on the use of commercial items for program managers as well as for integrated product teams and contractors that support the program manager. It provides an overview of the fundamental challenges that organizations face when they integrate commercial items to form a system. It then addresses the issues involved in buying from the commercial marketplace, summarizes lessons learned from programs that have made extensive use of commercial items, and offers suggestions.
It is left to each program manager to determine how to implement the suggestions contained in this document in a manner consistent with appropriate laws and regulations. The information and suggestions provided here are derived from real program experiences in which managers implemented commercially based solutions. These experiences reflect a wide range of program types: programs where the buyer was a commercial entity (e.g., a bank); programs in which the government directly acquired commercial items; and programs where a contractor was responsible for acquiring and integrating commercial items. Most of the programs studied were software intensive. However, a number of hardware programs were also considered. Many of the lessons are not unique to situations in which programs incorporate commercial items. Rather, they address concepts that should be considered during any system acquisition. These lessons have been included because programs that implemented commercially based solutions identified them as significant.

[1] Commercial items are defined in the Federal Acquisition Regulation (FAR), Part 2. The language has been paraphrased in the definitions below and is repeated in full in the appendix.

[2] Commercial items are a subset of the non-developmental item (NDI) category. Many of the fundamentals and lessons learned presented in this document also apply to the broader definition of NDIs. However, the NDIs not included in the FAR definition of "commercial item" (such as items developed for another program that are reused) are outside the scope of this document.

Terms and Definitions

There is a lack of precision in the definitions used for the term "commercial items." As such, the following section clarifies some of the major terms used in this document.

Business practices are the tasks, duties, and functions performed to support the objectives of an organization.

A ***commercial item***[3] is one customarily used for nongovernmental purposes that has been or will be sold, leased, or licensed (or offered for sale, lease, or license) to the general public. An item that includes modifications customarily available in the commercial marketplace or minor modifications[4] made to meet federal government requirements is still a commercial item. In addition, services such as installation, maintenance, repair, and training that are procured for support of an item described above are considered commercial items if they are offered to the public under similar terms and conditions or sold competitively in substantial quantities based on established catalog or market prices.

A ***commercial off–the-shelf* (*COTS)*** item is one that is sold, leased, or licensed to the general public; offered by a vendor trying to profit from it[5]; supported and evolved by the vendor[6] who retains the intellectual property rights; available in multiple, identical copies; and used without modification of the internals.[7]

A ***contractor*** is a company or institution that is under contract to the government and from whom a program manager expects to receive a delivered system as specified in a contract. A contractor may also be a vendor.

End users are those people who will be using the system in the operational environment.[7]

The ***marketplace*** is the aggregation of buyers and sellers where goods are offered for sale.

A ***stakeholder*** is any person or organization that is affected by or has an impact on a system or decision.[7]

System context encompasses all those considerations that define and constrain the system to be fielded: functional and non-functional requirements, end-user practices, business drivers, operational environment, constraints, applicable policies, budgets, and schedules.[7]

A ***vendor*** is a commercial enterprise whose purpose in producing a product is to offer it for sale in the marketplace, and not in response to specific program needs. The vendor may also be a contractor or subcontractor who is under contract to modify a commercial item in response to unique program requirements.

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[3] This definition is paraphrased from the FAR, Part 2. The complete definition is included as Appendix A.
[4] Minor modifications are defined in the definition of commercial items in FAR, Part 2. See Appendix A.
[5] This distinguishes the item from components that are built by a commercial entity for its own use and are subsequently offered to the program, but not to the wider commercial marketplace.
[6] The item could also be supported under special license agreement such that the vendor retains responsibility for the product.
[7] This is defined in COTS-Based Systems for Program Managers. See [CPM 99].

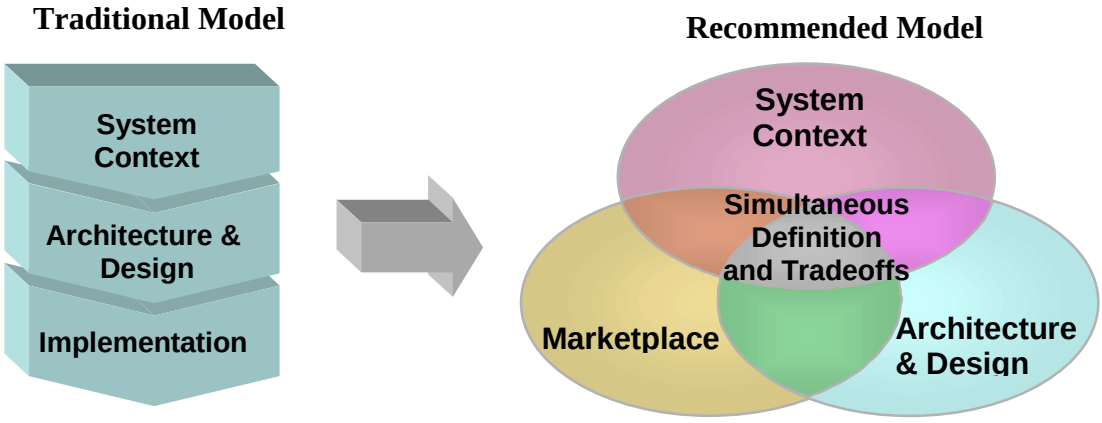
2. Using Commercial Items: Some Fundamentals

Using commercial items in DoD systems is not new. Most systems being developed today use some commercial items (e.g., computer hardware, operating systems, database management systems, and even batteries, engines, and air conditioners). What is new is the wider availability of commercial items and the desire and need to increase the use of these items in DoD systems in order to provide the DoD, particularly the war fighter, with the latest available technology.

The extent to which individual programs will use commercial items will vary. Some programs will integrate a few commercial items within a largely custom-built DoD system. Other programs will find a commercial item from a single vendor that can largely replace a custom DoD system. Still other programs will build systems that are integrated from multiple commercial items purchased from different vendors.

There is no single set of rules that covers this broad range of possibilities. Deciding how commercial items affect a specific program depends on the degree to which the program intends to use commercial items, the extent to which introducing the commercial item alters the physical characteristics of the system[8], and the complexity of integrating commercial and custom DoD items. There may be several competing approaches, and the program manager must determine which is most appropriate. Regardless of the approach selected, some common fundamentals have been observed in programs that have used commercial items.

First, ***increased reliance on commercial items implies a different paradigm of system acquisition***. The most fundamental change involves the dynamic interaction between the system context, the system architecture and design, and the commercial items available in the marketplace. Managing this interaction requires unprecedented cooperation among the program office, the stakeholders, the contractor, and in many cases the vendor in order to effect the tradeoffs necessary to keep the program on track. The changes from the traditional acquisition paradigm are illustrated below.



[8] For example, flat panel displays have been successfully introduced in airplane cockpits. Alternately, a new engine on an airplane may impact aircraft stability or other airplane components.

The cooperation depicted in the recommended model is fundamental to implementing many elements of acquisition reform—not just those involving commercial items. All programs benefit from close working relationships among the various parties. Unfortunately, many programs (including those making use of commercial items) continue to follow a model akin to the traditional model where an attempt is made to fully specify requirements before design alternatives and marketplace exigencies are considered. If a program is to maximize its opportunities to benefit from the commercial market, then marketplace technologies, products and dynamics must influence many aspects of the system context (including requirements), the architecture and design, and the acquisition strategy. In short, the goal in design of a commercial-based system must be to adapt requirements to the capabilities available in the marketplace rather than adapting commercial capabilities to DoD requirements.

Second, ***the marketplace, not the program manager, drives development of the commercial item.*** Development of commercial items is driven primarily by the vendors' perceptions of what will sell to the largest number of potential users. This can be an advantage because a DoD program does not have to directly fund performance or functional enhancements to commercial items. Vendors commonly implement such enhancements in order to retain or increase market share. However, reliance on the marketplace also means that program managers must recognize that a vendor may remove capabilities that are important to a DoD program, and other capabilities that are not needed by the program may be added. While the program manager does not directly control the characteristics of a commercial item, as occurs when a contractor or subcontractor develops a custom product, this does not imply that the program manager has no control over the system to be deployed.

The program manager must conform to the behavior of the other buyers in the marketplace, and then exert control by managing and verifying requirements in a manner that optimizes the use of commercial items—often by adopting the requirements of the other buyers as closely as is practical. Market research must be performed to evaluate the capabilities of available commercial items, the performance of vendors, and the relative size of the program to the vendor's business base. Business relationships must be established with contractors and vendors to ensure that program needs are communicated in a manner that maximizes the program's leverage. Finally, the system must be engineered to accommodate marketplace-driven changes to commercial items throughout the system life cycle.

Third, ***the difference between integrating commercial items and developing a custom capability is fundamental.*** In custom development, the program directs the behavior of system components and the interfaces among components. Program managers who use commercial items have little insight into how the commercial items are put together, how they behave, and why. Commercial items are built around vendor-specific assumptions, such as unique approaches to error handling, data access, and interaction, in the case of software. The details of these assumptions are typically unavailable to the program manager and are likely to differ from those of other system components. Identifying the assumptions of commercial items and developing a strategy for working with (and around) these assumptions makes integration challenging.

Finally, ***using commercial items means that many acquisition activities are repeated throughout the life of the program.*** Frequent changes driven by the marketplace are likely to make activities typical of sustainment necessary even before initial system delivery. Similarly,

activities typical of development may be repeated after system deployment because a system based on commercial items is never really “complete.” In some sense, system development and sustainment activities merge. The opportunity to enhance system performance or capabilities through rapid technology insertion is one of the motivators for using commercial items. However, new, changed, and obsolete commercial items necessitate repeated cycles of requirement definition, commercial item evaluation, and system engineering. Some form of replanning and reengineering will be ongoing throughout the life of the system.

Numerous acquisitions have stumbled for lack of careful consideration of the above fundamentals. However, there are logical remedies to the unique risks imposed by commercial items—and those risks, when addressed correctly, can be far outweighed by the benefits. As a first step in identifying and mitigating these risks, the program manager should understand the lessons learned by similar programs and determine how these experiences can enhance program acquisition.

3. The Implications of These Fundamentals: Some Key Lessons Learned.

The programs that have incorporated commercial items are diverse. In spite of this diversity, a few common themes can be identified in their experiences. In the following sections, common themes involving business practices, commercial item evaluation, buying practices, and life-cycle engineering are discussed in detail in terms of individual lessons learned. Examples from actual[9] programs are provided to illustrate the lessons. Suggestions for the program manager conclude each section.

3.1 Embracing Commercial Business Practices

The use of commercial items frequently means embracing commercial business practices that are embedded in the commercial item. The commercial item embodies the vendor's expectation of how it will be used. This includes the concept of operation it supports, interface and data standards, architecture and design, and the characteristics of form, fit, and function. Equally important are the vendor's business practices and strategies in areas such as development, maintenance, distribution of updates, and availability of spare parts. Many DoD requirements must be adjusted to accommodate both the vendor's anticipated uses of the commercial item *and* the vendor's business practices in order to maximize the item's effectiveness in meeting program needs.

3.1.1 A gap will exist between DoD and commercial use—and the gap may be large. The program manager and the stakeholders must define and bridge the gap between the DoD system context and the commercial use anticipated by the vendor through investigation and negotiation. In one case, a successful program was able to maximize the use of commercial items through extensive negotiation with the program's stakeholders. Together they made environmental concessions (e.g., decreased operating temperature and shock parameters) to facilitate the use of commercial items. Another successful program influenced commercial buyers to adopt DoD practices in the marketplace. In several other programs the extent of the gap was not well understood by any of the parties involved. Vendors, program offices, and the contractors believed that commercial items provided most of the required capability, when in reality the items provided more limited capability. One program made no serious effort to estimate the gap between the services provided by the preferred commercial solution and the actual DoD requirements because program managers believed that a commercial solution was mandated by high-level DoD policy.[10] In all of these cases, program offices and contractors later discovered that commercial items lacked essential capabilities. Adding these capabilities required expensive custom development, and resulted in cost and schedule overruns that could have been avoided had the programs instituted meaningful and open communication among the vendors, the contractors and all of the program stakeholders.

3.1.2 DoD standards and compliance documents may restrict the use of commercial items. While the use of military standards has declined substantially, the need for interoperability between weapon and command and control systems has introduced a new set of standards.

[9] To maintain confidentiality, the names and identifying details of the programs are omitted. Programs represent both major weapon systems and information systems from both the DoD and commercial industry.
[10] For a summary of DoD policies related to commercial items, see [POLICY].

For instance, the DoD has specified requirements among information systems for software infrastructure, reusable components, and interfaces to supporting systems. The Joint Technical Architecture (JTA) and the Defense Information Infrastructure/Common Operating Environment (DII/COE) are examples of these. The JTA and the DII/COE demand that key architectural decisions[11] be made before commercial items are selected, and that the commercial items used must conform to those decisions. However, many programs have found that this demand constrains the choice of available commercial items. One program identified a similar problem with DoD data standards, where only a small (less than 10%) match was found between the relevant standards and the data definitions employed by commercial items.

3.1.3 Modifying the commercial items is not the best way to bridge the gap. Some programs failed because of a firm expectation that commercial items should be modified to accommodate program requirements. Like many DoD programs, one private corporation fell into the trap of modifying most of its commercial items in order to give them a unique corporate flavor. As a result of the practice, many of the corporate programs modifying commercial items experienced recurring technical problems and cost overruns. In contrast, the stakeholders of a successful DoD program made a firm decision to modify system requirements and not commercial items. The program delivered the basic capability in 90 days for 20% of the cost of a previous unsuccessful effort to build the same system. The failure of the previous effort was attributed to extensive modification of commercial items.

3.1.4 If the gap is too great, commercial items may not be appropriate. Some attempts to modify DoD requirements to facilitate the use of commercial items have been unsuccessful. In one case, an initial decision to embrace commercial business practices was abandoned because the DoD organization was already employing more mature practices than those supported by commercial items. The program made a reasonable decision to commit to custom development and ongoing sustainment. In another case, a commercial item was substantially enhanced to address unique DoD practices. The enhancements were so significant that essentially a custom system was delivered. The vendor justifiably would not support the item under the standard commercial maintenance agreement. The program had to contract with the vendor for unique support services for the life of the system.

3.1.5 Buy-in from key stakeholders is critical. It is not enough to issue a top-down directive that the organization implement a new business practice. Key stakeholders should understand and accept the extent of the change required. This means that stakeholders must be involved very early in the process. Some programs have misjudged the importance of involving all stakeholders. In one organization, the DoD end users agreed to change their business practices and adopt those made necessary by use of a commercial item. However, one key group of stakeholders was not consulted. This group, a commercial firm that provided distribution services under a different commercial model, rejected the new practices and forced a return to business as usual. Eventually the program was cancelled. In another program, end users stopped deployment of the system by identifying deficiencies in the look and feel of a commercial item during operational test and evaluation. In contrast, a successful program employed external experts who understood the ramifications of the commercial item on

[11] Level 5 DII COE compliance requires segmented applications, installation using COE tools, and operation with the COE kernel. Level 7 requires that applications not duplicate functionality provided by COE services. See [C4I STANDARDS].

business practices. These experts set clear expectations and helped stakeholders make the necessary adjustments to use the system.

3.1.6 Requirement specifications must be flexible and negotiable. A traditional development model that specifies all system requirements prior to considering the capabilities available in the marketplace is ill suited to the development of systems incorporating commercial items. The resulting requirements are unlikely to be sufficient for the selection of appropriate items because they do not incorporate the broad range of marketplace, vendor, and product characteristics that must be considered in the selection process. Many significant characteristics only become evident during market research and evaluation of commercial items. In addition, without flexibility in requirements, it is unlikely that any commercial item will suit program needs. One program demonstrated little willingness to leave some details undefined until later in the development process. The program office and the end user attempted to finalize all system requirements in advance of market research. This increased the gap between the commercial item offerings and the documented requirements. As a result, the program struggled to identify and incorporate commercial items. In contrast, a successful program pared down requirements to reflect essential, as opposed to customary or preferred, business practices. This allowed for flexibility in choosing an acceptable commercial item.

3.1.7 New approaches to program management can enable increased use of commercial items. Many program managers find that to maximize the use of commercial items, they must "invent" a unique approach to requirements management. Within a month of embarking on its development path, the integrated product team (IPT) of a successful program crafted a new development process that sought to maximize the use of appropriate commercial items. This process identified both strengths and shortfalls in the capabilities provided by commercial items. This information allowed the program to develop strategies to mitigate the shortfalls, while at the same time identifying opportunities for improved business practices within the DoD organization. In another successful program, the IPT was used as a mechanism for identifying and making tradeoffs among system context, architecture and design, and the capabilities of commercial items. Requirements were collected and prioritized, and costs were estimated based on the commercial availability of the required capability. This information was used to rework program priorities. A third successful program developed an unusual incentive strategy that rewarded individual engineers for identifying commercial items that could be used in the system.

Suggestions

The following suggestions can help organizations embrace commercial business practices:

—*To understand the marketplace*

- Conduct market research independent of the contractor.
- Identify all significant commercial players in the relevant application area.
- Participate in the relevant conferences, trade shows, and user, professional, and standards groups.
- Identify the technology domains represented by the application area.

—*To understand the system context*

- Track changes to all commercial item guidelines and direction from the DoD.
- Reference these guidelines and direction in contract specifications.

- Propose changes to guidelines and direction to reflect new commercial items needed in the system context.
- Maintain a flexible view of requirements and business practices.
- Identify all of the stakeholders and involve them early.
- Pare down stated requirements to reflect only essential stakeholder needs.

—*To bridge the gap*

- Determine the gap between the capabilities and services provided in the marketplace and those required by the system.
- Include the vendor in tradeoff discussions when possible.
- Provide incentives to encourage the contractor to investigate all solutions that lead to the appropriate outcome.
- Don't modify the commercial item.
- Plan for a life-cycle support system for *any* modified commercial item.
- Plan to make repeated tradeoffs among the system context, the architecture and design, and the capabilities in the marketplace.
- Document all tradeoffs made.
- Provide early functional demonstrations to get stakeholder buy-in.

3.2 Evaluating commercial items

In some cases, commercial item evaluation is performed as part of source selection. This is a highly constrained form of evaluation that must be conducted only in accordance with source selection criteria and the source selection plan. However, the definition of evaluation applied in this document is far broader. Evaluation is also necessary to assist in identifying commercial capabilities when defining source selection criteria, in choosing among alternate architectures and designs, in determining whether new releases continue to meet requirements, and in ensuring that the commercial items function as expected when linked to other system components. These forms of commercial-item evaluation provide critical information about the tradeoffs among system context, architecture and design, and commercial capabilities.[12] Unfortunately, evaluating commercial items in order to identify system tradeoffs is an unfamiliar process for many program managers (and their users). It is equally unfamiliar for many contractors who are more comfortable with simply meeting a specified set of requirements.

3.2.1 It is critically important to evaluate <u>all</u> aspects of a commercial item. After a commercial item is selected, characteristics of the item and the vendor become integral parts of the system. Characteristics such as security and information assurance, inter-operability, reliability, and maintainability are of particular importance. One program selected commercial items with the expectation that the vendor would provide the necessary maintenance capabilities. However, the vendor's commercial support strategy did not provide the spares, training, or repair cycles necessary for military use. The program was left with a choice: redesign the system or buy the additional capability. Other programs struggled because they did not evaluate concerns such as the vendor's financial stability and strategic direction, the

[12] There is a wide range of techniques that can be used to evaluate commercial items in support of these tradeoffs. See [EVALUATION TUTORIAL] for a discussion of some of these evaluation techniques.

volatility of the technology on which the commercial item was based, or the frequency of commercial-item releases. On the other hand, successful programs deliberately considered these and other characteristics of the commercial item, the vendor, and the marketplace (e.g., positioning and innovation) in the evaluation process.

3.2.2 Evaluating various commercial items means comparing things that may not compare very well. A vendor's success in the marketplace depends on its ability to offer unique capabilities to attract customers. This often results in products within a market sector that are functionally, architecturally, or technically different. One program evaluated two technologies in order to determine which one was best suited for use in a communication system. The program found that the technologies could not be directly compared because each reflected different assumptions about the system in which the technology would be used. In order to conduct the evaluation, the program first had to define system architectures that reflected the best use of each technology. Then, these architectures were evaluated against the characteristics desired by the program. A decision on a specific commercial implementation could only be made after the system architecture was selected.

3.2.3 Commercial items are not always commercial off-the-shelf (COTS). The FAR definition of commercial items allows each program great latitude. Yet, the desired benefits from selecting commercial items are maximized when the items fit the more narrow definition of COTS. Programs have, on occasion, purchased commercial items they assumed to be COTS that were really versions of systems used in-house or custom-produced for another organization. In one case, the one-of-a-kind item purchased did not represent best commercial practice and had no user base or established distribution and support system. The program was subsequently cancelled. In another case, a contractor claimed that dozens of commercial items were being incorporated into a system; the program wrongly assumed that the commercial items were COTS. A post-delivery examination exposed these items to be little more than contractor-specific tools and scripts. As a result of these contractor-specific items, the program was unable to reconstruct the system without the long-term support of the contractor—an outcome they had hoped to avoid.

3.2.4 Even unavoidable tailoring of commercial items can increase program risk. Some commercial items are designed for custom tailoring. For example, database systems often require a specialized schema tailored to the user's data and applications. Likewise, passenger aircraft are designed to accommodate unique seating arrangements, engines, and communications packages. Although such tailoring is a necessary and acceptable way of doing business, any modification, including tailoring, can be a maintenance liability. One program purchased a commercial item that required extensive tailoring to meet system requirements. Program managers thought they had purchased a system solution. Rather, they had committed to development and maintenance of scripts written in a fourth-generation programming language. Significant effort was required to rework the scripts every time the commercial item was updated. In addition, the program was forced to commit to long-term use of the commercial item in order to protect its investment in scripts. Another program found that development of tailored scripts was complex and required the same careful engineering and management as traditional software-development activities. In addition, the ability to tailor commercial items invited ad hoc requirement changes and customization by end users.

3.2.5 Incomplete evaluation of commercial items will affect program planning in unexpected ways. Realizing the promise of reduced cycle times and lower program costs requires detailed insight into the capabilities of commercial items and the fit of those items within the context of the integrated system and the program schedule. It is an unfortunate commercial practice for vendors to hype new items or versions long before they are ready for release (this is one reason for the term "vaporware"). In fact, vendors often use marketplace reaction to press releases about upcoming products to decide whether or not to even produce the commercial item. One DoD project based its system schedules on the very optimistic promises made by vendors. The project was behind schedule at its inception because deliveries promised by vendors for the start of the program turned out to be many months late. Other programs fell victim to vendor claims of a fully capable commercial item only to later find that many months of vendor effort were needed to prepare the item for delivery. A detailed evaluation of vendor claims and a careful assessment of the program risks inherent in claims that could not be verified should have been conducted as part of product evaluation.

3.2.6 Evaluation will be repeated many times during the life of the system. Over the life of a DoD system, new versions of commercial items will become available and the vendor's business practices will typically change rapidly. In addition, some vendors may withdraw their commercial items from the marketplace, while other vendors may enter with new items.[13] Each of these changes may call for a new evaluation to determine whether the commercial item will continue to meet current system requirements or whether a new item adds desired capabilities or performance. One commercial organization consistently failed to reevaluate the security characteristics of new releases (versions) that provided access to a sensitive proprietary database. A security expert later expressed the concern that the corporation had not experienced any serious security breaches only because it had been lucky. A DoD program did not reconsider a decision to buy a commercial item when plans to change end-user business practices were dropped. As a result, the program invested significant effort in modifying the commercial item to bridge a newly opened gap. On the other hand, another DoD program reconsidered a commercial item two years after it was rejected because of the vendor's pricing strategy. Over the period, the vendor's pricing strategy had changed. Subsequently, the commercial item was selected and incorporated into the system.

3.2.7 A test bed is an excellent mechanism for gaining insight into the design and behavior of a commercial item. Vendors do not typically provide detailed information about such areas as commercial-item architecture, design, implementation, performance, and limitations. This lack of visibility into the workings of commercial items can hamper efforts to evaluate them for use within a larger system. One program found that building a test bed was a necessary step in product evaluation. Unless it was impractical to do so, the program did not buy any commercial item that had not been evaluated in this test bed. Another program found that participation in test beds by the end users allowed those users to contribute to decisions regarding tradeoffs among commercial item function, cost, and other factors. Other programs found that cost and schedule benefits accrued when test beds were used to discover program risks before significant rework was necessary. However, one program had unrealistic expectations about the cost and schedule savings that would result from the use of test beds. The program deployed the test bed directly into a war zone as an early demonstration of the

[13] Commercial software vendors generally have a release cycle of 18 months or less in order to stay competitive in the marketplace.

technology. The program expected that money spent on the war zone test bed would result in decreased funding requirements during full-scale development of the system. Instead, system costs went up and the schedule was extended as end users drove operational capability in a different direction than was planned for the program.

Suggestions

The following suggestions can be helpful for evaluating commercial items:

—*To develop the skills needed*

- Employ outside experts to support program-office evaluation activities.
- Train the program office and the stakeholders on how to evaluate commercial items.
- Repeat this training as personnel or the nature of the commercial items being evaluated change.
- Select a contractor who has past experience in evaluating commercial items.

—*To conduct evaluations*

- Decide in advance what information you want to gain from the evaluation of a commercial item.
- Select evaluation techniques based on the type of information required and the importance of the selection to the program.
- Unless it is impractical, evaluate potential commercial items in a system test bed.
- Consider both the capabilities of the commercial item and the business practices of the vendor.
- Take into account the business motivations of the vendors.
- Understand the vendor's strategy, and talk to other buyers.
- Understand where you stand in relation to the vendor's other customers.
- Budget for repeated evaluations throughout the program's life cycle.

3.3 Working with Contractors and Vendors

Programs are most effective in working with vendors when a program adopts practices and expectations that are familiar to vendors. Further, not only must the program act like a commercial organization, but it must also expect to be treated like a commercial organization by the vendor. Some program managers have expressed frustration that vendors do not react to program needs and direction. Other program managers have tried to use the same techniques with vendors that had been successful when applied to contractors and subcontractors—usually with disappointing results**.** It is incumbent on the program manager to determine how important the program is to a specific vendor as part of the commercial-item evaluation. The program manager can use this knowledge to establish an appropriate relationship with the vendor. In some cases, the program manager can influence the vendor to be responsive to unique program needs (e.g., by incorporating new features into the commercial item). At the same time, the DoD's unique requirements and expectations will not always sway the vendor. In this case, the program manager should revisit requirements and expectations to make sure they are absolutely necessary and, where appropriate, work to adjust them to allow the use of commercial items[14].

[14] The DoD must justify the need for a particular requirement, including an analysis of alternate means for satisfying a requirement, before commencing an acquisition. However, it is difficult to perform a good analysis

3.3.1 Tailor contractual relationships to the realities of the marketplace. The use of commercial items means that the program office and the contractor will need new skills. Contractors have traditionally been selected for their ability to build custom systems, not for their knowledge of the marketplace, expertise with specific commercial items, or ability to integrate items. A contractor's ability in these new areas and its ability to rapidly accommodate frequent technology changes will likely be as significant as the traditional factors considered in source selection. In addition, the contractor's business relationships and vendor alliances will now have the same significance as a large cadre of skilled labor. Also, a vendor is most concerned with meeting the needs of the wider marketplace, even when a DoD program represents that vendor's largest single customer. One procuring organization was strongly motivated to apply innovative commercial buying practices for purchasing a commercial item. However, the organization expected to fit those commercial buying practices within the framework of the traditional government procurement process (e.g., government specifications, paperwork, test programs, etc.). The organization assumed that the vendor would adapt to the government bureaucracy when in fact it was necessary for the program to adapt to the buying practices used in the commercial marketplace. The program found that every time the vendor adapted to suit the government, the cost of the commercial item increased.

3.3.2 Program decisions should reflect total ownership cost.[15] Both commercial and DoD programs frequently underestimate the unique sustainment costs associated with commercial items. These costs include market research, evaluation, test and integration for version upgrade, commercial-item replacement, technology refresh, and annual licensing fees. An unsuccessful program failed to capture the sustainment costs for commercial items. Sustainment costs were the responsibility of a different part of the organization. This part of the organization was consistently underfunded, and upgrades to deployed systems were delayed because of a lack of resources for testing and integration of new commercial releases. Another program was forced to slip a very aggressive schedule because training, documentation, purchase, and installation costs were not considered in making budget decisions. Successful DoD programs address many of the issues regarding cost by embracing total ownership cost models that incorporate both routine sustainment costs and costs for frequent technology updates of commercial items.

3.3.3 Vendors' price models are incompatible with familiar DoD cost models. The DoD traditionally uses cost models that are constructed from labor hours and materials plus profit. However, the price of a commercial item is determined by other marketplace factors. New price-based techniques are necessary. Program managers often have little experience in determining whether quoted prices are reasonable. One program was unable to streamline the procurement process nearly as much as anticipated because of a lack of experience in considering marketplace factors when conducting price-based analysis. Another program found that government financial managers could not determine the reasonable price for modifications to a commercial item—no comparisons with similar contracts or price history information were available. On the other hand, most programs discovered a much broader

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of alternate means without a thorough evaluation of commercial items in the marketplace. In practice, the manner in which requirements are stated can remove commercial items from consideration.

[15] For a definition of total ownership cost, see [TOC].

selection of relatively low-cost commercial offerings when traditional cost accounting data was no longer required.

3.3.4 Key vendors can be strategic partners. Do not assume that the contractor alone has sufficient insight into the commercial items. Where possible, it is important to involve vendors directly. Relationships with key vendors can take many forms. After a failed attempt at building a system, one program office determined that extensive custom modifications to a commercial item were largely to blame. For a subsequent attempt, a strict rule was adopted to resist any modifications to the selected commercial items. The program office requested that the vendor not make any DoD-specific modifications. The program made suggestions to the vendor, but asked that the vendor only make a change if it made sense commercially. The vendor checked on the viability of any enhancements by asking other buyers. This successful program was able to influence, rather than direct the vendor. Other programs found that including vendors as part of integrated product teams helped foster a more trusting partnership among the vendor, contractor, and program office.

3.3.5 Licenses and data rights define the relationship with the vendor. Licensing is the primary vehicle for securing the use of commercial items such as software; data rights are marketplace vehicles for protecting a vendor's intellectual property.[16] License agreements and data rights can and should be negotiated. One program expressed frustration that the de facto selection of a commercial item had already been made prior to release of the solicitation because of the beneficial pricing arrangements from previously negotiated *enterprise* licenses. While the larger organization saved money in negotiating one set of licenses covering use by many programs, this practice limited the individual program's flexibility in choosing the most appropriate commercial item for the system. Another program neglected to negotiate for all necessary licenses as part of the initial procurement. After the commercial item was selected and system development began, the vendor's price for additional licenses increased dramatically.

3.3.6 Commercial items frequently come with little technical data. Vendors rarely produce technical data in a format that can be used by a program—much of this data exists only in the minds of the engineers who developed the item. Therefore, it is difficult for the vendor to share the technical data that is necessary for thorough evaluation or that is traditionally required to operate and maintain DoD systems. Even when technical data exists in formats consistent with program expectations, the cost can be prohibitive because vendors are protective of their intellectual property. Yet some commercial items are so critical to the system that the program must be protected from a vendor's potential unwillingness or inability to support older releases of the product through the life of the system. Some programs found that an agreement to put technical data in an escrow account (rather than purchasing technical data directly) was a cost-effective compromise. However, one program never checked that the escrow account was set up and maintained by the vendor. When the vendor went out of business, the program was forced to gather what technical data it could from personnel who had previously worked for the vendor. On the other hand, successful programs negotiated terms of the escrow to include the essential data and contingencies,

[16] With a license, only rights to use the current version are conveyed. This is *not* the same as "buying" the commercial item.

audited the escrow account regularly to make sure the data was current and complete, and budgeted for the cost of the escrow throughout the life of the system.

3.3.7 Programs frequently overestimate the impact they can have on vendors. The relationship between the program and the vendor is, in most instances, very different from the relationship with a contractor. While contract incentives shape the relationship with a contractor, the vendor is selling a product, seldom program-unique services. Yet, programs have been successful in influencing product changes. In one case, a program worked as part of a users group to influence other customers to support changes needed by the DoD—and the vendor implemented the widely supported changes. On the other hand, other vendors agreed to customize software in anticipation of a huge number of DoD licenses. Two factors soured the relationship: changes were more widespread than planned and the number of licenses the DoD purchased was a small fraction of what the vendors originally anticipated. The DoD contract was thus less important to the vendors, which program managers believed resulted in reduced capability and poor quality in the customized commercial item. Other programs were convinced that changes to commercial items would be included in subsequent commercial releases. In several cases the custom enhancements never became part of the commercial item; the programs had to choose whether to maintain a unique version of the commercial item, or redesign the system without the modifications.

3.3.8 Consider long-term sustainment before modifying commercial items. Custom modifications to a commercial item, even if implemented by the vendor, result in *custom* items[17]. In the absence of specific contractual agreements, the vendor has little incentive to maintain custom enhancements. One organization found that, even with a maintenance contract, updates to a custom version lagged significantly behind the vendor's commercial releases and users were forced to live with older (customized) versions of the commercial item[18]. In another case, the vendor was not willing to maintain the unique version and the program office was incapable of maintaining it. Thus, *no one* was both willing and able to shoulder the burden for long-term maintenance. A successful organization that built a number of systems based on commercial items refused any modification of commercial items as not maintainable at reasonable cost.

Suggestions

The following suggestions can help organizations implement commercial buying practices:

—*To adjust buying practices*

- Train financial management and contract personnel in commercial buying practices.
- Adapt business and engineering models and acquisition strategies to accommodate the impact of using commercial items.

—*To develop and execute program budgets*

- Base planning on total ownership cost rather than catalog price.
- Investigate emerging price and cost models.[19]

[17] The definition of *commercial item* from the FAR, Part 2, allows for "minor" modifications made to meet federal government requirements. In light of problems experienced by a large number of programs that have modified commercial items, a strong position against modification is taken here.

[18] For a discussion of whether the government can choose to ignore upgrade releases of a commercial item, see section 3.4.3.

[19] One such model is COnstructive COTS (COCOTS), a cost model designed by Barry Boehm and colleagues to capture the most important costs associated with COTS component integration. See [COCOTS].

- Perform market research to support determinations of reasonable value.
- Include a budget and schedule for unexpected commercial impact.

—*To strengthen program, contractor, and vendor relationships*

- Verify the claims made for commercial items by vendors and contractors.
- Verify the availability of commercial items.
- Examine any acquisition strategy to see where it can be made more flexible or better suited to the unique commercial aspects of the system in question.
- Use contract incentives to encourage appropriate relationships .
- Maintain close relationships with vendors to exploit improvements and avoid surprises.

3.4 Engineering for life-cycle support

The importance of system engineering in systems that integrate a number of commercial items has been frequently overlooked or underestimated. At least one program struggled because it viewed the system under construction as simply a procurement of a set of qualified items. Systems that integrate multiple commercial items require extensive engineering to define system architecture with a modular design that is open enough to facilitate the insertion of new commercial technology. This is not a "one time" activity because changes in commercial items and in the marketplace may drive frequent reengineering of the system throughout the life of the program. The program manager must expect to analyze requirements, evaluate commercial items, and design, integrate, and test the system at various points in the life of the system. Failure to evolve the architecture and reengineer the system to address changes in commercial items and the marketplace will potentially result in a system that cannot be maintained as vendors drop support for obsolete commercial items.

3.4.1 Commercial items can drive the system architecture and design. Frequent changes in commercial items and their underlying technologies create a particular challenge for defining a system architecture. The architecture must be flexible enough to incorporate new releases of commercial items and to remove obsolete commercial items as necessary. One otherwise successful program selected a system architecture that was dependent on a specific commercial item. Unfortunately, the vendor went out of business. The program evaluated both commercial and noncommercial options to replace the obsolete item, but there were no acceptable alternative items. It was discovered that any change in the obsolete item would invalidate many other design decisions. The program was forced to retain the obsolete commercial item in spite of the new maintenance burden. By carefully selecting the system architecture, another program was able to replace various commercial items in a system through a succession of major updates. The updates included replacing the software language, the computer hardware, and the major communications protocols.

3.4.2 Integrating commercial items requires extensive expertise. Although the expertise is growing, relatively few programs or contractors have extensive experience integrating commercial items into DoD systems. Knowledge of both the system context and each selected commercial item is necessary. One program assumed that heterogeneous commercial items could be integrated with relatively minimal effort. The program neglected the hard engineering work needed to develop realistic integration and test schedules, to specify acceptance criteria for the system, or to plan for long-term system evolution. These oversights

resulted in unhappy users, finger-pointing between the vendors and the program office, and cost and schedule overruns. Another program found that predicting the performance of a system composed of a number of integrated commercial and custom items was difficult. Prototyping and incremental testing, which might have identified performance problems, was not used; performance problems were not uncovered until operational test and evaluation. As a result, modifications to the system were required and the number and duration of test missions more than tripled. Several other programs found that unique technical expertise was required to integrate commercial items because the internal architectural and usage assumptions of the items were unknown.

3.4.3 Plan for obsolescence and upgrades. It is tempting to assume that a program office can avoid the problems associated with upgrade by simply continuing to deploy an older release of a commercial item. While this may be true for some hardware items, it is rarely the case for software items, where new and desirable capabilities and performance are frequently added, bugs are fixed, and vendors drop maintenance for older releases. A release or two can sometimes be safely skipped, but most software commercial items (and many hardware commercial items) must eventually be upgraded, if only because of dependencies on other system components that *must* be upgraded. Except in very specific cases, the DoD is normally ill prepared to implement the necessary changes to old versions of commercial items in order to avoid technical obsolescence and keep them functioning—even when good technical data is available. However, by adopting an open system architecture[20] with modular designs, maintaining close relationships with commercial item vendors, and monitoring the marketplace, one particularly successful program not only avoided technological obsolescence, but also developed a "sparing" model that reduced the cost of spare components by 40%. Several programs were successful by deliberately pre-planning for frequent upgrades of commercial items, technology insertion, and retirement of obsolete items. Of course, even the most careful planning cannot anticipate all exigencies, such as a vendor going out of business or being taken over by a larger firm with different priorities. In the words of one program manager, you have to "pick a horse and ride it until the legs fall off." But you should also be ready to switch horses.

3.4.4 New configuration management techniques are critical. Frequent changes to commercial items have caused many programs to maintain multiple configuration baselines both during development and in the field. This places unusual demands on traditional configuration-management processes that strive to maintain a single configuration baseline. Several programs that depended on multiple commercial items found that some items required specific versions of other items in order to interface effectively. Upgrading one commercial item caused a chain reaction that demanded changes to other commercial items within the system. Given that vendors release items according to their own schedules, the programs needed a configuration-management system that could select from among multiple versions of commercial items in order to construct different system configurations. One program that was distributed over multiple locations attempted to maintain only one version of the system deployed at a time. This was impractical, however, because the process of updating all sites took up to one year. Many programs found that individual sites were not always willing to upgrade to the latest version of the system. There were many valid reasons for preferring

[20] The Software Engineering Institute has done considerable investigation into this topic. See [OPENSYSTEMS].

alternate configurations (e.g., compatibility with hardware and other systems, cost). However, without careful management, this can create a maintenance nightmare when a change has to be propagated across all configurations (as was the case in Y2K updates).

3.4.5 End-user support requires careful consideration. Effective implementation of large, complex systems requires substantial end-user support to ensure that the system is implemented correctly, that users are knowledgeable in using the system, and that they have access to customer support that responds to their questions and maintains the system. This is compounded when the system is deployed to multiple locations. One program provided user guidance rather than enforce a strict deployment and usage policy because of legitimate differences between deployment sites. Given that the different user sites operated in different ways, it was important for the sites to be able to tailor commercial items and the system to their needs and even deploy the system in a site-specific manner. The program office acted as a center of expertise on how the sites could deploy the system, and as a clearinghouse, letting the sites know what had (and had not) worked at other sites. In fact, the program delayed widespread deployment of commercial item upgrades until the new version was evaluated at selected end-user sites. In another program, the end users found that the training, guidance, and help-desk support provided by the program office were not adequate to allow the end users to integrate the system into their site-unique environments. Each site wrote a separate contract with the vendor to tailor the support provided. This was effective from the program-office perspective because individual sites bore the cost for this support. However, the objective of standardizing the DoD business practice was not achieved as each site purchased separate training and support service, and the total ownership cost was significantly increased.

3.4.6 Extensive program testing of commercial items may be required. Programs often underestimate the impact of testing commercial items. Often DoD application of commercial items requires qualification and operational testing and evaluation (e.g., live-fire testing) to show that the items continue to perform as expected in unique military environments. In addition, if the commercial item has been modified, regression testing at the system level may be needed to ensure that the modification does not change the expected performance of the system. For example, some programs found that higher performance engines could outperform the airframe, while others found that faster hardware or software components could introduce timing problems or security holes. Lack of insight into the internal workings of the commercial item changes the nature of the test program. One program's ability to conduct operational test and evaluation was complicated by the fact that data normally generated during the development testing was not available for analysis by the operational test team. Another program that was using multiple commercial items found that even basic, advertised capabilities of commercial items had to be tested before the program could begin its planned integration testing. The program's initial plans and schedules for testing commercial items underestimated the effort required by a factor of six.

Suggestions

The following suggestions can help organizations engineer their systems for life-cycle support:

—*To develop the needed skills*

- Train the system engineers on the challenge of integrating commercial systems.

- Select a contractor who has expertise in the system context, the commercial marketplace, and integration of independently developed components.
- Use independent contractors who are familiar with the marketplace to evaluate the architecture against projected technology and product enhancements .

—*To engineer the system architecture*

- Recognize the impact that available commercial items will have on the system architecture.
- Review the architectural alternatives being considered and the factors that will be used to select the system architecture.
- Validate assertions made about the flexibility of the system architecture.
- Plan for commercial-item updates and technology insertion as part of the development cycle.
- Anticipate periodic reanalysis and redesign of the system and evolution of the system architecture.
- Align contract incentives with program objectives through the life cycle.

—*To manage change*

- Ensure that rigorous configuration management is exercised.
- Base interfaces on publicly recognized industrial standards that are widely supported in the marketplace.
- Monitor the marketplace for technology advancements.
- Establish plans to work with vendors for problem resolution.

—*To test commercial items*

- Unless it is impractical, evaluate potential commercial items in a system test bed.
- Focus test beds on high-risk items.
- Test for unanticipated side effects in areas such as security, safety, reliability and performance from commercial-item upgrades.

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4. Summary

There are no “silver bullets” when dealing with commercial items. While there are significant benefits, these benefits can be attained only by understanding and addressing the significant new challenges that are driven by the fundamental differences between building items and buying them. It must also be emphasized that the risks associated with traditional system development do not disappear simply because the system makes use of commercial items. This last point is critical: no matter how much of a system is provided by commercial items, the overall system still must be engineered, developed, integrated, tested, delivered, sustained, and managed.

The program manager is ultimately responsible for ensuring that the system meets cost, schedule, and performance parameters. Success in using commercial items to meet those parameters requires the following: being an informed consumer, planning for continuous evolution of your system, and being flexible and willing to negotiate throughout the life cycle of the system.

Acknowledgments

C. Albert and E. Morris of the Software Engineering Institute, Carnegie Mellon University, prepared this document. It was inspired by and based in part on three other sources:

1. Brownsword, L., Oberndorf, P., and Sledge, C. *COTS-Based Systems for Program Managers* (briefing). Software Engineering Institute, Carnegie Mellon University, Pittsburgh, PA. 1999.
2. Carney, D., Oberndorf, P., Morris, E., Clapp, J., Engert, P., and Meehan, S. *ESC Program Manager’s Handbook on Use of Commercial Software*. Dec. 1, 1998.
3. Oberndorf, P., *Lessons learned from the use of COTS components.* Unpublished notes. 1999.

We also thank Col D. Bentley, L. Brown, D. Carney, CAPT E. Case, R.N. Donatuti, J. Foreman, M. Gagliardi, B.Garner, B. Hammons, S. Hawthorne, T. Marz, C. Meyers, M. Myers, P. Oberndorf, D. Plakosh, C. Sledge, J. Smith, K. Sorber, and W. Tracz for their insightful comments during development of this document.

5. References

[C4I STANDARDS] For information on the Joint Technical Architecture (JTA), see http://www-jta.itsi.disa.mil/. The Defense Information Infrastructure (DII) Common Operating Environment (COE) can be found at http://spider.dii.osfl.disa.mil/dii.

[COCOTS] COnstructive COTS is a cost model designed by Barry Boehm and colleagues to capture the most important costs associated with COTS component integration. It is available at http://sunset.usc.edu/COCOTS/cocots.html.

[CPM 99] Brownsword, L., Oberndorf, P. and Sledge, C., *COTS-Based Systems for Program Managers (Briefing)*, Software Engineering Institute, Carnegie Mellon University, 1999. For information, contact po@sei.cmu.edu.

[DoDD 5000.1] Defense Acquisition, March 15 1996 (Incorporating Change 1, May 21 1999) states policies and principles for all DoD acquisition programs and identifies the Department's key acquisition officials and forums. It can be found at http://web.deskbook.osd.mil/ under Reference Library, Mandatory Documents, DoD Documents, 5000.1.

[EVALUATION TUTORIAL]: This site discusses some techniques that can be used to evaluate commercial items in support of these tradeoffs: http://www.sei.cmu.edu/cbs/cbs_slides/98symposium/eval_tut/index.htm.

[OPENSYSTEMS] The Software Engineering Institute has done considerable investigation into this topic. This site provides points of contact, course information, and documents related to development of open systems: www.sei.cmu.edu/opensystems/.

[POLICY] Oberndorf, P. and Carney, D., *A Summary of DoD COTS-Related Policies*, Software Engineering Institute, Carnegie Mellon University, 1998. Available at http://www.sei.cmu.edu/cbs/papers/monographs/dod-cots-policies/dod-cots-policies.htm

[TOC] Gansler, J., *Definition of Total Ownership Cost (TOC), Life Cycle Cost (LCC) and the Responsibilities of Program Managers*, USD (A&T) Memorandum, Nov. 13, 1998.

6. Additional Sources of Information

Acquisition ReformNET Homepage. This site provides a wealth of information to government and commercial organizations regarding federal acquisition: http://www.arnet.gov.

Air Force Information Technology Superstore. This site provides access to a number of hardware, software, and service providers: http://web1.ssg.gunter.af.mil/CIT-PAD/.

Buying Commercial and Nondevelopmental Items: A Handbook. Office of the Under Secretary of Defense for Acquisition and Technology, April 1996. Available at http://www.dsp.dla.mil/documents/sd%2D2.html.

Carney, D., *Quotations from Chairman David: A Little Red Book of Truths to Enlighten and Guide on the Long March Toward the COTS Revolution.* Software Engineering Institute, Carnegie Mellon University, July 1998. This humorous document provides important insight into the use of COTS products. Available at http://www.sei.cmu.edu/publications/documents/99.reports/lrb/little-red-book.html.

Carney, D. and Oberndorf, P., "The Commandments of COTS," *Crosstalk*, May 1997. This document presents a number of critical messages regarding the use of COTS products. Postscript version: http://www.sei.cmu.edu/cbs/papers/paper3.ps.

Clapp, Judith A. and Taub, Audrey E. *A Management Guide to Software Maintenance in COTS-Based Systems.* The MITRE Corporation, Bedford, MA. November 1998.

Enterprise Software Initiative (ESI), Department of Defense. ESI provides favorable license agreements for a number of commonly used commercial software items. See http://www.nawcad.navy.mil/its/EnterpriseSoftware.

Office of the Under Secretary of Defense (OUSD), Defense Procurement Office. Develops, interprets and publishes procurement policy for the Department of Defense: http://www.acq.osd.mil/dp.

SEI COTS-Based Systems Monograph Series. This series addresses a number of topics regarding the use of COTS products in DoD systems. Available at http://www.sei.cmu.edu/activities/cbs/monographs.html.

Appendix A

FAR Definition of Commercial Item:

(a) Any item, other than real property, that is of a type customarily used for nongovernmental purposes and that —
    (1) Has been sold, leased, or licensed to the general public; or,
    (2) Has been offered for sale, lease, or license to the general public;

(b) Any item that evolved from an item described in paragraph (a) of this definition through advances in technology or performance and that is not yet available in the commercial marketplace, but will be available in the commercial marketplace in time to satisfy the delivery requirements under a Government solicitation;

(c) Any item that would satisfy a criterion expressed in paragraphs (a) or (b) of this definition, but for —
    (1) Modifications of a type customarily available in the commercial marketplace; or
    (2) Minor modifications of a type not customarily available in the commercial marketplace made to meet Federal Government requirements. Minor modifications means modifications that do not significantly alter the nongovernmental function or essential physical characteristics of an item or component, or change the purpose of a process. Factors to be considered in determining whether a modification is minor include the value and size of the modification and the comparative value and size of the final product. Dollar values and percentages may be used as guideposts, but are not conclusive evidence that a modification is minor;

(d) Any combination of items meeting the requirements of paragraphs (a), (b), (c), or (e) of this definition that are of a type customarily combined and sold in combination to the general public;

(e) Installation services, maintenance services, repair services, training services, and other services if such services are procured for support of an item referred to in paragraphs (a), (b), (c), or (d) of this definition, and if the source of such services —
    (1) Offers such services to the general public and the Federal Government contemporaneously and under similar terms and conditions; and
    (2) Offers to use the same work force for providing the Federal Government with such services as the source uses for providing such services to the general public;

(f) Services of a type offered and sold competitively in substantial quantities in the commercial marketplace based on established catalog or market prices for specific tasks performed under standard commercial terms and conditions. This does not include services that are sold based on hourly rates without an established catalog or market price for a specific service performed;

(g) Any item, combination of items, or service referred to in paragraphs (a) through (f), notwithstanding the fact that the item, combination of items, or service is transferred between or among separate divisions, subsidiaries, or affiliates of a contractor; or

(h) A nondevelopmental item, if the procuring agency determines the item was developed exclusively at private expense and sold in substantial quantities, on a competitive basis, to multiple State and local governments.

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