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THE PROBLEM WITH AVIATION COTS

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Commercial off the shelf (COTS) has become a byword for acquisition reform, but there are significant risks associated with the use of COTS products in military systems. These risks are especially acute for aviation systems. This article explains how COTS can negatively affect military acquisitions and gives ideas on how to plan and resolve COTS-caused problems.

To take advantage of the fast pace of technological advances in industry, the Department of Defense (DoD) is acquiring commercial products and components for use in military systems. Using these commercial items, called commercial off the shelf (COTS), provides the DoD with numerous potential benefits. Primarily, COTS purchasing allows military acquisition to incorporate new technology into military systems more quickly than do typical developmental programs. COTS can also reduce research and development costs. Even more important, the DoD has looked to COTS purchases to help reduce operations and support costs for military systems. Figure 1 shows why this is highly desired by the DoD; the cost of operations and support is almost three quarters the overall cost of a typical system (Jones, 1994; Phillips, 1996).

With this in mind, what could be the worst misfortune to befall an item procured as COTS? What if the item changed and the original was no longer available commercially? What if its commercial replacement would no longer work in the military system for which it was procured? The very worst misfortune, which incorporates both of these problems, would be if the item were suddenly to become government-unique, with no replacement available commercially. Becoming government-unique wouldn't entirely defeat the purpose of a COTS acquisition, but it would significantly affect support, the longest tail, and as Figure 1 shows, the greatest cost in the acquisition life cycle.

This misfortune could never affect our COTS procurement—or could it? When you have finished reading this article, you will realize that not only *can* it affect your

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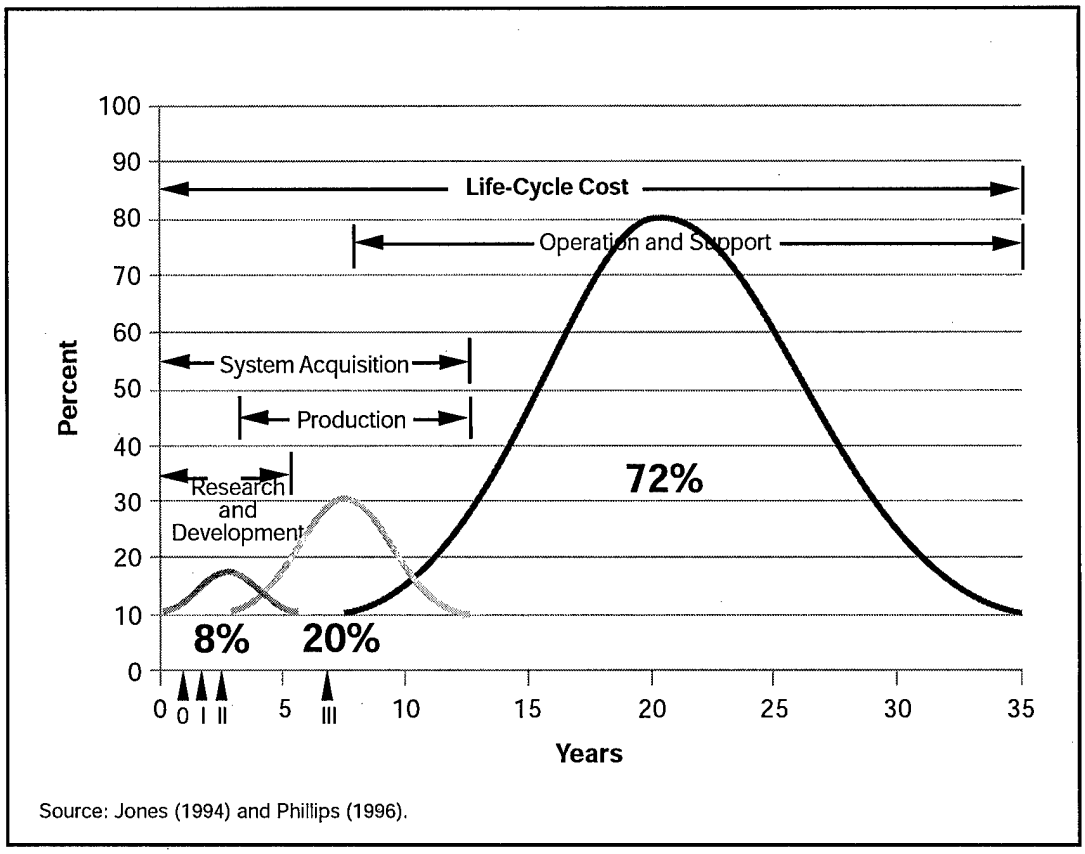


Source: Jones (1994) and Phillips (1996).

Figure 1. Typical Cost Distribution of a System

COTS procurement, but if you are acquiring aviation parts and systems, it probably already *has*. In any COTS acquisition, the acquirer needs to have already planned and prepared for this eventuality. This article shows how to plan for and gives ideas on how to constrain this COTS problem.

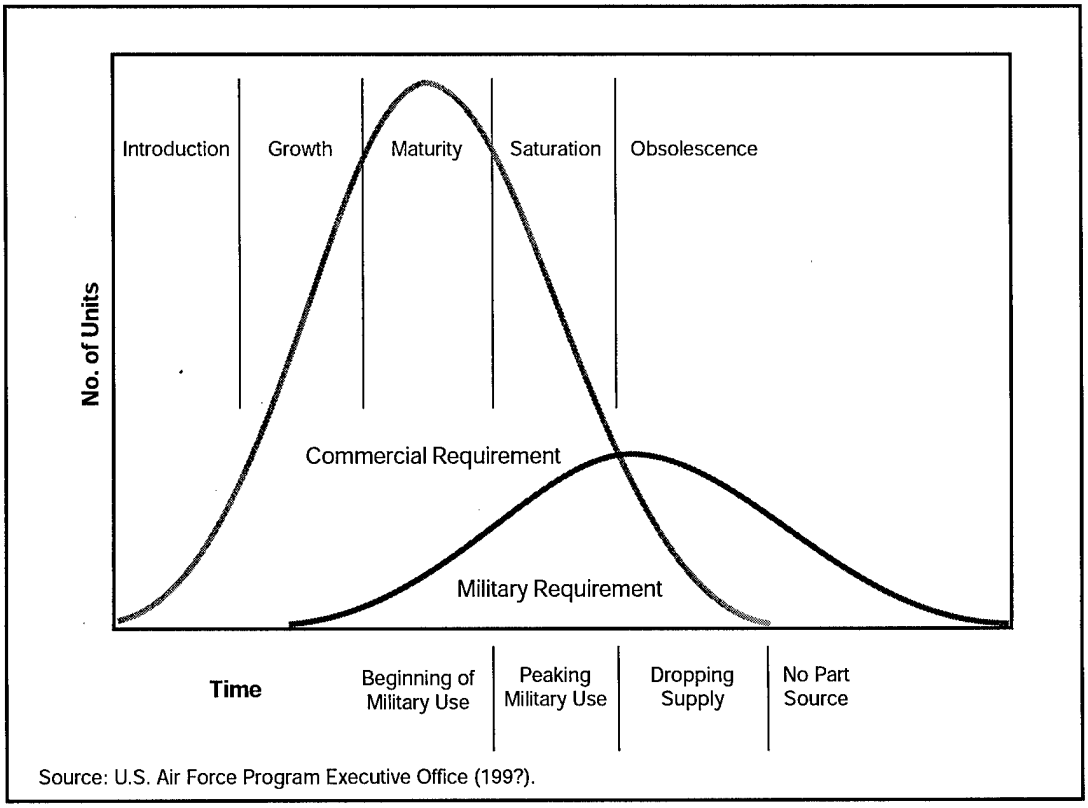
A COTS item can become government-unique whenever the manufacturer discontinues or makes a change to the item. If the item is changed, its original becomes government-unique when the government either doesn't acquire the variant or doesn't reflect the change in the systems incorporating the item and the systems' documentation. (A system, in this definition, is the higher-level mission component that the item is procured to support. For example, an aircraft and its support equipment is a system; a radio installed in the aircraft is an item.)

After a manufacturer makes a change to an item, its new variant might possibly be purchased and used without any negative effect to the system for which it was procured. In this case, even though the original item is now government-unique, the change didn't affect the form, fit, interface, or mission characteristics of the device. Unfortunately, manufacturers' changes routinely affect form, fit, interface, and mission characteristics, and the effects of these COTS item

changes for systems incorporating them are significant.

The problems of changing form, fit, and interface should be obvious; these characteristics generally cannot change if the variant item is to be installed and to operate correctly. The acquirer must usually make modifications to the system to accommodate form, fit, and interface changes. Changes to mission characteristics do not necessarily result in modifications to the system, but they can cause significant problems if they affect the overall ability of the system to perform. For example, if the new item has a temperature range less than the original, the system could possibly fail when it is used outside the bounds of that temperature range.

The most devastating cause of government-uniqueness is when a manufacturer discontinues an item. Figure 2 shows that for a large number of COTS acquisitions, this result is inevitable (U.S. Air Force Program Executive Office). The life of a typical military acquisition exceeds 20 years, yet the life of a typical civil product, especially in electronics, is much less. From our own experience we know that it is almost impossible to purchase an "ancient" Z80-based computer, but right now the Z80 lives on in the Air Force's AP–102 computer. This problem is not isolated to the electronics industry. For example, aviation "steam gauges," the mechanical gauges on instrument panels, are becoming nearly impossible to obtain —electronic gauges are replacing them.



Source: U.S. Air Force Program Executive Office (199?).

Figure 2. COTS Obsolescence

The above concepts provide the definitive framework under which COTS must be understood: The manufacturer is free to make changes to or even discontinue the manufacture of the COTS item without notice. As long as item changes don't affect form, fit, interface, mission characteristics, or supply, there is no problem for the acquirer. The problem is that the acquirer has no control over these changes. When changes do affect form, fit, interface, mission characteristics, or supply, these changes become a significant problem for any COTS acquisition. This is especially true for aviation COTS.

AVIATION-SPECIFIC PROBLEMS

The effect of a manufacturer's changes to aviation COTS can be boiled down to two specific difficulties, airworthiness and forced modifications. Airworthiness is the primary safety characteristic of any aircraft. It is the primary element proven in the testing of the aircraft. The Federal Aviation Administration (FAA) certifies the airworthiness of most COTS items for aircraft. These items must be certified in the system as well as individually.

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Military system certification, except for FAA-certified aircraft, is accomplished wholly by the aircraft's configuration management (CM) authority. What this means for COTS articles is that a simple change of mission characteristics, including improved functionality, will always drive a recertification of the aircraft. This recertification can range from a paper review to full flight test. Considering the rate of change of COTS items, this is a daunting prospect for the CM authority. In addition, COTS item changes can also drive a change to the specifications and technical data of any system on which these items are installed—also a daunting prospect.

The other difficulty for aviation COTS, which also affects any system, is forced modifications. A forced modification is one that is caused by the change of form, fit, interface, function, mission characteristic, or supply of the item. When supply is affected, the acquirer must support the discontinued item or find a replacement. The latter may force a modification.

More common in aviation COTS is an FAA-directed change to an item called an airworthiness directive (AD) FAA, 1996).[1] Airworthiness directives are Federal Aviation Regulation (FAR)-based orders that mandate a change to an aviation item or system. These directives are regulatory in nature and "no person may operate a product to which an airworthiness directive applies except in accordance with the requirements of that airworthiness directive" (FAA, 1996).

The manufacturer has two choices in implementing the AD: Discontinue the product or make the required change. The user of the item also has two choices: Get a replacement product, if available, or make the changes required by the directive. When the change affects the form, fit, or interface of the item, an AD forces a modification to the system to accommodate the item. For FAA-certified aircraft, the system must also be certified

by the FAA for flight. For government-certified aircraft, to comply with such an AD, the CM authority must modify the system and certify airworthiness.

But there is no requirement for the government to change its COTS items to accommodate an AD. In such cases, the item becomes government-unique. Because the government self-certifies, it is not uncommon for non-FAA-certified government aircraft to not make AD-directed changes.

Further, because the government in many cases does not subscribe to technical changes from manufacturers, the CM authority may not be aware of ADs to a system's components.

This problem is exacerbated when the CM has established a depot for a COTS acquisition and is, in that case, supporting the component without knowledge of or real commonality with the original item. ADs are not an isolated or uncommon problem. In the case of aircraft, ADs normally occur more than once per year on even well-established air vehicles, and it is typical to have thousands of ADs affecting a single aircraft model.

All this boils down to the fact that, for aviation, a COTS item will become government-unique in a very short period of time—from a few months to a year after the acquisition of the item. Government uniqueness means forced review, modification, support changes, and recertification when the change is recognized—or blissful ignorance and risk if the change is not recognized.

Some Solutions

What can be done to prevent these problems for aviation systems specifically and all systems generally? One solution has been hinted at, and this solution has been accomplished with varying degrees of success since the first acquisition of COTS items. This is the acknowledgment of an item's potential government-uniqueness before the manufacturer makes any changes. In this strategy, the acquirer purchases spares and builds a government depot activity to support the item. This solution does take advantage of the COTS item commercial development, but the overall cost savings may not be significant because the longest tail—the support tail—is at least as long as any normal government item development. In fact, the support tail may be costlier because the government has not been involved in the item development.

"Another solution is to purchase enough spares for the total life of the system and item."

Many programs use this strategy; the C–130 improved auxiliary power unit program is one example. Another solution is to purchase enough spares for the total life of the system and item. The AP–102 computer program used this strategy to ensure sufficient Z80 chips to support the life of the system. Again, this is not an optimum solution because it usually increases the item's logistics tail. In this case, if the item's life expectancy is less than predicted or the item's life is extended, the government has no other recourse than to entirely replace the item or to develop a

support capability. These two solutions, government depot and lifetime spares buy, prevent forced modifications and subsequent airworthiness certification requirements, but as discussed above, they also can introduce risk. They also defeat two major potential advantages of COTS: the ability to reduce the support tail and the chance to take advantage of future commercial developments in the item.

There exist four other solutions to these problems that do take full advantage of the possibilities of COTS acquisition, but they are each fraught with their own risks. Each is a variant of what is commonly known as contractor logistics support (CLS). In the first alternative, the acquirer can purchase the servicing information support of the manufacturer. This allows the CM authority to make decisions based on changes to the item. If the CM authority knows of a manufacturer's changes to an item, they can choose to acquire a replacement or modify the system as required to allow continued use of the variant item (Defense Systems Management College, 1997).

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The risks involved in this are three. First, when an item changes, there is the cost to acquire and certify a new item if the decision is made to replace it. Second, there is the cost to certify and possibly modify the system if the item is retained. And third, there is the cost to set up support if a decision is made to not make any changes to the item. The advantages of retention or replacement are the continued COTS logistics tail and guaranteed item certification. System recertification is still required. If the item is retained in its original configuration, the decision to support a now government-unique item leads to a typical high-cost government logistics tail. To my knowledge, this pick-and-choose method of systems support has not been used intentionally; however, after a manufacturer has made unexpected changes to a COTS component, many programs have found themselves in this situation.

The second alternative is that the acquirer can purchase manufacturer support for the item. The risks in this are similar to that of purchasing servicing information support; however, the manufacturer has more incentive to keep the item within form, fit, and interface configuration for the system. When changes in the system are required to support changes in the item, the manufacturer can aid the CM authority. This is a very common method used to support COTS.

In the third alternative, the acquirer can purchase the full, integrated support of the manufacturer. This allows the manufacturer to make changes to the system along with changes to the item. The contractor may have some total system performance responsibility (TSPR), but the CM authority must still recertify the system. The AC–130U is using this method to manage COTS in its new integrated weapon system support program. This is the most common method used today to support COTS items and systems through CLS.

The fourth solution is for the acquirer to purchase full system support that would allow an integrator to automatically make the necessary changes to the system to

accommodate any item changes. In this scenario, the contractor would have TSPR and certify the weapon system. This fourth option is used now primarily to support FAA-certified government aircraft. It could potentially be used to support any government aircraft or system incorporating COTS items.

The message should be plain. COTS acquisitions lead the acquirer down two support paths: the government-unique high-cost logistics tail and the COTS manufacturer support tail. Both paths involve risk and guarantee future costs for any system incorporating COTS items. The potential of COTS acquisitions is embodied in a lower cost development, initial acquisition, and support costs, but that potential must be balanced with the knowledge that COTS acquisitions will either force modifications and recertifications or lead to a typical government-unique logistics tail.

COTS for aviation isn't dead, but it isn't a simple solution to aircraft and aviation acquisitions. It requires careful planning and forethought that must be incorporated into any program contemplating a COTS acquisition.

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ENDNOTE

1. An example of airworthiness directives can be viewed at www.safetydata.com