Supporting Commercial Software

Lt. Col. Lionel D. Alford
United States Air Force

Commercial and Nondevelopmental Items (CANDI) has become a byword for acquisition reform, but there are significant risks associated using CANDI products in military systems. These risks are especially acute for software. This paper explains how CANDI can negatively affect military acquisitions and gives ideas on how to plan and resolve CANDI-caused problems.

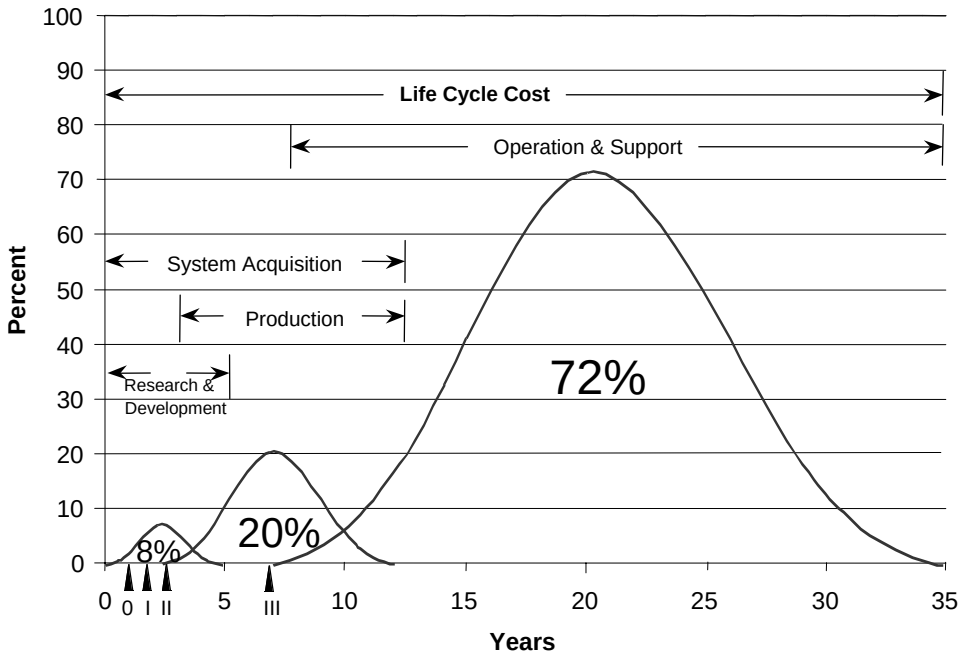
To take advantage of the fast pace of technological advances in industry, the Department of Defense (DoD) is acquiring commercial products and components, called CANDI, for use in military systems. CANDI provides the DoD with numerous potential benefits.

Primarily, commercial purchases allow military acquisition to incorporate new technology into military systems more quickly than typical developmental programs. CANDI also can reduce research and development costs. Even more importantly, the DoD has looked to commercial purchases to help reduce operations and support costs for military systems. Figure 1 shows why the DoD finds this highly desirable; the cost of operations and support is almost three-quarters the overall cost of a typical system. What could be the worst misfortune to befall software procured as CANDI—that the software changed and the original version was no longer available commercially? What if the commercial replacement would no longer work in the military system for which it was procured? The absolute worst misfortune that incorporates both of these problems is if the software were to suddenly become government-unique—no replacement was available commercially. Becoming government-unique would not entirely defeat the purpose of a commercial software acquisition, but it would significantly affect support, the longest tail and as shown in Figure 1, the greatest cost in the acquisition life cycle. This misfortune could never affect our commercial procurement, or could it? When you have finished this article, you will realize that not only can it affect your commercial procurement—if you are acquiring software, it probably already has. In any commercial acquisition, the acquirer needs to plan for this eventuality. This article will show you how to prepare for and give you ideas on how to constrain this problem.

An item is "government-unique" when the government is the only source of the item—this is the conceptual opposite of a commercial item. In terms of logistical support, an item is a discrete unit that can be individually acquired for the logistical support of a system. Software, in this definition, is an item while a system is the higher-level mission component the item is procured to support. For example, an aircraft and its support equipment are a system; a radio installed in the aircraft is an item, and the software that integrates the radio into the aircraft is an item. Whenever a manufacturer discontinues or makes a change to a commercial item, the item can become government unique. When the manufacturer changes the item, if the government does not acquire the variant or does not reflect the change in the systems incorporating the item and the systems' documentation, the original becomes government unique. After a manufacturer makes a change to an item, the government might be able to purchase and use the new variant without any negative effect to the system. In this case, although the original item is now government unique, the change did not 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 commercial item changes for systems incorporating them are significant. The problems of changing form, fit, and interface should be obvious; if the variant item is to be installed and operate correctly, these characteristics cannot change. To accommodate form, fit, and interface changes, the acquirer must make modifications to the system. Modifications are costly and usually result in the original item becoming obsolete. Changes to mission characteristics do not necessarily result in system modifications, but if they affect the overall ability of the system to perform, they can cause significant problems. For example, if the new software version incorporates undocumented features or unnecessary compatibility, the entire system's security could be at risk.

Although software configuration changes can cause havoc in any program, the most devastating cause of government

Figure 1. *Typical Cost Distribution*[1]



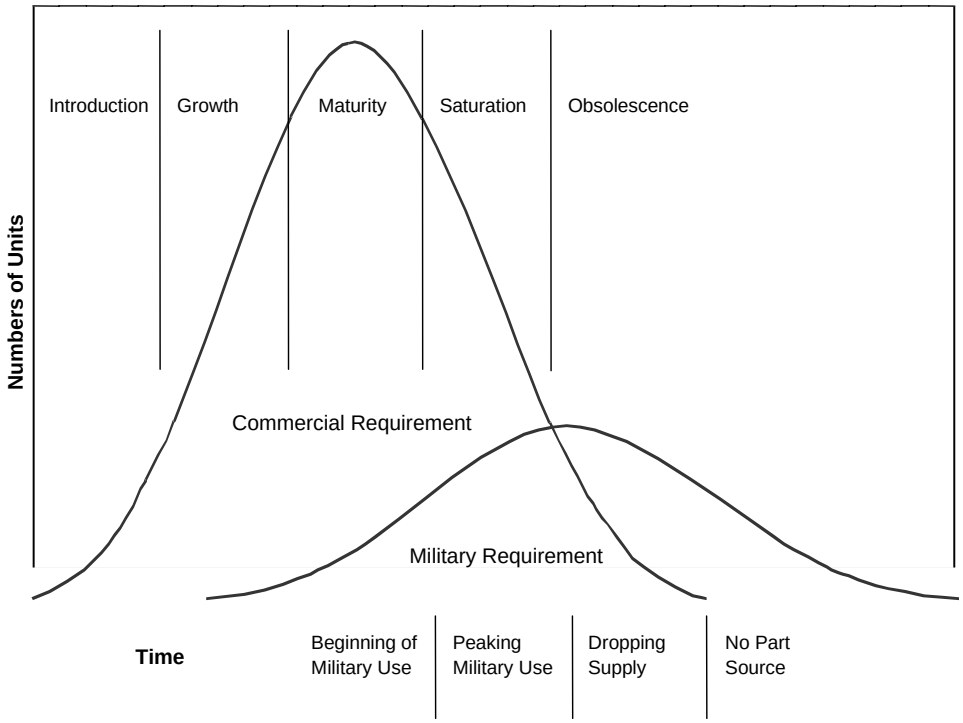


Figure 2. *COTS Obsolescence*[2]

uniqueness occurs when a manufacturer discontinues an item. Figure 2 shows that this is inevitable for a large number of commercial acquisitions. The life of a typical military acquisition exceeds 20 years, yet the life of a typical civil product, especially in electronics is much less. This example is for hardware, but the critical integration of most of our modern hardware systems is via software. Not only does the software have to change to accommodate changing items, but as hardware improves software must continue to increase in capability. Through experience with computer hardware, we know an "ancient" Z80-based computer is almost impossible to purchase, but now the IBM 1750 chipset, a 5 MHz Z80 generation processor, lives on in the Air Force's AP-102 computer. The critical difference with software is that although the IBM 1750 still powers the AP-102, the software that interfaces and operates the AP-102 has changed almost yearly since the first fielding of the AP-102.

The above concepts provide the definitive framework under which commercial software must be understood: without notice, the manufacturer is free to make changes to or discontinue the manufacture of the commercial item and its supporting software. As long as the manufacturer's item changes do not affect form, fit, interface, or mission characteristics the acquirer has no problem. The problem is that the acquirer has no control over these changes, and when changes do affect form, fit, interface, or mission characteristics, these changes become a significant problem for any commercial acquisition. This is especially true for aviation CANDI.

The effects of a manufacturer's changes to aviation CANDI 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 FAA certifies the airworthiness of commercial items for aircraft, and these items must be certified in the system as well as individually. In addition, certification is an inherent governmental responsibility that cannot be delegated to a contractor [1]. Because of this, military system certification, except for FAA-certified aircraft, is accomplished wholly by the aircraft's configuration management (CM) authority. In the Air Force this authority is the Single Manager (SM). What this means for CANDI software 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. The rate of change in commercial items can be significant. This is especially true for aviation CANDI. Considering the rate of change of commercial items, frequent recertification is a daunting prospect for the CM authority. In addition, commercial item changes also can drive changes to the specifications and technical data of any system on which these items are installed, a daunting prospect.

Forced modifications are the other difficulty for aviation CANDI that also affects any system. A forced modification is a system's modification caused by the change of form, fit, interface, function, or mission characteristic of the item. When a change affects a mission characteristic, the acquirer must support the discontinued item or find a replacement. The later may force a modification. More common in aviation CANDI is a FAA-directed change to an item called an airworthiness directive (AD) [2]. Airworthiness directives are Federal Aviation Regulation-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 [2]." 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: find 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 FAA must also certify the system for flight. For government-certified aircraft, the CM authority must modify the system and certify airworthiness in order to comply with an AD. However, the government is under no obligation to change its commercial items to accommodate an AD. If the government does not change a commercial item to comply with an AD, the item becomes government unique. Because the government self-certifies, commonly, non-FAA certified government aircraft do not make AD directed changes. Further, because in many cases the government does not subscribe to technical changes from manufacturers, the CM authority may not be aware of ADs to a system's

components or software. This problem is exacerbated when the SM has established a depot for a commercial 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. Typically on well-established airvehicles, ADs normally occur more than once per year, and thousands of ADs may affect a single aircraft model.

All this boils down to the fact that, for aviation, a commercial item will become government unique in a very short period of time—from a few months to a year following 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.

Change to aviation CANDI is not the only certification problem that confronts the SM or Designated Approval Authority (DAA). Communication and intelligence C^2 software and hardware systems require their own item and system certifications. The terms "networthiness" and "infoworthiness" are beginning to come into their own. These terms refer to the security of hardware and software systems connecting communication and intelligence infrastructures. Any changes to an item or software requires recertification of the system for security. For communication and intelligence C^2 software and hardware systems this is the DAA's responsibility. In all other cases, the CM authority must certify the security of the software.

Commercial Support Strategies

What can be done to prevent these problems for software 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 commercial items.

Organic Support

This approach 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 original commercial item 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. Many programs use this strategy; the C-130 improved auxiliary power unit program is one example.

Lifetime Spares

Another similar 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 IBM 1750 chipsets 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. Further, although lifetime buys might seem to freeze software changes, as the example of the AP-102 computer shows this is rarely the case.

These two solutions, government organic support 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 CANDI—the ability to reduce the support tail and the ability to take advantage of future commercial developments in the item.

There are four other solutions that take full advantage of the possibilities of commercial acquisition, but they are each fraught with their own risk. Each of these four solutions is a variant of what is commonly known as Contractor Logistics Support (CLS). In this context CLS does not refer to basic maintenance support but rather to data and software support of modifications to support changes to commercial items.

Purchase Technical Information

In the first alternative, the acquirer can purchase the manufacturer's servicing information support. 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. The SM has three options:

- First, when an item changes, if it is decided to replace the item, the SM must acquire and certify the new item.
- Second, if the item is retained with changes, the SM must certify and possibly modify the system.
- Third, if it is decided to not make any changes to the item, the SM must set up government-unique support.

The advantages of retention or replacement (Options 1 and 2) are the continued commercial logistics tail and guaranteed item certification. The SM must still recertify the system. If the item is retained in its original configuration (Option 3), 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 commercial component, many programs have found themselves in this situation.

Purchase Manufacturer Support

The second CLS alternative is that the acquirer can purchase manufacturer support for the item. The risks are similar to purchasing servicing information support; however, the manufacturer has potentially greater 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 common method used to support CANDI.

Purchase Manufacturer Modification Support

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 CANDI in its new Integrated Weapon System Support Program. This is the most successful method used today to support commercial items and systems through CLS; however, it requires a continuing commitment to the manufacturer and to support funding.

Purchase Full Manufacturer Support

Fourth, the acquirer can 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 a government agency other than the military (the FAA, for example) would certify the weapon system. This option is used now primary to support FAA-certified government aircraft. It could potentially be used to support any government aircraft or system incorporating commercial items. A problem with this method of support is that FAA certification of aviation systems may not fulfill military requirements. In addition, the DAA or SM must still certify system security.

Conclusion

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

CANDI software is a viable method of military acquisition, but it is not a simple solution. It requires careful planning and forethought that must be incorporated into any program contemplating a commercial acquisition.◆

References

1. Office of Federal Procurement Policy. (Sept 92). OMB Policy Letter 92-1, Inherently Governmental Functions. OFPP Pamphlet No. 6 (Revised), Fourth Edition, December 1992. Washington, DC: Government Printing Office.
2. Federal Aviation Administration. (Feb 1996). Part 39—Airworthiness Directives, Federal Aviation Regulations. Washington, DC: Government Printing Office.

See www.safetydata.com for an example of Airworthiness Directives.

Notes

1. Source for figure is Defense Systems Management College. (December 1997). T5-610 Acquisition Logistics and Systems Engineering, Technical Perspective: Logistics Management.
2. Source for figure is Obsolescence Crisis. Joint Stars: Joint Surveillance Target Attack Radar Briefing.

About the Author

Lt Col Lionel D. Alford, Jr. is the Aeronautical Test Policy Manager for Air Force Materiel Command, Wright-Patterson Air Force Base, Ohio. He is an Air Force experimental test pilot with over 3,600 hours in more than 40 different kinds of aircraft and is a member of the Society of Experimental Test Pilots. He has served as the Chief, Special Operations Forces Test and Evaluation Division at Wright-Patterson, Chief, Testing Commercial Aircraft for Military Acquisition Office at Edwards Air Force Base, Calif., holds an Airline Transport Pilot license, and was the chief test pilot for a number of Air Force acquisitions. He is a graduate of Defense Systems Management College Advanced Program Management Course. He has a master's degree in mechanical engineering from Boston University and a bachelor's degree in chemistry from Pacific Lutheran University.

Lt. Col. Lionel D. Alford Jr.,
USAF, HQ AFMC/DOP
Bldg. 262, Room S143, 4375 Chidlaw Road
Wright-Patterson AFB, Ohio 45433-5006
Voice: 937-257-8496
Fax: 937-656-1246
E-mail: Pilotlion@aol.com,
Lionel.alford@wpafb.af.mil