COTS FOUNDATIONS: ESSENTIAL BACKGROUND AND TERMINOLOGY

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ABSTRACT. One of the hottest topics in government procurement over the past ten years has been the application of commercial-off-the-shelf, or COTS products. And so it is critical that those responsible for procurement understand the foundations, recent history and terminology for this emerging paradigm. This paper defines COTS by giving a comprehensive history, explaining essential elements and defining terms and acronyms. It focuses on the recent history since the landmark "Perry Memo" of 1994, to current progress. Important issues such as intellectual property are also presented. The purpose of this paper is to provide a background as well as a working reference for academics and government procurement officials.

INTRODUCTION

Recently, a colleague said to me *"I am just getting into the aerospace business and it has taken me a full year to learn the acronyms."* And so it is with any new paradigm – especially those that are technical or complicated – a new language is born. The COTS community epitomizes this. Although it has been around for more than a decade, the terminology is still not well known.

The spark for this paper came at a COTS software conference when I used the term "MOTS." A few people laughed and later told me they thought I made it up as a joke. Indeed not. The term has been defined and in use for more than 10 years. I thought that if people *at a COTS software conference* did not know a fundamental COTS term, then it was

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time to put some definitions out there. Each word and acronym has a specific meaning that delineates it from another word or acronym. To speak precisely in technical exchanges, these subtle meanings are important.

This paper is intended to be a reference not only for academics, but also for those in government acquisition who need to speak with authority about COTS procurement. This paper is not a study, experiment, nor meant to profess new theory; it is a background, reference and clarification of the COTS paradigm. It will first cover a brief history of the COTS movement in the United States Department of Defense (DoD), and then define terms and acronyms, including the official definitions, practical ones, and examples and summaries when appropriate.

A BRIEF HISTORY OF COTS IN DOD PROCUREMENT

Make no mistake: the DoD has been using commercial products since the Revolution. Guns, ammo, pitchforks, paper, feather pens, and so on. More recently, personal computers (PCs), aircraft, and cell phones. During the mid-twentieth century, air superiority had been established as necessary to an effective defense, and aerospace and computing (a required component of aerospace) were coming into their own. The integrated circuit, more commonly known as the "chip," was initially developed privately – that is to say not by the government. However, it was the government *pull* (mostly for aerospace) for this new technology that allowed it to be produced in quantity, thus making it available commercially. In the mid-1980s personal computers were available at reasonable cost and commercially available to the public. Since then, the decreasing cost and increasing computability of the personal computer is well known.

In 1965, Gordon Moore (co-founder of *Intel*, but then of *Fairchild Industries*) postulated that chip density would double every 18 months. This of course is the famous "Moore's Law,"[1] which has held in approximation ever since. Chip density and thus computing power has indeed increased exponentially. Correspondingly, the cost of computing has gone down.

The DoD was instrumental in the technology boom of the second half of the twentieth century: computing and aerospace to name two key

industries. Since in those days, many projects were feasibility studies, as new technologies were unproven, the then fledgling companies could not afford to sponsor them as one failure could cost them the company. And there were many, many failures. Accordingly, the DoD developed appropriate contracting methods where the government would assume financial risk. This was especially important for projects that if unsuccessful would quite literally as well as figuratively blow up in industry's face, and many did. There were countless technological failures in aerospace, but there was ultimate success. So much so that within the time period discussed, aerospace technologies moved seamlessly into the commercial world. Today commercial communication satellites account for everyday communications, television, credit card transactions, and countless other tasks.

In 1994, then Secretary of Defense William Perry well recognized the potential for commercial products in the DoD and authored what has come to be known as the "Perry Memo."[2] Entitled *Acquisition Reform – Mandate for Change*, Perry asserted that business policies that once made sense were no longer applicable to current technologies. Commercial-off-the-shelf, or COTS would become an integral part of DoD procurement. For its feasibility studies both of the past and present, the government uses contracting methods suitable for such. For example, the cost-plus-award-fee (CPAF) contracting method, where the government covers all the contractors cost, plus adds an award fee (their profit), works well for an unproven technology. The government program manager and his or her staff oversee every level of development and verify all costs. The award fee is based on the contractor's performance. However, this method would clearly *not* make sense when buying an item off the shelf. Rather, a firm-fixed price (FFP) is typically applied.[3] With FFP, the government does not have the responsibility or latitude to monitor every component of the product. Whereas with CPAF, the government program manager is required to monitor every step of the project. With a custom system designed under CPAF, the government designed appropriate *milspecs* (military specifications) essentially designing the product.[4]

With a COTS item – already built – the government *cannot* monitor the build process, nor should it. For example, Dell computer hardware is widely used in the DoD. Think of what a waste of time, money, and really how downright silly it would be for DoD program managers to monitor operations at a Dell facility. And so, *milspecs* cannot apply; they

simply do not make sense (Carter & Perry, 1999). Rather, the government puts forth performance-based requirements, and then the program manager finds a COTS product that meets those needs. Typically, the government can test the COTS product prior to purchase on a firm-fixed price basis. The concept is simple and the advantages are clear for procurement of proven technologies.

- Risk is low since the product is already established.
- Cost is known ahead of time.
- Time is saved.

Better, faster, cheaper. That is, *if* the commercial product fills the performance requirements.

In the 'old days,' there simply were no high-tech items available off the shelf. Today, one can purchase computers, servers, memory, solar cells, aircraft and even satellites off-the-shelf. Currently, about 80% of satellite communications used by DoD Central Command are on commercial satellites. In many cases, if a commercial product serves a large enough portion of the product performance requirements, it is either used if deemed satisfactory, or modified. There are many different terms for the varying stages of modification, discussed later.

COTS TERMINOLOGY

This section defines each important commercial-related term using government terms.[5]

Commercial Item. This is an enormously broad term that incorporates many agencies and many types of products. My apologies for including all this, but it bears presentation for a complete and comprehensive knowledge of other commercial procurement-related terms. Skim at the most. The government definitions are as follows.

COMMERCIAL ITEM (FEDERAL ACQUSITION REGULATION

(a) Any item, other than real property, that is of a type customarily used by the general public or by nongovernmental entities for purposes other than governmental 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— B-1

(1) Such services are procured for support of an item referred to in paragraph (a), (b), (c), or (d) of this definition, regardless of whether such services are provided by the same source or at the same time as the item; and

(2) The source of such services provides similar services contemporaneously to the general public under terms and conditions similar to those offered to the Federal Government;

(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. For purposes of these services—

(1) "Catalog Price" means a price included in a catalog, price list, schedule, or other form that is regularly maintained by the manufacturer or vendor, is either published or otherwise available for inspection by customers, and states prices at which sales are currently, or were last, made to a significant number of buyers constituting the general public; and

(2) "Market Prices" mean current prices that are established in the course of ordinary trade between buyers and sellers free to bargain and that can be substantiated through competition or from sources independent of the offerors;(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) 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.[6]

COMMERCIALLY AVAILABLE OFF-THE-SHELF ITEM

(a) Any item of supply—

(1) Other than real property, that is of a type customarily used by the general public or by nongovernmental entities for purposes other than governmental purposes, and that has been sold, leased, or licensed to the general public;

(2) That is sold, leased, or licensed in substantial quantities in the commercial marketplace; and(3) That is offered to the Government, without modification, in the same form in which it is sold, leased, or licensed in the commercial marketplace.

Standard options are not modifications (does not include bulk cargo, as defined in 46 U.S.C App. 1702, such as agricultural and petroleum products.[7]

COTS (Commercial-Off-The-Shelf)

COTS items are commercial items that have been sold, leased, or licensed in substantial quantities in the commercial marketplace and that are offered to the Government without modification. The COTS definition does not include services or bulk cargo, such as agricultural and petroleum products. A product does not have to be COTS to meet the "commercial item" definition. COTS items are a subset of commercial items. The commercial item definition is much broader and embraces products other than those that are presently available off the shelf. It includes items that have only been "offered" for sale, lease, or license to the general public—the items do not need to have been actually sold, leased, or licensed yet. It also includes items that have evolved from a commercial item and are offered for sale, even if they are not yet available in the commercial marketplace. However, only evolved items that will be available in the commercial marketplace in time to satisfy the delivery requirements stated in the solicitation meet the "commercial item" definition. In addition, all other elements of the commercial item definition at FAR 2.101 must also be met.[8]

NONDEVELOPMENTAL ITEM (FAR 2.101)

(a) Any previously developed item of supply used exclusively for governmental purposes by a Federal agency, a State or local government, or a foreign government with which the United States has a mutual defense cooperation agreement;

(b) Any item described in paragraph (a) of this definition that requires only minor modification or modifications of a type customarily available in the commercial marketplace in order to meet the requirements of the procuring department or agency; or

(c) Any item of supply being produced that does not meet the requirements of paragraph (a) or (b) solely because the item is not yet in use.[9]

NONDEVELOPMENTAL ITEMS

> Nondevelopmental items (NDIs) are considered commercial items if the procuring agency determines that they were developed exclusively at private expense and sold in substantial quantities on a competitive basis to multiple state and local governments.[10]

MOTS (Modified-Off-The-Shelf)

Modified COTS (MOTS) - COTS items that have been modified to meet a specific form, fit, function or interface requirements.[11]

GOTS (Government-Off-The-Shelf)

"GOTS" is a commonly used term for NDIs that are Government-unique items in use by a Federal agency, a state or local government, or a foreign government with which the United States has a mutual defense cooperation agreement. The words "of a type" facilitate the acceptance of a best-value GOTS/NDI offer in response to a competitive FAR Part 12 solicitation when the offered GOTS/NDI items are sufficiently like similar items sold, leased, or licensed, or offered for sale, lease, or license, to the general public. [12]

IP (Intellectual Property)

With regard to acquisition, this one is so sticky that the DoD has dedicated an entire publication to it.[13] In order to successfully and legally procure commercial products, one must understand the parameters, subtleties and meaning of *intellectual property*. The concept is simple, but the application is complicated – different in every case; every contract. *Intellectual property* is the intangible property that accompanies the deliverable. Just as when an individual owns a book, he or she does not own the copyright on the intellectual material in the book. Or, closer to home, if you have purchased this journal, you now own the journal, but cannot copy the material in it; as it is intellectual property. You paid more for the journal than the value of the paper because you purchased the knowledge that went into publishing it.

For example, when the government adheres to a performance requirement and procures a software program, it now owns a license to use the software, but does not own the source code; that is the *intellect* required for the program to work. In the case of software, the source code is intellect that has been developed before the contract and called

"background IP." This is *typical* of software, but there are many cases where the government needs to own the source code in order to either modify and fit their system, (as in a MOTS software program) or wants to own it for security reasons. In some cases, government managers want to own source code for fear of the software company going out of business and not being able to provide support or upgrades. Commercial companies are typically reluctant to give up the rights to their own source code, as development costs are huge, and is usually their core technology. Without a doubt, this has required changes in the DoD procurement philosophy, and a need for government users and managers to more seriously consider when control is necessary, and when not. And when control is optimal financially, and when not. For example, though I am typing this on a laptop furnished with Windows software, and I own the license to use this Windows program, I do not own the source code for it. That's fine. *I don't want the source code, I just want something that will help me type this paper.*

Software is a very interesting case as it is nearly pure intellectual property. Transferring it costs nearly nothing; the greatest cost for the company is development; indeed their intellectual property. In almost any case, it is considerably more expensive for the government to own the intellectual property. On the other hand, if a software program is produced under a government project (design and build), then it is the government that needs to be covetous of the IP; in this case the source code, as it has paid for the intellectual property.

As mentioned, with IP, much depends on the project, and contracts are ideally tailored to meet needs while optimizing budgets. The IP government handbook cites one of the FARs that addresses this.

ISSUE CATEGORY 2: PATENT RIGHTS—RETENTION BY THE CONTRACTOR

Regarding large, for-profit businesses, the only provisions of the Patent Rights—Retention by the Contractor (Long Form) clause that are statutory and cannot be waived or modified are the Government-purpose license and "march-in rights." Therefore, the contracting officer can obtain a FAR deviation modifying the FAR 52.227-12 patent rights clause for all other issues arising under this clause.

This being “Issue 2,” you have no doubt guessed that there are more. You are right: dozens more. The government procurement officer should be well familiar with these.[14]

The cited document provides examples of how to organize and prosecute contracts involving IP.

COTS RELATIVE TERMS

The following figures illustrate how the aforementioned terms relate to one another and provides a summary of definitions. As shown in Figure 2, commercial products are often the building blocks for more specialized products. Computers and workstations are typical; though some workstations are still custom-made for very specialized tasks. But even a custom-made workstation will use commercial chips and other parts – say the keyboard. Commercial parts such as bolts and steel frequently go into aircraft; though with some fighter aircraft the bolts and steel must be custom-made. Commercial communication satellites are now common, but other satellites made for specialized purposes are custom-built.

FIGURE 1
The Commercial to Custom Hierarchy:
As one moves up the triangle to the apex, typically cost, development time, specialization increase

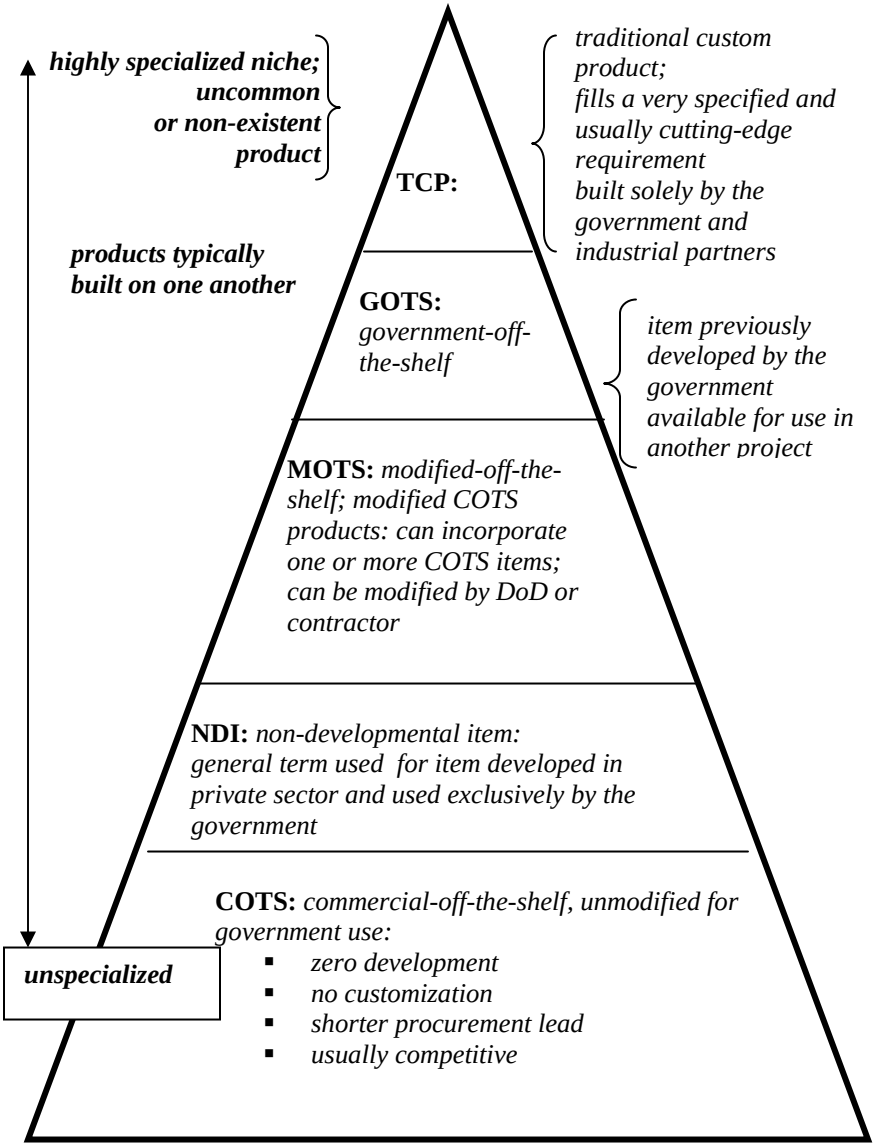
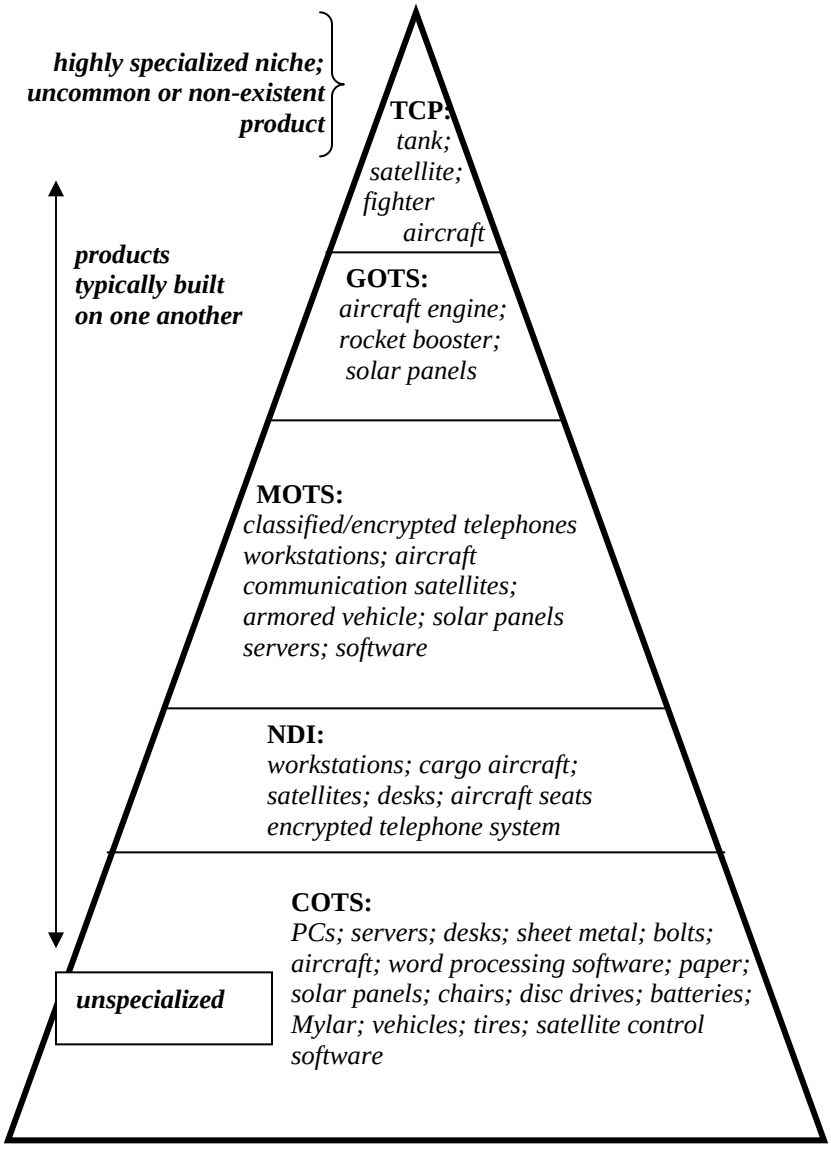


FIGURE 2
From the Known to the Unknown: Building Upon Proven Technologies



EXAMPLES AND EXPLANATIONS

COTS

At the base of the triangle is COTS. COTS products are everywhere, ubiquitous, and often incorporated in the items above them in the hierarchy presented in this diagram. For example, a satellite ground station may have custom-built satellites, but could easily have COTS workstations, servers, and software. Off-the-shelf PCs are easily used as workstations, and there are many remarkable COTS software products available for orbital use. An aircraft carrier is surely a custom-designed product; unavailable for public purchase surely goes without saying. But hundreds of items that comprise the carrier are commercial, for example: PCs, tools, refrigerators, food, calculators, and so on.

The advantages of COTS products are clear. In the most obvious example of a workstation, it is interesting to look at its history. While the government, along with its industrial partners were developing workstations from the mid-twentieth century, the commercial world was considering PCs. There were many who believed that there would be no use for a personal computer, after all, what does an individual need a computer for? Others saw it differently. In the 1970s the first personal computers became available on the commercial market, and within a decade they were readily available and affordable. In the ensuing years, PCs became *better*, *faster* and *cheaper*. They also became viable workstations, and many companies quickly discovered the advantage of using them as such. Now in the twenty-first century, PCs are an essential way of life for the average American. With all this technology available commercially, the government was still building custom workstations well into the 1990s; spending hundreds of thousands of dollars more than if they had procured a COTS PC. Why? The government is bureaucratic and sluggish to catch up with what is most efficient.[15] It has been 12 years since the "Perry Memo," and though the COTS movement is underway, it has been slow and problematic.

As stated, COTS is exactly that: a totally unmodified product that is available to anyone "off-the-shelf." It is important that the reader not confuse a COTS product with those that are made by defense contractors. Though technically these industries are commercial, they do produce DoD items that are *not* available to the general public.

NDI

The nondevelopmental item is slightly different from a pure COTS product as the NDI is developed and built in the private sector for government use only, and generally does not have commercial applications. Sometimes workstations need to vary from those in the commercial world. For example in a space (satellite and missile) monitoring facility, there may be a need for a larger screen, or different keyboard. This is something that the DoD could easily special order from a commercial vendor.

MOTS

MOTS products and systems incorporate COTS products, modified for government use. For example, the Iridium communication system, originally designed for commercial use, is widely used in the DoD. Iridium phones are also used by the general public, but with their worldwide satellite communication capability, have become invaluable to DoD. The needs of the DoD, and especially the warfighter, are somewhat different than the commercial world. Military personnel generally need secure communications. In this case, Iridium; the company itself modifies the hand-held units for DoD use. *Modified-off-the-shelf; MOTS.*

There are other cases where the government does the modifications, usually by hiring a contractor, or builds a system from COTS parts. One example is an Air Force satellite ground control station that was built in the 1999 for temporary use at a base that was being closed in favor of a consolidated station elsewhere in the United States. The commercial workstation market was fairly mature by then, and so the Air Force officer in charge of the project used COTS workstations, COTS software with few modifications and COTS servers to complete the system. In this particular case, it represented substantial savings and the appropriate firm-fixed price contracts were used. Also, risk was low as the procurement team used the “fly-before-buy” approach – that is all commercial items were tested prior to purchase. The procurement team had to make few modifications to get these COTS systems working together to command satellites.

MOTS systems are becoming more and more common in the government for many of the reasons mentioned above – *faster, better cheaper*.

GOTS

The government has designed and built countless successful systems. Before the "COTS Movement" of the 1990s and today, government program managers and their industrial partners employed the GOTS concept as a matter of time and money. For example, in the 1980s, when the DoD was experimenting with stealth technology, the legendary Lockheed Skunk Works was tasked to build two such experimental aircraft in an unprecedented 14 months. Ben Rich, then of Skunk Works, talks about this daunting task.

> We begged and borrowed whatever parts we could get our hands on. Since this was just an experimental stealth test vehicle, destined to be junked at the end, it was put together with avionics right off the aviation version of the Kmart shelf: we took out flight control actuators from the F-111 tactical bomber, our flight control computer from the F-15 fighter, and the inertial navigation system from the B-52 bomber. We took the servomechanics from the F-15 and F-111 and modified them, and the pilot's seat from the F-16. The heads-up display was designed for the F-18 fighter and adapted for out airplane. In all, we got about $3 million worth of equipment from the Air Force. That was how we could build two airplanes and test them for two years at a cost of only $30 million. Normally a prototype for an advanced technology airplane would cost the government three of four times as much." [16]

The cost savings garnered from utilization of common parts is well known. Aircraft, computer and auto manufacturers, to name a few operate this way in order it to be competitive. The legendary Ford Mustang was built on the somewhat clunky Ford Falcon chassis, and also used its suspension and drivetrain when first introduced in 1964.[17] Fast forward to the present, the Army's famed personnel carrier, the Humvee, was procured by the Army, but is used by all other services. It has also been used as a platform for other systems. The DoD has produced a myriad of high-performance products unavailable in the commercial world. As in the example above, it is quite common to see the same aircraft engine on different aircraft. This is also true with DoD satellite designs and parts. Costs are saved in nearly every process of the manufacturing: design, machining, production, testing and installation.

TCP. Traditional Custom Product.

I once again apologize to the reader for creating this acronym in 2002, but even until now I cannot find an official government acronym for the totally custom product. [18] This holds a special niche at the very apex of the triangle. Only for very specialized tasks, experimental and feasibility studies should this very narrow, usually very expensive realm exist. Dr. Perry recognized this and enacted it into law in the mid-1990s by doing away with *milspecs* except for extreme cases. *Milspecs* are now the exception and *performance requirements* are the rule.

One of the most interesting custom builds was the first imaging satellite, Corona, declassified in 1995. At the height of the Cold War, monitoring activities in the [then] Soviet Union were imperative and nuclear proliferation was very real. Airborne platforms such as the U2[19] were useful, but had limitations, and had also proven dangerous. Corona was developed and used from 1959 to 1972. The system filled a very important intelligence void. It was an analog film, bucket return system; which means that it actually used a very large format film, not available commercially (then or now) and dropped the "roll" of film from space, where it was caught by an aircraft, developed and disseminated. Nearly every phase and every part of this system was custom built to fit this highly unprecedented, and at first, experimental program. In the beginning failure was common, as 10 of the first 10 launch missions were unsuccessful—one problem would be fixed, and another would arise. But the tenacity paid off as the first successful Corona mission captured more square miles of imagery than all the previous U2 aircraft missions combined (McDonald, 1997).

Today, satellite imagery is available commercially. As digital technology became better, faster and cheaper, commercial companies saw a potential need for public and government use. Though the technology and resolution are controlled by the government, today's commercial imagery has a higher resolution than what Corona produced. This is a perfect example of how proprietary technology evolves to commonplace, and moves into the commercial world.

MOVING FORWARD

This paper has simply given an overview of COTS terminology. Each industry (computer hardware, software code, aircraft and satellites)

has its own COTS terminology. For example, with software, when two commercial software programs are merged, it is typically done with "glue code." I hope that other papers like this will emerge with those experts describing their languages.

One mistake that procurement officials and administrators often make is to assume that COTS are low tech, and custom products are high tech. Nothing could be further from the truth. In fact, the commercial world has far more sophisticated products in many fields including and especially computer software and hardware. With the PC revolution of the 1980s and 1990s competitive commercial companies were hungry to get into PCs, which were flying into peoples homes and offices. Technology screamed, and as a result there are countless computer and hardware products out there that just keep getting better with each upgrade, and the government will never, and should not attempt to keep up. When they can get it off the shelf cheaply, there is no reason. As such, in order for the DoD to stay ahead of U.S. adversaries, it is imperative to understand and integrate into the commercial world. If it is available commercially, anyone can have it, and the U.S. must assume that includes her adversaries.

If DoD procurement officials are to successfully procure COTS and related products, knowing the procurement techniques that accompany this paradigm is a requirement. The least of that is knowing the language.

ACKNOWLEDGEMENTS

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NOTES

1. In 2005 many celebrated the 40th anniversary of Moore's Law, and more importantly that it has held!

2. The 1994 “Perry Memo” was followed by several additional directives and acts of Congress placing this new philosophy into policy and law.
3. There are countless contracting methods that apply to both custom and commercial technologies. The two aforementioned are common examples.
4. Truly, the government and contractor would work together on the *milspecs.* With complex systems, it is substantially more complicated than this. There are advisors, consultants, and numerous processes that are enacted.
5. These are quoted in their entirety from the Commercial Item Handbook, (Version 1.0), Office of the Secretary of Defense; Acquisition, Technology and Logistics (Acquisition Initiatives) November 2001.
6. From The Commercial Item Handbook, (Version 1.0), Office of the Secretary of Defense; Acquisition, Technology and Logistics (Acquisition Initiatives) November, 2001, page B-1.
7. Ibid, page B-2.
8. Ibid, page J-1.
9. Ibid, page B-3.
10. Ibid, page J-1.
11. From the USAF Scientific Advisory Board: Ensuring Successful Implementation of Commercial Items in Air Force Systems, SAB-TR-99-03, April 2000, page 7.
12. From The Commercial Item Handbook, (Version 1.0), Office of the Secretary of Defense; Acquisition, Technology and Logistics (Acquisition Initiatives) November, 2001, page J-1.
13. From The Commercial Item Handbook, (Version 1.0), Office of the Secretary of Defense; Acquisition, Technology and Logistics (Acquisition Initiatives) November, 2001, page J-1.
14. See: Office of the Undersecretary of Defense for Acquisition, Technology and Logistics, (2001). *Intellectual Property: Navigating Through Commercial Waters: Issues and Solutions When Navigating Intellectual Property With Commercial Companies* (Version 1.1).

15. See: Office of the Undersecretary of Defense for Acquisition, Technology and Logistics, (2001). Intellectual Property: Navigating Through Commercial Waters: Issues and Solutions When Navigating Intellectual Property With Commercial Companies. (Version 1.1), page 4-6.
16. These reasons are multifold and complicated. For a review, please see: Baron, Sally J.F., *Keeping Pace: Organizational Barriers to Commercial Product Use in DoD, The Journal of Public Procurement,* Volume 4, Number 2, 2004.
17. From Rich, B.R. & Janos, L., (1994). *Skunk Works,* Back Bay Books, Boston, New York, London, pages 45-46.
18. Wikipedia.com, Ford Mustang. http://en.wikipedia.org/wiki/Ford_Mustang#Engineering.
19. See: Fellenzer, S.J., (2002) *Department of Defense Transformation: Organizational Barriers to Commercial Product Use in Aerospace Projects,* published dissertation, Stanford University, page 8.
20. See: Federal Acquisition Streamlining Act of 1994, Public Law 103-355 (FASA).

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