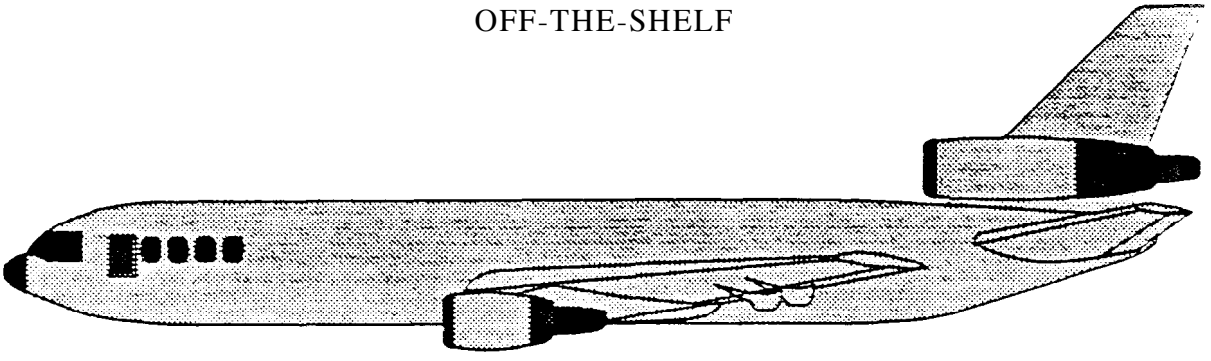
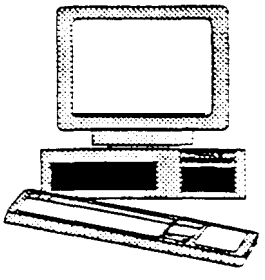
AIR FORCE MATERIEL COMMAND

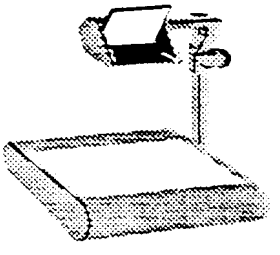
COTS

COMMERCIAL
OFF-THE-SHELF





GUIDE



JAN 1993

FOREWORD

This book provides guidance and criteria for the identification, selection, acquisition, logistics support and testing of the various categories of commercial equipment, computer resources and software. This book is not intended to direct, but to be used as a tool to assist the customer in developing a systematic approach for looking at the many aspects of the problem and making intelligent decisions.

As an aid to the user, *references in this guide* **to** *the draft Air Force* **policy on** *Commercial* **-Off-The-Shelf (COTS) are presented in bold, italicized print.**

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LIST OF ILLUSTRATIONS

1.0 Introduction. ***To establish the tone of this guidebook the*** following policy statement is quoted from ***the AF*** draft Sup to *DOD* 5000.2: ***"Commercial items should be acquired, used, and supported*** as found in the civilian market ***and allowed*** to evolve with the ***changes and updates the vendor provides to his commercial*** customers." You will see time and time again where this policy statement is stressed and referred to throughout this guide.

1.1 More and more commercial equipment and software are being used by the military, either standing alone or integrated into larger systems. Properly handled, this offers front-end acquisition advantages of lower research and development costs and less time to field than MIL-SPEC designs. If products are used unchanged, the Government can also benefit from the economies of dealing in a high-volume civilian market. There are many success stories. Improper planning, however, can cause long-term problems in mission performance and support that may more than erase these initial advantages. If the commercial alternative or its execution compromises design, operating or support integrity, the Air Force's war-fighting mission can be impaired.

1.2 The objectives of any Air Force acquisition are to obtain a product that will do its intended job in its intended environment; that can be repaired or replaced when it fails in a manner that doesn't degrade or add risk to its mission; and that can do these things at the least cost. Until recently, only equipment specifically designed for military use was thought capable of meeting the first two objectives, and it was also thought to be the least costly over its life cycle. However recent congressionally-directed policies have placed greater emphasis on using commercial items because studies have shown their initial costs and lead times to be generally less than for MIL-SPEC development. However, unless you carefully consider the total life cycle costs and risks of commercial versus MIL-SPEC items, ***you*** may make the wrong decisions. These decisions should never be automatic.

1.3 This guidebook is to assist you in deciding when to use commercial products and when to develop MIL-SPEC items, and, once that decision favors the commercial alternative, how you should handle testing and support.

NOTE: In this guide we will refer to the source of ***a*** commercial item as the "vendor," the "supplier" or the "manufacturer." By this we mean the company owning the rights to the design. Sometimes that company will be the prime contractor; frequently it will be a subcontractor.

2.0 What is "Commercial"?

MYTH BUSTERS 1

It can't be "COTS" without being commercial, "but it can be "commercial" without being "COTS."

2.1 The definition of a commercial item as stated in the DFARS PART 211 is "commercial items means items regularly used in the course of normal business operations for other than Government purposes which: (1) Have been sold or licensed to the general public: (2) Have not been sold or licensed, but have been offered for sale or license tc the general public: (3) Are not yet available in the commercial marketplace, but will be available for commercial delivery in a reasonable period of time: (4) Are described in paragraphs (1), (2), or (3) that would require only minor modification in order to meet the requirements of the procuring agency." In laymen terms a commercial item is a product (hardware or software) used for other than government purposes; sold or traded to the general public in the course of normal business operations and used "as is" when acquired by the government. That is the basis of the term, "commercial off-the-shelf" or "COTS," although the label is now commonly (and erroneously) applied to almost any non-MIL-SPEC item, including many not to be found on the civilian market.

2.2 In reality, the "commercial" designation can be broken down into several categories (Figure 1). Starting from pure MIL-SPEC (MIL-SPEC design using militarized parts), there is government-controlled design built to "best commercial practice" (commercial design practice and parts). Then there are vendor-originated commercial designs for which the military is the primary or only customer. (Call these "olive drab commercial.") Slightly beyond that, but not yet true COTS, are "commercial-type" items modified to meet some government-peculiar hardware or software requirement or addition, or otherwise identified differently from their normal civilian counterparts. Last, we have vender-controlled designs for the open market ("COTS"), as defined above. To more precisely describe these categories:

THE COMMERCIAL SPECTRUM

	HIL-SPEC	BEST COML PRACTICE	OLIVE DRAB COMMERCIAL	COML-TYPE ("SPECIAL")	COTS
DESIGN FEATURES	Govt Militarized	Govt: Not Militarized	Coml: Just for Govt	COTS: Mod for Govt	For Civil Market
EXAMPLES	Fighter Aircraft	Fixed Ground Radio	Tactical Radio	Embedded Computer	Television Monitor
% OF SALES TO GOVT	100%	100%	Probably 100%	Small (of basic Item)	Small
DESIGN DISCLOSURE	Full (piece part)	Full (piece part)	Mostly F^3* Maybe Full	Probably F^3* Full needed	F^3*
CONFIG AUTHORITY	Government	Government	Vendor cr Foreign Govt	Domestic or O/S Vendor	Domestic or O/S Vendor
DESIGN STAB. RISK	Low	Low	Moderate to Low	Moderate to High	High
LONG-TERM SPT/COST RISK	Low	Low	Moderate	High	Moderate to High

*Form, fit and function

Figure 1

a. 'MIL-SPEC" is the classic military approach to design and construction: A government design for government use. The Government is financing the desian effort, will ultimately own and control the design, and intends that it be rugged enouah to withstand battlefield use. The design philosophy and selection of parts are strictly according to military specifications and standards, and, typically, the acquisition cost and lead time are high.

b. Occasionally it will be decided that while the Government must sponsor the development of a peculiar piece of equipment, its application will allow the use of a less-rugged or standardized design approach. Thus the contractor is allowed to build to "best commercial practice." He uses parts and design practice solid enough to withstand typical civilian duty, but

which probably wouldn't stand up on the battlefield. It's still a government design for government use, but it's substantially less expensive to acquire.

c. "Olive drab commercial" products come from a segment of industry oriented to selling military equipment to the US and foreign governments and willing to undertake development of militarized or semi-militarized designs at their own expense. When we select their products the military gets what usually amounts to MIL-SPEC hardware without having to sponsor or wait for its design. These originate as nongovernment designs for noncivilian use except for the occasional product, such as an aircraft engine, that might have military roots. While we do not get design visibility or control over such items, we often do get the vendor's cooperation in keeping them stable because we're essentially the sole customer. (Military designs developed for foreign government should also be considered "olive drab. commercial").

d. A stock commercial design can become "commercial type" either through modification for the Government's use (para 6.4) or by having become peculiar by default, merely by being held stable while its brethren in other applications have received progressive updates from industry. COTS designs, especially computers, often cross over to this category when they are embedded in a larger system whose architecture won't allow routine COTS updates and revisions. Either way they become nongovernment designs for noncommercial use, but without the advantage of the Government being the vendor's sole customer. *When that happens those designs can no longer be considered* CUTS. (See Appendix 1, Question 4.)

e. That leaves COTS as a narrowly-limited category: A commercial product for commercial use. It is bought exactly as found in the civilian market, and allowed to flow with the changes and updates the vendor provides to his commercial customers. *Otherwise* if COTS *is allowed to be* modified or *not receive the upgrades provided to the commercial market it will become AF unique and no longer supported by the commercial mainstream.*

2.3 The last two categories are the primary considerations of this handbook; "best commercial practice" and "olive drab commercial usually respond to MIL-SPEC-type management. Be sure which category or categories you're dealing with; confusion between them can lead to costly mistakes.

MYTH-BUSTERS 2

Elsewhere in the DoD the term "nondevelopmental item (NDI)" is frequently used to mean "COTS." We do not do that here, because COTS is an NDI subset, not its equal. An NDI is any item that wasn't developed for this particular project. Figure 2 illustrates the relationship.

NONDEVELOPMENTAL ITEM HIERARCHY

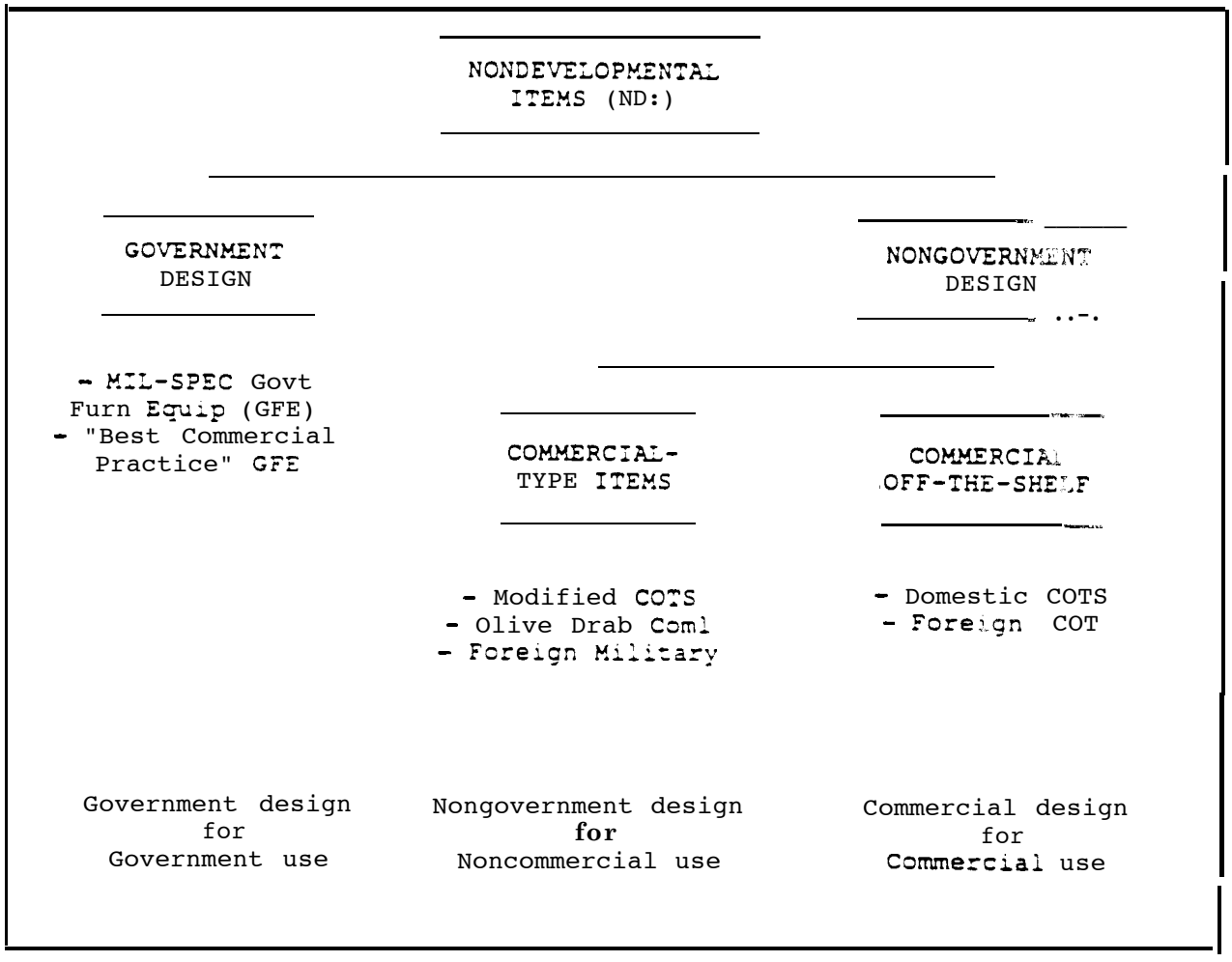

Figure 2

3.0 Selecting COTS.

3.1 Understand that the major advantage of adopting commercial design for military use essentially contains its major disadvantage: Because the Government didn't fund and wait for the design effort, we can get an advanced product cheaper and faster than if we had. However, for that same reason we have no legal right to know how the contractor or vendor designed the item, nor can we control changes to that design. If we start doing that it stops being COTS. This is mentioned frequently because it's really the key reason why effective COTS employment and support demand rethinking of some traditional approaches. With COTS you should expect to take what you get and normally do little to change or maintain it later, unless you make complicated and costly arrangements. Such arrangements essentially consist of buying the design-the contractor's or vendor's intellectual property-often (if he will even talk about it) only by paying him all the future profit he feels he might make by retaining his rights. In most cases you can't (and shouldn't) afford that, and frequently he won't make such a deal at any cost. COTS should be selected and supported only when it's reasonable; considering the potential penalties, you will sometimes find it smarter to choose development instead.

3.2 The rapidly changing market and technology of COTS items drives the realization of a limited useful life cycle. Effective management and support of commercial items can be achieved if, ***as stated in the draft AF Sup to DOD*** 5000.2, ***"support requirements shall be defined prior to RFP release. Support requirements shall include an up-front definition of the system support requirements*** to ***the item level, a lifetime support strategy and appropriate contract language to implement support strategy."*** Acquisition contracts which include support such as maintenance, support equipment and training for the total expected life cycle as well as pre-planned product improvements or replacement are needed.

Overall, management of commercial items which support military missions differs significantly from management and support of government developed items. These differences must be recognized and dealt with to achieve the full benefits available with commercial use.

3.3 Appendix 1, Considerations for Your Market Investigation, is provided as an aid to get you started with the market investigation. Be sure to use Appendix 1A, A COTS Decision Aid and Figure 3, Can the Air Force Tolerate the Risk, in conjunction with the questions in the appendix.

CAN THE AIR FORCE TOLERATE THE RISK?

MOD TYPE	MOD BY OEM	MOD BY PRIME	MOD BY GOVT
COSMETIC ONLY (FORM: ADD DECAL, CHG COLOR, ETC.,	OK	OK	OK
CHANGE SOFTWARE OR FIRMWARE ONLY (FUNCTION)	PROBABLY OK If properiy documented. Buy aata to snow change.	BE CAREFUL! May build in probiems, and degrade, not OEM will not improve product. recognize (support or OEH won't warrant) the recognize result. result, and a prime probably can't help. Besides how will you get source data and special equipment?	AVOID IT! Odds are you'll
AD2 ITEMS , NO SURGERY (FUNCTION: PLUG-IN, BOLT-ON,ETC.)	PROBABLY OK. OEM should be most responsible about inserting items from other source. Document it.	BE CAREFUL! If no proprietary connection with original or inserted item, may not be sensitive about latent glitches or induced failures. Buyer beware!	BE CAREFUL! It's usually easier to plug it in than to get help from either source if problems arise.
INTERNAL SURGERY (FUNCTION) or REPACKAGE/ RUGGEDIZE (FORM/FIT)	BE CAREFUL! Could mess up an otherwise reliable product; will certainly produce a "sport" the OEM may abandon when you need support.	AVOID IT! Prime has nc handle on some other source's internal configuration: May dc whatever works at the time, which can differ between successive examples. No relliable documentation in most cases, and it usually voids the OEM's warranty.	AVOID IT! The Government's track record in such things could be better: Who will help when tne trouble starts?

Figure 3

4.0 The COTS Acquisition Process.

4.1 When Should a COTS Decision be Made? As with any program decision, the later a CCTS decision is made the less chance there is that it can be tempered by operating and logistics considerations. You should start with a system requirements review and a good handle on the architecture/configuration alternatives. Then do a pre-competition market investigation. ***The draft AF Sup to DOD*** 5000.2 states ***"a market analysis shall be performed while the requirements document is still in draft form."*** As an example, that should represent the end of the Concept Exploration and Definition phase (Milestone 0) for computer resources and software. At that time the operational and support concepts should have been captured in a first-draft Computer Resources Life Cycle Management Plan (CRLCMP), which should include a general description of the computer resources needed. If that wasn't done, the request for proposal for Milestone I, Demonstration and Validation, and Milestone II, Engineering and Manufacturing Development, must detail the COTS requirements. Failing even that, the remaining opportunity to review the COTS items a contractor proposes to use is during the preliminary design review (PDR). Unfortunately, that might also be the only chance if the acquisition is of a system potentially using embedded COTS; design visibility simply might not be adequate before that point. (If COTS items are to be embedded in a larger system by a prime contractor, be sure that he acquires all the required information from his proposed vendors rather than just speculating on his own.) Regardless of the time frame, the following procedures should generally be followed when COTS is to be involved.

4.1.1 If the COTS review can't be accomplished until the Preliminary Design Review (PDR), use data from the Logistic Support Analysis Record (LSAR), if applicable, as a tool to making an informed COTS decision that will ensure adequate support of the system. Figure 4 depicts the suggested LSA tasks to ensure necessary analyses are performed and required data is delivered. The LSA requriements and guidance, MIL-STD 1388-1A and -2B, must be properly tailored, with COTS in mind, and implemented early in the program to ensure the LSAR data base contains all the necessary information when needed. Also, be sure that the contractor doesn't do LSA only after the fact, and that he is prepared to answer all COTS selection questions at the PDR, augmenting the LSA data as necessary.

4.1.2 ***AF draft Sup to DOD*** 5000.2 ***states "When nondevelopmental items are included in a developmental***

TYPICAL LOGISTICS SUPPORT ANALYSIS (LSA) PROCESS FOR COTS SELECTION AND SUPPORT DECISIONS

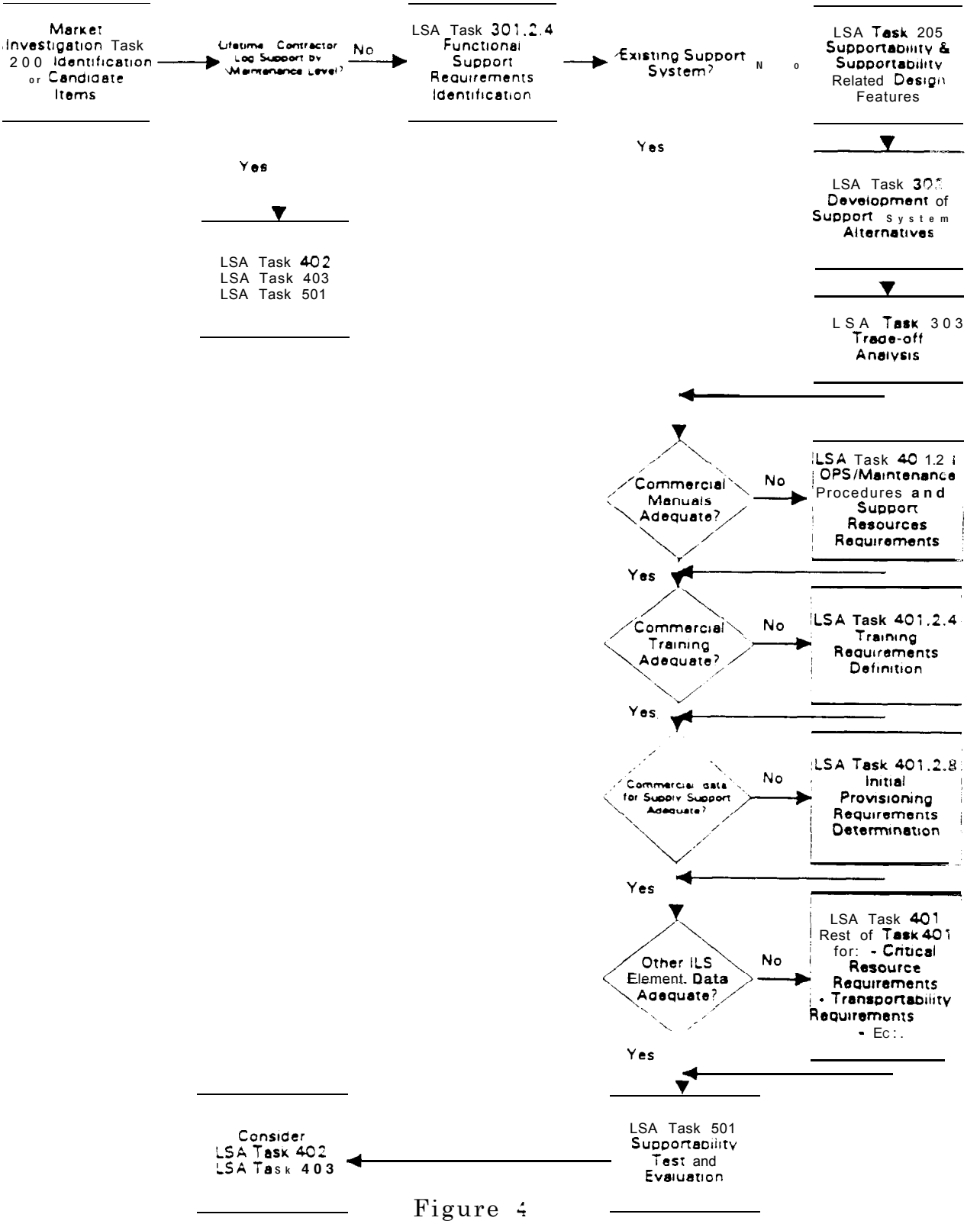

Figure 4

system, the acquisition command will ensure nondevelopmental item deliverables. are included in the logistics support analysis (LSA). As a minimum, the LSA will address the interface between NDI and new development items and will determine whether the existing NDI data are sufficient for system life cycle support. The LSA must address vendor and Government support responsibilities for the NDI throughout the system's life cycle."

4.1.3 Level of assembly. The complexity of the configuration of the commercial item and the portion it constitutes of the total system will determine how early in the acquisition cycle a decision regarding its usage is made. For example, a decision to select the Boeing Co. *767* aircraft could be made at the support readiness review during the Concept Exploration phase whereas a decision to use a Boston Co. roller bushing in the system design may have to be deferred until the Program Design Review, since subsystem product design efforts may preclude an earlier decision on the lower levels of the system assembly. The key point to remember is to make decisions to select commercial items for the system as early as possible consistent with the evolvement of the system configuration.

4.2. Preparing for a Market Investigation. The market investigation is an indispensable tool for finding out if COTS is suitable for the application, and to determine the availability of products and sources. It might even provide a sanity check for some of your original system design goals, but it is not for source selection (or rejection). As in any acquisition, build your evaluation criteria from the user's validation of functional and support requirements and the recommendations of the Acquisition Strategy Panel. Don't slant the investigation to make COTS the only acceptable alternative, but only as one among several possible choices (paragraph 2.2). COTS may not be the best or least expensive choice, and an artificial limitation could keep that fact from coming to light.

4.3 Conducting a Market Analysis. *The draft AF Sup to DOD 5000.2 requires that each acquisition agency establish procedures to conduct a market analysis. The market analysis shall be performed while the requirements document is still in draft form and the results incorporated, as appropriate, into the operational requirements document prior to validation.* Market analysis may vary from desktop research and informal telephone inquiries to comprehensive industry-wide reviews, but they are normally conducted in two steps:

a. First, make a general survey of the market place (and the Government: Don't forget GFE; AFMC's Cataloging and Standardization Center can help by conducting research and providing interchangeability and sustainability information) to determine the nature of available products and the number of potential sources. Based on this preliminary determination, decide:

(1) Is there sufficient information to support a decision whether COTS is appropriate for the requirement?

(2) If not, what additional information is needed to support a sound COTS decision?

b. Second, collect any additional information required, usually by actually going to the market with your specific needs.

4.3.1 When your criteria are ESTABLISHED, develop informational requirements to ensure that interested suppliers are adequately informed about the specific equipment or function sought, the support required and the evaluation process. For preliminary research, make maximum use of available data (e.g., contractor sources, user experience, independent test and certification agencies). Before sending out inquiries, a "Sources Sought" synopsis in the Commerce Business Daily can be used to announce the upcoming investigation to prospective suppliers. (ESC/AVSC maintains an Air Force bidders list for computer hardware and software items. For a copy or consultation on commercial computer systems acquisition, contact ESC/AVSC, Hanscom AFB MA 01731-6340; DSN 478-3413.) The informational requirements should then be provided to all suppliers who request them.

4.3.2 This marketing analysis is a continual process through PDR. It is started during the concept exploration phase for more complex commercial systems, e.g., aircraft, ships, and vehicles, and continues throughout the following acquisition phases for less complex commercial equipment items to be used at the lower assembly levels as part of the new system.

4.4 What to Tell Prospective Sources. In preparing for the market investigation, RFP or PDR, provide a complete description of the system, equipment or item required. (For an RFP or as a contractor prepares for PDR, this coverage should be in the specification or (sub)contract provisions.) Include all operational/support requirements, covering at least:

a. Detailed operating parameters for hardware and software

b. Environmental conditions/performance demands. e.g.:

(1) Reliability requirements

(2) Usage (fixed, airborne, tactically deployable, etc.)

(3) System interface, integration requirements

(4) For computers, required software language, speed, throughput, ports, memory and expansion potential. NOTE: Ada programming language is required for all DoD applications, unless a waiver is Granted.

(5). Far communications-computer system interface: requirements for:

(a) Use of Government Open Systems Interconnection Profile (GOSIP) communications protocols (Federal Information Publication 146)

(b) Use of Latest-generation language tools, and compliance with American National Standards Institute (ANSI) standards

(c) Software portability across the Air Force communications-computer systems

(d) Ability to integrate into the total Air Force communications-computer environment

(6) Operating duty cycle (24 hours, intermittent, etc.)

(7) Climate (operating, shipment and storage)

(8) Altitude (operating, shipment and storage)

(9) Shock/Vibration (operating and shipment)

(10) Input power quality (drops, surges, spikes, noise etc.)

(11) Environmental stress screening (ESS) reguirement

(12) Nuclear hardening requirements (inadvisable for COTS)

(13) Chemical/biological/radiological survivability

(14) Electromagnetic interference (EMI)/electromagnetic compatibility (EMC)/TEMPEST requirements

(15) Electrostatic discharge (ESD) protection

(16) Any other tougher-than-commercial demands

(17) Other environmental factors (both types and amplitudes applicable to the system:

(a) Natural environmental stresses, e.g., sea conditions, rain, winds, snow loads, sand & dust, humidity, salt fog, solar radiation, et. al.

(b) Induced environmental stresses, e.g., fire, explosion susceptibility, acoustic noise, acceleration-temperature extremes, et. al.

(18) Combat vs. peacetime operations.

c. Maintenance and support expectations

(1) Maintainability requirements

(a) Self-test requirements

(b) Limitations, if any, on organizational-level support equipment (SE)

(c) Protective gear (weathaer, chemical, biological) that must be worn by O-level maintainers.

(d) Requirements to preserve nuclear hardness during maintenance actions at all levels.

(2) Planned maintenance echelons

(3) Maintainer proficiency levels

(4) Software maintenance plans

(5) Limitations on evacuation of reparables (battlefield, underground, rough handling, etc.)

(6) Maintenance environment (weather, mud, etc.)

(7) Supply support, SE needs, limitations

(8) Training needs

(9) Technical data needs for reprocurement, repair, identification, etc

(10) Engineering data needs. (See para 5.2.1.1 for drawings and para 5.2.1.4 for manuais)

d. Frequency management concerns

(1) Frequency requirements

(2) Frequency allocation status (AFR 700-14)

(3) Conformance to rules for government use of frequency spectrum.

4.5 What tc Ask Prospective Sources. Select from these questions (and add more) to guage what the market has to offer in COTS function and supportability:

a. What portions of the system or equipment do you intend to provide in the form of commercial cff-the-shelf (COTS) equipment?

(Not applicable if you're going in telling them what must be COTS.)

b. How, in detail, will each COTS item or assembly meet the above requirements?

c. Must any of it be modified to meet the Government's requirements? Is so, is the vendor(s) willing to aaccept support responsibility for the modified assets or will the Government be required to provide its own support? If the later case, the vendor(s) must be willing to share design visibility and control with the Government so the modified design can be maintained and supported by the Government?

d. How stable is the design of the COTS equipment? Give history and your perception of future stability prospects for each design proposed. How mature is the current design, and what are your criteria for measuring that?

e. How long has each proposed COTS design been on the commercial market? How many are currently in commercial use? What are the prospects for product longevity? How long will you support it?

f. What's the reliability history of the product (mean times between critical failure and corrective maintenance actions)?

g. What are the maintainability features of the design (i.e., self-test features, accessibility, need for separate support equipment to verify failures, preventive maintenance needs, etc.)?

h. What flexibility do you offer for the Government to perform its own software maintenance? Will you allow the Government to acquire licensing and subscription services to enable organic or competitive software maintenance? For all software? For a portion of the software? If the latter, state which portion. What are your conditions on licensing and subscription service?

i. If the COTS equipment is to be used as part of a system how do you perceive the criticality of each COTS design in interfacing with other subsystems, software etc. for overall system integrity? That is if it later became necessary to replace a COTS item because the original became unsupportable, could it be done without driving a major modification or replacement of the entire system?

j. Can the proposed item(s) be maintained according to the conditions we have given you, or will special arrangements be required?

k. Is there a competitive market for contract repair and support of the proposed item(s), or is it restricted to a single source?

l. Is the proposed equipment covered by a warranty? What are the warranty's provisions? If your product will reach the Government through a prime contractor, will your warranty carry through with it?

m. Identify at least 3 commercial users of your product. Also name present military customers, if any.

n. What is your estimate of your product's life cycle cost?

o. What training is needed to operate/maintain your product, and is such training available from any source besides yourself?

p. What about data rights and copyrights on commercial manuals and installation instructions? Availability? Cost?

q. How will the search for and selection of commercial off-the-shelf equipment be accomplished during the course of the design effort as the product design evolves to lower levers of assembly?

4.6 Analyzing the Replies. Upon receipt of the market investigation response or proposal, evaluate how the respondents' replies meet your needs. Also contact past customers cited by the respondents, as appropriate. Use Appendix 1A for guidance in making COTS-or-development decisions, and paragraph 6.0 to aid in judging test requirements. The evaluation should rank the need for competition equally with other considerations; don't raise requirements beyond needs merely to limit the number of potential sources. When this process is complete, share your results (including software support strategies, as applicable) with the appropriate staff function who in turn will make them available to an Air Force, DoD or Government-wide data base.

4.7 Placing COTS on Contract. RFPs and contracts must clearly state what category of "commercial" is to be provided.. Remember, "best commercial practice," "olive drab commercial" and "commercial-type" are not COTS. Confusion as to the real requirement has led to litigation by unsuccessful bidders who have claimed the ambiguity undermined their competitive position. A procedure must be established within the development contract to enable the contractor to select and government approve the pruchase and use of COTS identified for the system after contract award.

5.0 Integrated Logistics Support (ILS).

5.1 Logistics Needs for Commercial Products. When all of the selection factors have been reviewed and a decision has been made in favor of commercial design, you must prepare to live with it.

> MYTH-BUSTERS 3
>
> Buying COTS doesn't mean you can forget logistics. The basic support needs for COTS are the same as they are for any other hardware or software: There still must be supply support and assets accountability; there still must be support equipment, training, and technical data (unless total contractor logistics support) to enable system restoral within a practical maintenance concept; there still must be provision for module repair and/or the acquisition of replacements for condemnations. The differences are mainly in emphasis.

5.1.1 The preferred method of support for COTS products is through local acquisition and locally-acquired contractor service. However, since COTS is now invading our systems and inventories on so much larger a scale, combat readiness, economic realities and the demands of the Competition in Contracting Act may dictate that we provide support on a worldwide scale through wholesale methods. Logistics decisions must recognize the limitations that come with adopting COTS products and be documented in an Integrated Logistics Support Plan or -Logistics Support Plan. Don't reason away logistics by assuming that full support will always be contracted. Any decision for life-cycle contractor logistics support (CLS), if not directed at the outset, must be agreed upon by all users and support commands, and must be accompanied by adequate planning. Even if CLS is selected, the data described in paragraph 5.2 is still required because it will be needed to compete CLS contracts. In the absence of a formal CLS agreement, plan for an appropriate level of organic management and support for COTS assets.

5.1.2 The draft AF Sup to DOD 5000.2 states "When determining the support for a commercial item, *the acquisition and* 'using *commands shall evaluate the contractor's support, alternate vendors' support, and* government *support with regards to impact on competition, mission requirements,* total *support* cost *and support availability. For recompetition and identification purposes,* acquire *engineering data* to *the appropriate level with the system or* equipment."

5.1.3 *The draft AF Sup to DOD 5000.2 states "Even* when *Government support* is used, contractor-provided *supply support* is *preferred since it is generally less* expensive *to use an established inventory system rather than creating a new one."*

5.1.4 Support prospects for the various categories of"commercial" (Figure 1) vary according to how close they are to "MIL-SPEC:"

a. Since "best commercial practice" differs from "MIL-SPEC" only in parts selection and design detail, expect very similar support conditions: Design control documented through detailed specifications and full design disclosure engineering data; MIL-SPEC technical orders; sparing to the piece part; and organic repair of recoverable assemblies. We'll say little more about the "best commercial practice' category: It's really not "commercial" when it comes to support.

b. With the other three commercial categories the vendor is totally in charge of design below the threshold of form, fit and function (F^3). That means he may change anything he wants to inside, giving the **customer** *no* notice or accounting as long as F^3 remains the same. This affects us in different ways, depending on the category:

(1) "Olive drab commercial" suppliers tend to emulate military support conditions, allowing us to manage much as if their products were really MIL-SPEC. That's because most of their business for those product lines is with the military: The supplier is still in charge, but will probably accommodate us indefinitely as long as we use their product. Thus we'll not say much more about that category, either.

(2) Suppliers of "COTS" and "commercial-type" have little incentive to accommodate the military, because we are usually just tagging onto a much larger commercial trade. We shouldn't expect to dominate it, and can rely on little or no internal configuration stability, visibility or control unless we buy the design: Changes are driven by market pressures alone, and can happen daily. That fact affects the way we must look at logistics.

(3) *"The using and acquisition commands will review all proposed changes due to vendor changes. The using command will evaluate the mission impacts of changes due to subscription*

related computer resources upgrades. The acquisi tion command will evaluate the system hardware and software updates."

5.1.5 Design Interface (DI). The following LSA' tasks should include the COTS equipment on the premise that even if we cannot change its configuration, we do need to know its impact on the supportability of the system. These tasks as described in MIL-STD-1388-1 include as a minimum:

a. Use Study (LSA task 201) to establish usage and environmental stress definitions.

b. Mission Hardware, software, and support System Standardization (LSA task 202) where standardization and interoperability -is a requirement.

c. Technological Opportunities (LSA task 204) to help identify those new technologies that can enhance the effectiveness and supportability of the system.

d. Supportability and Supportability Related Design Factors (LSA task 205) with particular emphasis on identifying proprietary data (subtask 205.2.3) and NATO constraints (subtask 202.5.6).

e. Functional Requirements (LSA task 301) with particular focus on performing a Failure Modes and Effects analysis, a Reliability Centered Maintenance analysis and establishing preventative and corrective maintenance task inventories (subtask 302.2.4).

f. Evaluation of Alternatives and Tradeoff analysis (LSA task 301) will provide a number of DI considerations as affected by the *use* of COTS. Particular focus should be applied to repair level analyses, diagnostics, energy tradeoffs, survivability tradeoffs and transportability tradeoffs (subtasks 303.2.7, 303.2.8, 303.2.10, 303.2.11 and 303.2.12.

g. Other LSA tasks in the 400 and 500 Tasks sections as appropriate to the system being developed and the stage of the acquisition process.

5.2 Four major areas of concern in COTS support are configuration management and data; maintenance and sparing policy; the repair process; and sustainability. Figure 5 -portrays general comparisons in these areas between MIL-SFEC and COTS designs. Note that many of our "standard" support assumptions must be reexamined when COTS is involved. The following expands on that.

COTS: DESIGN DRIVES SUPPORT

KEY CONCERN	THE NEED	FOR GOVT DESIGN	FOR COTS
CONFIGURATION & DATA	- To know internal design - To control internal design -...With engineerrng data complete & usable by Govt to be able to identify stocklisted parts	- Full design disclosure data - Govt controls configuration - MIL-SPEC tech data	- External design data only, If any - OEM controls configuration - OEM's catalog
MAINTENANCE & SPARING POLICY	- To repair failed items - To repair failed items in-house - Modules interchange both ways - Repair at intermediate level	- Assumed - Assumed - Assumed - Assumed	- Don't assume - Probabiy not - Maybe not; No control below F3 - Usually impossible
REPAIR PROCESS	- Repair suppcrred at designated levels: --By design -- In manuals --- Up-to-date -- Using ATE -- With parts by requisition	- "Maintainer friendly - MIL-SPEC TOs - Updated by Govt - ATE "knows what to expect" - Spares in the supply system	- Top skills needed - OEM service manuais, if any - Service bulletins - Probably manual testing only - Heavy on local purchase
SUSTAINABILITY	- Systems longevity or budget for new system	- Many years possible through upgraaes, mods	- 5 year max life not uncommon; 10 years a miracle

Figure 5

MYTH-BUSTERS 4

We'll just demand that the COTS supplier strictly control internal configuration and dutifully let us know every change he makes. Wrong! By definition, the Government takes COTS as it comes, and when it comes to configuration we're just along for the ride like any other customer.

5.2.1 Configuration management and data. We have already said much about government configuration control of COTS: There won't be much except by special arrangement. Regardless, try to prevail on the vendors to hold to F^3 for the duration of the system's production run, to avoid major system modifications at least until fielding. It's still their design, so that's all you can do.

5.2.1.1 Except under very unusual circumstances, it's not smart to demand full design disclosure (to the piece part) engineering data, either for initial provisioning or system support. Even if the vendor were agreeable to selling and you had the money, the data would quickly be obsolete because you still wouldn't have design control. Contractors can unilaterally change the design as necessary to suit their customer/market requirements. In the event that organic depot maintenance is planned or in the unlikely event that organizational maintenance is to include repair (not just removal and replacement) of assets, COTS designs should be documented at the F^3 threshold (Fig 5) through revisions to the commercial drawings as described in MIL-T-31000. The control drawings must be complete in content (including full function, performance and interface information) to enable any competent source to furnish interchangeable items without resorting to the original designer. Such drawings should support competitive acquisition of interchangeable replenishment spares, must serve as system interface documentation, and are also needed for quality acceptance of contractor repaired items.

5.2.1.2 Logistic Support Analysis (LSA) for COTS. As we have explained, it usually makes no sense to demand design information on COTS items below the F^3 threshold, It likewise makes no sense to demand that COTS items be broken down for LSA: LSA guidance should tell the contractor not to take COTS LSA below the F^3 threshold.

5.2.1.3 Technical orders must also be selected according to the overall COTS support philosophy: If there is to be no design disclosure below the F- threshold, and assembly/module repair is to be restricted to a contractor or specialized depot, it isn't logical to demand detailed MIL-SPEC technical orders for COTS line replaceable units (LRUs). MIL-SPEC system-level technical orders should guide system operation and organizational-level troubleshooting to the LRU for system restoration. Any data acquired below the LRU level should be unchanged copies (except for any required additional safety warnings) of the vendor's own service manuals, augmented by subscription service to his periodic service bulletins. Since repairs below the LRU level should rarely be performed at the organizational or field levels, distribution of this data should only rarely be made to the base level. Reference copies should always be available at the ALC for engineering and management purposes, and should be obtained for depot use if any organic repair is to be done. Commercial manuals recommended for organic repair purposes must be evaluated for acceptability IAW MIL-X-7296 and must not have been duplicated from a previously approved commercial manual. If the recommended commercial manual is not acceptable and cannot be supplemented to MIL-M-7298 requirements then, and only then, will MIL-SPEC technical orders be authorized. Following distribution, bulletins and other subscription service data should be submitted by the equipment specialist via AFMC Form 252 to become supplements to the commercial manuals.

5.2.1.4 ***The AF draft Sup to DOD 5000.2 states: "Technical data and documentation for the logistics support of commercial items will ...be procured IAW DFARS Part 211.7004-1 (h) (I) through (h)(4), reference (g). For aircraft flight manuals, review such manuals the ...contractor provides. If these standard commercial manuals meet . ..the*** requirements ***of T.O. 00-S-1, MIL-H-7700, and MIL-H-7298, no further action is required. If the manuals do not, supplement contractors manuals or obtain manuals that satisfy USAF requirements." . .."Documentation for Government use of nondevelopmental items must be sufficient for life cycle operation and support but need not be in accordance with military documentation standards."***

5.2.1.5 The draft AF Sup to 5000.2 states that "When a system includes CUTS software, arrange and budget for appropriate software licensing and subscription service to continue through the life cycle." If the Government secures change authority, the Computer Resources Life Cycle Management Plan (CRLCMP) must clearly define the limits of what the Government can change, and restrict alterations in any way that will void the licensing or subscription service. Also remember that independent software changes by the Government, or a Government freeze to an earlier COTS software version, will turn COTS into "commercial-type" just as certainly as do similar activities with hardware. Avoid them whenever possible.

5.2.2 Maintenance and sparing policy. As stated above, employment of COTS will usually lock us into 2-level maintenance: Organizational and depot. With very few exceptions, the nature of COTS equipment will limit piece-part repair at the organizational (blue-suit) level to the most rudimentary actions: e.g., changing printer "daisy wheels" or tractor belts. Except for these operator-level parts replacements, organizational repair should be limited to changing cards, modules cr subchassis only down to where the configuration is known and stable (i.e., the F^3 threshold). Before provisioning, validate the need to place spares in inventory instead of relying on commercial sources. Guidance on when COTS should be provisioned was formally found in DoD Directive 4140.40, Provisioning of End Items of Materiel. DoD Instruction 5000.2, Part 7, states that this directive is to be combined with DoD Directive 4140.1, Inventory Management Policies. (Remember, take action to stock list all "government-owned" LRU spares that are identified in maintenance planning for organizational removal and replacement concerts. This must be accomplished to ensure adequate distribution and control of assets between the base-level user and the contractor, even if there are no plans to stock at ALC level.)

5.2.2.1 Breaking down COTS items is sometimes unavoidable, but whenever the breakdown goes below the F^3 threshold there is a good chance the cards and modules will not be two-way interchangeable: The shelf spare may not operate in the socket. The lower you go the higher the risk. Consequently, any sparing below the F^3 threshold with COTS will probably be counterproductive as well as difficult; it is almost never feasible to go down to the piece-part. Find the dividing line (or, in other words, define LRUs) by carefully working out the F^3 threshold with the prime contractor and his vendors during or close to the provisioning guidance conference. It's essential that definition be established early in the provisioning cycle, because provisioning documentation must be built around it. Do not try to buy provisioning documentation that breaks the equipment down below the defined sparing level.

MYTH-BUSTERS 5

Don't automatically think "piece-part" when somebody says "provisioning." Sparing only down to the major assembly is still provisioning - just fewer items.

5.2.2.2 Decisions on COTS component repair should be carefully considered. The cleanest, but often unacceptable costly choice for dealing with a failed COTS item is to discard it (source-maintenance-recoverability (SMR) code F_ZZN). Barring economic discard, the next most desirable choice is contract repair, preferably via competition (Appendix 1, Question (11)), but sole source to the original manufacturer if there is no other alternative. A good strategy is to price support options while the original buy is still in competition. The riskiest course is organic depot repair, which should be selected only under exceptional conditions because it will have to be a specialized operation if even possible at all: The vendor might refuse even to let us buy the data and tools to build a capability. (SMR codes P LDT or P LAT represent the latter three choices.)

5.2.3 The repair process. If an organic depot is selected for COTS, setting it up definitely can't be done "business as usual." Depots are attuned to the MIL-SPEC approach: regulation manuals, automatic test equipment, standard parts and procedures. If they are to repair something that can't be supported by these things, they must be flexible because they will be going into "no man's land" below the F^3 threshold. Special arrangements must be made in recognition that:

a. Piece-part configuration will be soft.

(1) Will it be reasonably stable?

(2) Did the vendor select parts or otherwise tweak subassemblies to make them work with each other? (Is each "identical" item different?)

(3) Are other vendor's COTS items incorporated into the design?

b. Documentation won't be standard.

(1) Has it been reviewed for adequacy to support repair? Testing/quality control? Researching piece-parts?

(2) Will service bulletins be available? Adeguate?

c. Parts supported won't be standard.

(1) Are parts generally common? Foreign/other exotic?

(2) Can common parts be requisitioned (stocklisted values, etc.)?

(3) Can uncommon parts be locally purchased?

(4) If not, can they be specially contracted?

d. Specialized skills will be needed fcr repair, data maintenance and parts support. Will they be available? Equal tc the job? Is training available?

e. Testing will probably have tc be manual.

'Will high complexity make that impractical? Is automatic test equipment indispensable? Complex peculiar support equipment?

f. Some assemblies may be proprietary.

Can the vendor's rights be protected if competitor's personnel are in the same shops? Can the contractor's manuals be copied?

5.2.3.1 If the above can't be answered satisfactorily, organic repair is probably not a viable choice.

5.2.4 Don't neglect Packaging, Handling, Storage and Transportation (PHS&T) requirements. Make sure PHS&T requirements are considered in the initial planning cycle as well as part of the test and evaluation schedule. Once COTS items enter the military distribution environment, they will be handled the same as MIL-SPEC items. Your PHS&T planning factors should include: intended use of the item, anticipated environmental conditions, type and mode of shipments, criticality and fragility of the item, hazardous characteristics if any to include weight and cube, and intended storage conditions and length. Remember to apply, when necessary, the requirements of MIL-STD 2073-1 and 1367. Participate in various management and technical reviews and in source selection proceedings in the evaluation of PHS&T elements. Depending on where they must be shipped and stored, consider applying the requirements of MIL-STD-2073-1.

5.2.5. Sustainability. Because of the design control the Government has had over MIL-SPEC designs, many have been maintained and upgraded to serve multiples of their original design life, some nearing forty years. Market pressures usually send commercial designs on their way far sooner than that, into an obsolescence not so easily dealt with: When we have never been equipped to repair or modify an item, the disappearance of a cooperative source will force its replacement. It isn't uncommon for this to occur within five years, which means that retrofit funding should be routinely projected approximately at the time of original system fielding. LSA Task 403, Post-Production Support Planning, can aid in evaluating this, and preplanned product improvement (P^3I) would be a logical vehicle to carry it out. This applies to software as well at hardware: the CRLCMP should contain cost estimates for maintenance and eventual replacement of COTS soft-ware. Licensing and subscription service represent a significant annual cost, and replacement cost will also be considerable. Resistance to such a fact-of-life approach could be seen as a vote against the use of COTS.

5.3 Interchangeability Control During the Life Cycle. As a system ages and COTS LRUs are contractor repaired or repienished, changes in design revision levels can sneak in. Although it isn't supposed to happen under F^3 and interface controls, these changes have been known to produce new or repaired items that will no longer work in the system. Such problems are hard to spot until the trouble starts. Try to prevent them by maintaining subscription service to the vendor's service bulletins or engineering change orders (ECOs) and ensuring that revision level changes get a close engineering review. If the review (and perhaps an actual test) confirms no effect on hardware or software interchangeability, submit cataloging action to pick up the additional part number under the item's original stock number. If the new revision proves noninterchangeable, your choices will probably be:

a. Upgrading the system to enable a change to the neu revision.

b. Buying "life-of-system" spares of the old revision and programming funds to replace the system or

c. Freezing the old revision as a government "Unique" (This will remove the item from the COTS category (Paragraph 2.2.d and Appendix 1(4)).

MYTH-BUSTERS 6

A little modification never hurt anybody. Or did it? With COTS, even little modifications are generally a bad idea. Modifying COTS forfeits the economy-of-scale advantage that is one of its prime selling points while aggravating an already shaky support picture inherent in many COTS situations: It gives us the worst of both worlds.

5.4 Modifications to COTS. We can probably name no Air Force system or equipment that has survived its life cycle without requests that it be modified. Your COTS selections will not be exempt from that. The key fact is that when you modify COTS it isn't COTS any more but "unique," to Government use and has been removed from the commercial mainstream. You've just given 'up most of what support base you might have had with COTS, because when the vendor (who still controls the design) chooses to

discontinue support of such a tiny portion of his market, the Government will be stranded. The few remedies are very expensive if even possible at all, and worst you might experience long term loss of a system while trying to fix the resulting problems.

5.4.1 Many COTS modifications originate early in system design during transactions between prime contractors and vendors. Beware also of the "little touches" a prime might add to a COTS item after he receives it in his plant. While various "must haves" like warning decals should cause no problems, deeper changes can. Figure 3 discusses these. It's up to you to catch modifications during design reviews and, if they're really necessary, prepare to deal with them. Ask a lot of questions; don't let a modified COTS situation go undetected until time for provisioning. Figure 6 explores the support logic involved when COTS becomes "commercial type."

5.4.2 ***The AF draft Sup to DOD*** 5000.2 ***regarding modification of commercial items is as follows: "Modification to nondevelopmental items, other than commercial items, are permitted. In those rare instances where commercial item modifications are absolutely required to meet mission needs, a suitability analysis, a life cycle cost analysis, and a coordinated modification agreement reached between the using, supporting, and acquiring agencies are required."***

5.4.3 ***The draft AF Sup to 5000.2 states " Government contracts should contain language prohibiting the contractor from*** **modifying** ***deliverable commercial*** **items** ***without specific*** **written** ***approval from the Government:***

5.5 COTS Warranties. Common sense and congressional mandate (Title 10, U.S. Code, Section 2403) say we should take advantage of warranties. This applies especially to COTS. You or the prime contractor spent time and money during the market investigation finding good products from reliable sources. In order to preserve their reputations and stay competitive, those sources customarily back their products very solidly. They do that by offering a good commercial warranty. You probably can (and should) use it as it comes. You might also want to see AFR 70-11, "Weapon System Warranties". Finally, keep these thoughts in mind:

a. DO learn that warranty. Know its provisions.

b. DO watch out for the time trap. Make sure the warranty hasn't reached its time limit by the time you can fieid the product. If you invest money in a warranty it might be **because you** have to buy an extension to the period of coverage.

C. DO make sure the warranty transfers to the Governmer through the prime contractor. Since the prime, not the

WHAT HAPPENS TO SUPPORT WHEN COTS STOPS BEING COTS?

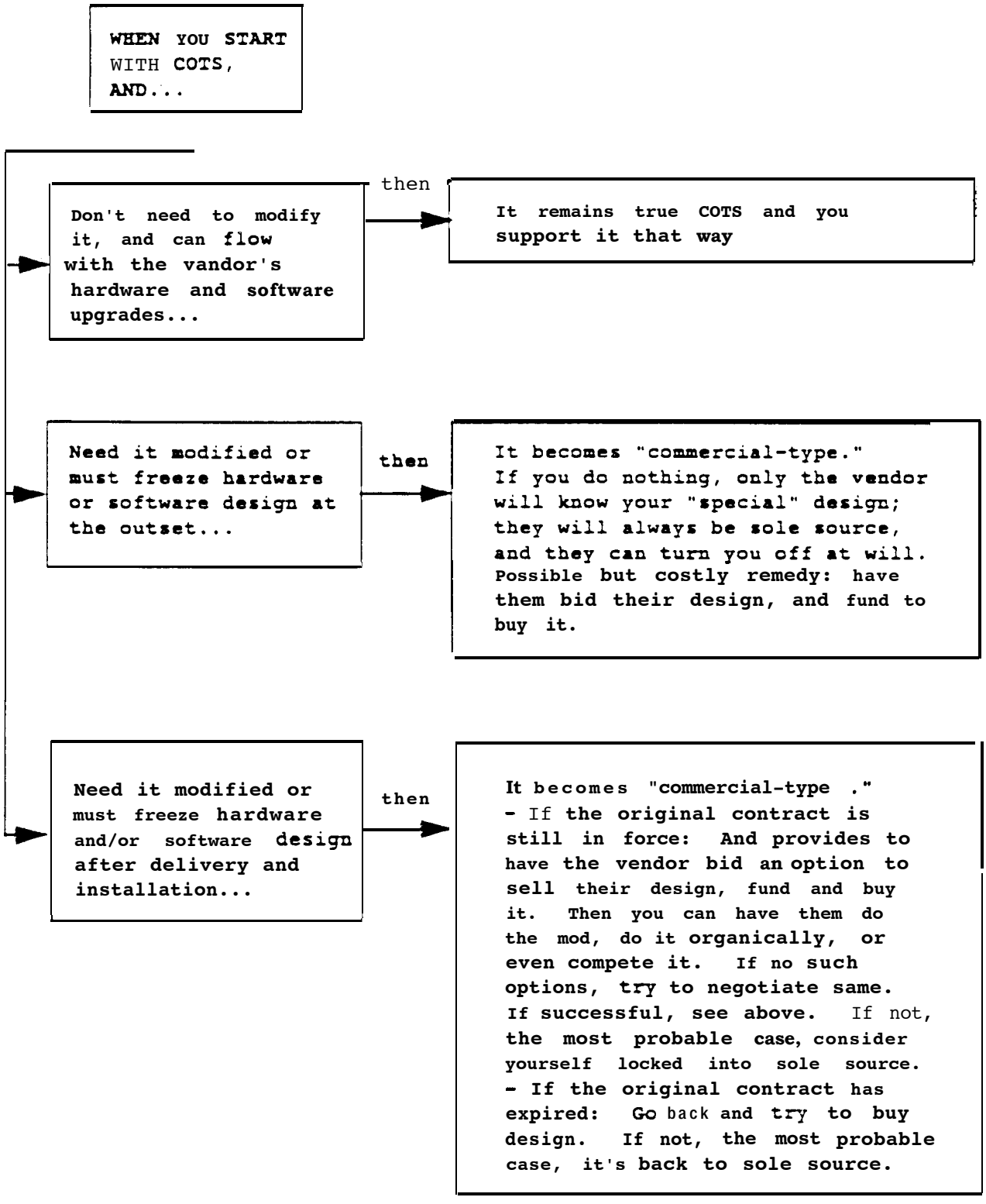

Figure 6

Government, was the original customer, such a transfer may not be automatic. It also may not be easy.

d. DO consider including mail back provisions in the warranty plan, repair for warranty failures that are valid, and failures that are not covered in warranty. Also, include shipping instructions and make special considerations for shipments of warranty assets to overseas locations.

e. DO determine whether or not support/peculiar equipment is covered under warranty.

f. DON'T try to impose a warranty intended to upgrade the product except as the vendor might decide to upgrade it on his own. Remember, you are in the COTS world of "What you see is what you get." If it wasn't a solid, reliable product with a good warranty, you should have disqualified it.

6.0 Test and Evaluation/Product Assurance.

6.1 HOW Much Should You Test? An important advantage of the commercial alternative is reduced delivery time. This is realized through the elimination of the research and development phase of the acquisition cycle and subsequent development test and evaluation. In general, you should not test when the equipment will be used and maintained by similarly skilled people in the same environment as that for which it was designed and existing data (contractor or other sources) provides reasonable answers to performance and supportability issues. Operational testing is strongly recommended if support or climatic environments differ from the contractor's. Further, emphasize preselection testing to minimize technical, operating and support risk.

MYTH-BUSTERS 7

You're not testing to see how you must change the COTS item to make it work. You're testing to see if it will work as it comes in an intended environment . Rule of thumb: If it doesn't work, look for a different item.

6.2 Depth of Testing. Testing requirements must be tailored to each specific situation. The following is a general idea of testing appropriate to each application. (AFR 80-14.) Stress the goal of minimum testing, regardless of the application.

6.2.1 Stand-alone COTS in a commercial-like (same-environmentj application. No testing should be required if the application is the same as civilian use of the item. If there is any doubt, acquire and qualify a test sample prior to selection. After quantity deliveries of a successful item, any deficiencies that appear should be covered by the vendor's commercial warranty.

6.2.2 Stand-alone COTS in a military (different-environment) application. Feasibility testing in the military environment (typically, qualification operational test and evaluation (QOT&E)) should be required to qualify a test sample prior to

selection. After quantity deliveries of a successful item, any deficiencies that appear should be covered by the vendor's commercial warranty.

6.2.3 COTS embedded in a larger system. Feasibility testing to qualify a test sample should be done prior to selection and integration into the system. Preproduction testing (typically, development test and evaluation (DT&E)) of the complete system is required. Hardware/ADP software integration tests are required. User testing (typically, operational test and evaluation (OT&E)) is required at the system level. COTS deficiencies that appear during or after system-level testing should be covered by the vendor's commercial warranty.

6.3 Testing Prior to a COTS Decision. Limit Government testing at this stage to that absolutely necessary to obtain data to make the commercial product decision:

a. As an initial step, minimize testing by:

(1) Obtaining and assessing contractor test results.

(2) Obtaining usage data from other customers.

(3) Observing contractor testing at his facilities.

(4) Obtaining test results from independent test organizations.

(5) Consider the procurement of prototypes, obtained from different vendors that meet the requirements.

(6) Negotiate a bailment agreement with the vendor. A bailment is simply an agreement with the vendor to offer their equipment for a specific period of time to be tested in a specific manner, free of charge.

b. If this initial data collection doesn't provide enough concrete information to make a sound COTS decision, an evaluation phase will be needed. Commercial product candidates should be bought or leased, and short user evaluation tests (including logistics support) should be conducted in the operational environment. (AFR 700- or 800- safety procedures must be followed while conducting user testing.) The results must:

(1) Directly support the acquisition strategy to accept or reject the commercial alternative.

(2) Reject COTS designs that do not measure up to the application.

(3) Assist in preparation of solicitationdocuments.

6.4 Testing After a COTS Selection. All testing must be described and justified in tne system specifications and test and evaluation master plan coordinated with the AFMC system support manager and approved by the system program director. If the acquisition is of computer resources and software, describe the testing according to the data items called out in DoD-STD-2167A. Again, "no testing" is the goal when it makes sense.

6.4.1 Development Testing. System level only. No development testing should be conducted at the COTS assembly level: COTS is already deveioped. If it doesn't meet your performance standards, select other COTS or go for a non-COTS design effort.

6.4.2 Operational Testing. Selection of COTS items does not automatically mean there will be no need for operational testing. However, operational testing should be 1 imited or waived by the operating command if the program office can show that market investigation data and, as applicable, preselection qualification testing will satisfy their requirements. That certification should be included in program documentation and be approved bv the operating command, who should also participate in the preselection testing.

6.4.3 Supportability Evaluation. The impact of COTS on system supportability requires testing to include as a minimum reliability testing, O-level maintainabilitv testing, energy usage tests, human factors engineering tests, live fire test5 (when required), standardization measurements and safety analyses.

6.5 Follow-on Evaluation. Testing of the commercial product immediately after the first unit is equipped (typically, follow-on operational test and evaluation (FOT&E)) is oriented to validating and refining the logistics support strategy. The using command shall determine FOT&E requirements. These tests are mainly to aid the users and supporters in refining their support structure. Later, additional testing may be required to verify that vendor upgrades and revisions will work in the system. Results may drive a "freeze" to an earlier configuration, but that should be avoided if possible.

6.5.1 Conduct follow-on compatibility testing *in* fielded systems for all significant hardware or software revisions to a COTS item. This testing should verify that the F^3 interface is not violated, and be completed before the Government accepts the change. Review the vendor's service bulletins and ECOs (paragraph 5.3, above) to identify which changes will require testing.

6.6 Other Test Considerations.

6.6.1 Quality Assurance Provisions. A quality assurance provision should be specified fcr each system-level functional and physical requirement in the contract. However, quality control of individual COTS items should be covered by the vendor's commercial warranties.

MYTH-BUSTERS 8

We'll make the vendor put on Government-style quality control. Or will we? Part of the reason you chose the COTS product was its high quality. The vendor is obligated by commercial competition and his warranty to keep that quality high. Maybe it's counterproductive to wade into him with an extra set of government-imposed quality demands. Think it over.

6.6.2 System Safety Requirements. Safety verification (testing) of the hardware may be necessary to ensure safety acceptability in the military environment.

7.0 Conclusion. In this handbook we have offered definitions of COTS and other categories of "commercial", spelled out Air Force Policy and have provided guidance in acquiring usable COTS equipment and making it supportable through alternative ways of addressing Integrated Logistics Support (ILS). We have presented such topics as selection criteria, contracting requirements, essential ILS activities and open competition guidelines, We have also attempted to expose COTS myths and pitfalls and how to avoid them. You will have to develop specific requirements to meet your program's needs, possibly with assistance from Air Force test facilities, laboratories and system users. You will also need to coordinate with contracting and the Staff Judge Advocate. Most important, remember that COTS won't just take care of itself. Know what you're getting into and plan how you'll handle it before you start: Later will be too late.

GLOSSARY

Assembly: An item made up of any number of parts or subassemblies joined together to perform a specific junction, can be dissembled without destruction. (Examples: fan; hydraulic actuator; electrical power supply.)

Best commercial practice: Design and fabrication of a product using techniques and parts employed by competent suppliers to the civilian market; conforming to military specifications (MIL-SPEC) or using government standard parts only by coincidence. In the context of this handbook, an item developed at government expense the government has allowed to be designed and/or built without conformance to MIL-SPEC.

Commercial item: A product, such as an item, material, component, subsystem or system, sold or traded to the general public in the course of normal business operations at prices based on established catalog or market prices. (FAR 11.001.)

Commercial-type item: A commercial item modified to meet some government-peculiar physical requirement or addition or otherwise identified differently from its normal commercial counterparts. (FAR 11.001.)

COTS: Commercial off-the-shelf. (See 'commercial item' and 'off-the-shelf item.')

Configuration: The functional and physical characteristics of hardware/software as set forth in technical documentation and achieved in a product.

Control drawing: An engineering drawing that discloses configuration and configuration limitations (i.e., form, fit and function); performance and test requirements; weight and space limitations; **access** clearance, pipe and cable attachments, etc., to the extent necessary that an item can be developed or acquired on the commercial market to meet the stated requirements; or, for the installation and co-functioning of an item to be installed with related items. Control drawings are a Level 3 drawing product, but do not illustrate full design (piece-part) disclosure. They are identified **as** envelope, specification control, source control, altered item, selected item, interface control and installation control. (DoD-STD-100C) and Vendor Item Drawing (MIL-STD-100E)

End item: A discrete, often complex item capable of independent operation. (Examples: Airplane; radar set; ground powe generator.)

Engineering data: Engineering drawinqs, associates lists. undimensioned drawinqs, tooiinq data, flat patterns, master printed circuit patterns, numerical control data,' test methods and procedures, acceptance test criteria, electrical schematic and logic diagrams, configuration item specification, etc., and documents they reference which are required to define the geometry, assembly and operation of parts, assemblies and systems. Engineering data is intended to document design such that when replacement items are fabricated and assembled accordingly, their physical and performance characteristics will duplicate those of the original items.

F^3: Form, fit and function.

F^3 threshold: In the hierarchy of engineering data, the threshold above which detailed design is illustrated (full design disclosure); at which form, fit and function are depicted by control drawings (F^3); and below which there can be expected to be no design disclosure. (See Figure 5.)

Form, fit and function: The descriptors that permit fabrication of an interchangeable item by any competent manufacturer without disclosing internal desiqn detail. Generally expressed in the various types of control or vendor drawings (DoD-STD-100C; MIL-STD-100E).

Full design disclosure: In engineering design, Drawings that set forth internal design detail sufficiently complete that any competent manufacturer can fabricate an essentially identical item without recourse to the original designer. Coverage is normally down to the piece part and detailed manufacturing process. (MIL-T-31000.) Full design disclosure for COTS items in such packages is usually restricted to specific drawing types and is limited to form, fit and function definition.

Line replaceable unit (LRU): Any assembly or part that can be replaced at the organizational level to restore operation of the system or eguipment. Usually in reference to a reparable (exchangeable) module, but can be a piece part

MIL-SPEC: Having to do with, or under the control of US military specifications or standards; militarized.

Module: As assembly or subassembly usually characterized by the performance of a complex function and ease of removal from its higher assembly. (Exampies: Servo amplifier; power supply regulator. Electronic printed circuit board assemblies are often called modules.)

Nuclear hardness: The ability of a system or equipment to survive in a man-made hostile environment. Usually achieved through special design attributes and/or parts selection to withstand one or more of the effects of nuclear detonation.

Off-the-shelf item: An item produced and placed in stock by a contractor, or stocked by a distributor, before receiving orders or contracts for its sale. It may be commercial or MIL-SPEC. (FAR 46.101.)

Olive drdb commercial product: A product usually developed commercially by a vendor who retains the rights to the design, but sells the product exclusively or nearly exclusively to the military.

Part (or piece part): An individual component of an assembly or subassembly which cannot be disassembled without destruction; usually replaced rather than repaired upon failure, (Examples: coil spring; transistor).

Subassembly: An assembly which forms a portion of a higher assembly.

System: An aggregation of end items, interfaces and support functions designed to fulfill a specific mission requirement. (Example: An operational fleet of fighter aircraft, including avionics, weapons delivery and ground support equipment; a worldwide communications network.) Typically, a system is made up of apparatus *or* equipment, trained personnel, facilities, data and procedures, and computer programs.

Technical Data Package (TDP) See Engineering data (MIL-T-31000).

APPENDIX 1

CONSIDERATIONS FOR YOUR MARKET INVESTIGATION
(USE APPENDIX 1A WITH THIS PROCESS

(1) CAN A COMMERCIAL ITEM MEET AF'S REQUIREMENT?

IF NO, DON'T USE IT. OTHERWISE, CONTINUE.

(2) WOULD GOVERNMENT FURNISHED EQUIPMENT (GFE) DO IT?

IF YES, USE GFE IF POSSIBLE. OTHERWISE, CONTINUE..

(3) CAN A COMMERCIAL ITEM SURVIVE THE INTENDED MILITARY USE?

- ENVIRONMENTAL CONDITIONS
- PERFORMANCE DEMANDS
- MAINTENANCE/SUPPORT EXPECTATIONS

IF NO, DON'T USE IT. OTHERWISE, CONTINUE.

(4) MUST IT BE MODIFIED FOR MILITARY USE?

IF YES, GO TO FIG 3: **CAN** THE AF TOLERATE THE RISK? OTHERWISE, CONTINUE.

(5) NUCLEAR HARDNESS REQUIRED AT COMPONENT LEVEL?

IF YES AND YOU ARE NOT PREPARED TO BUY THE DESIGN, DON'T USE IT. OTHERWISE, CONTINUE.

(6) IS THE DESIGN RELATIVELY STABLE?

IF NO AND THE AF WILL NOT PARTICIPATE IN THE UPGRADES, YOU WILL CREATE GOVT SPECIAL (COML-TYPE) ITEM. OTHERWISE, CONTINUE.

(7) WILL AF LATER NEED TO MODIFY INSIDE F^3 ENVELOPE?

IF YES AND AF WILL NOT BUY DESIGN TO OBTAIN VISIBILITY, DON'T USE IT. OTHERWISE, CONTINUE.

(8) GOOD PROSPECTS FOR PRODUCT LONGEVITY, VENDOR SUPPORT?

IF NO, PLAN FOR -EARLY UNIT REPLACEMENT. OTHERWISE, CONTINUE.

(9) SUBSTITUTE POSSIBLE WITHOUT MAJOR SYSTEM IMPACT?

IF NO, PLAN FOR EARLY SYSTEM REPLACEMENT. OTHERWISE, CONTINUE.

(10) CAN IT MEET THE AF'S SUPPORT CONDITIONS?

- AS DEFINED IN PROGRAM DOCUMENTATION, SUCH AS:
  - STATEMENT OF NEED
  - SYSTEM OPERATIONAL REQUIREMENTS DOCUMENT
  - COMPUTER RESOURCES LIFE CYCLE SUPPORT PLAN

IF NO AND YOU CAN'T LIVE WITH THAT, DON'T USE IT. OTHERWISE, CONTINUE.

(11) COMPETITIVE **BASE FOR REPAIR/SUPPORT?**

IF NO, BETTER NOT USE IT. OTHERWISE, CONTINUE.

(12) CONTRACT REPAIR/SUPPORT CONSIDERATIONS?

- CONDITIONS (MOBILITY, ETC.)
- COST
- SURGE

IF NOT OK, DON'T USE THAT ITEM. OTHERWISE, CONTINUE.

(13) LOWEST COST **ALTERNATIVE?**

- INITIAL
- LIFE CYCLE

IF NO, DON'T USE IT. OTHERWISE, IF EVERYTHING IS OK AT THIS POINT - GO **FOR IT!**

APPENDIX 1A

A COTS DECISION AID

The following expands on the decision process in Appendix 1. Use it as an aid in COTS/development decision making during market investigation, proposal reviews or design reviews.

(1) Can a commercial item meet AF's performance requirements? [Will it do the job?) If not, find one that will. This first, most obvious question is sometimes not carefully enough asked, which often results in selection of a COTS item that has to be modified in order to work. Thus we slip to "commercial-type," that orphan category whose risks are described in (4), below. Deal carefully with this question during the market investigation phase and save expensive grief later.

(2) Would government furnished equipment (GFE) do the job? If so, and if it can be available in time, consider using it. GFE is just another category of NDI, and it can offer the advantages of being MIL-SPEC to begin with and already having its own logistics support structure. It can also offer the disadvantage of not being available or serviceable when you need it. It warrants a close look. AFMC's Cataloging and Standardization Center (ASC) can help with GFE research.

(3) Can it survive intended military use? If not, don't use it, The physical and operational demands of military use are frequently tougher than commercial applications. In communications-electronics we sometimes take designs intended for fixed installations in controlled environments and try to use them where they will encounter severe shock, vibration, climatic stresses and/or the attentions of insufficiently-experienced maintainers. Thus a high-reliability civilian design becomes a government loser. Modifications can be done to add strength, but they introduce their own problems (see (4)), turning a commercial design with all its advantages into a "special" over which the government enjoys no control. Very carefully examine every potential selection of commercial product in this light. If there is unacceptable risk inherent in its use, use a different product or go for development.

(4) Must it be modified for military use? If so, it becomes "commercial-type:" Prepare to buy into the vendor's design. We have a tendency to think we can us-e a commercial design straight off the supplier's shelf--mostly: We just want to modify this or that little thing, to make it "perfect" for our application. This "sorta off-the-shelf" approach should be avoided, since it produces a device no longer recognized by the supplier because it's no longer in their line, while not manageable in-house either. For adequate support the modified design needs to belong to the Government, but under normal circumstances it will not; unless you make extraordinary (and costly) arrangements you will

have no engineering visibility or control over it. Thus you w be tied sole source tc a vendor who often will not care ab your needs relative to that "little special," which after all might represent only a tiny fraction of tneir business. If you absolutely must modify a commercial design, recognize that you're knocking it out of the "commercial" category and buy into it from the start. (This also applies when you lock in a software biasing so that you can't tolerate subsequent hardware revisions.) 'Buying in' entails learning what the design was before the change (by obtaining detailed engineering data) and controlling configuration afterwards so you can sustain your government-peculiar product like any other. Market investigations must establish which suppliers will agree to let you do that, and you must fund to cover the probably-substantial cost. Figure 3A describes the comparative risks involved with various kinds of modifications done by different entities.

(5) Nuclear hardness at component level? If so, prepare to buy the vendor's design or go for development. Nuclear hardness is the ability to withstand a variety of effects that result from nuclear detonation. Protection from these effects might be built into the internal design of the unit involved, provided by external packaging, mounting and filtration, or achieved by a combination of these things. If strictly external measures will protect a commercial item from the specified effects, there should be no problem with using it in a hardened applicatic However, because of the configuration management deman mentioned above, a requirement for nuclear hardness through internal design should normally be considered directly contradictory to the use of a commercial product. Even if a commercial design tests "hard" without modification, the Government has no control over subsequent design changes: The next item off the assembly line may be entirely different inside -- and no longer hard -- and the Government will have no way of knowing or controlling that. Further, this lack of control over production changes is only the start of our troubles: In order to maintain hardness during the life cycle the Government must be able to see into and control piece-part configuration to keep hardness from being maintained out. You can't do that unless you own the design, so plan to buy it or develop the item from the beginning.

(6) Is the design relatively stable? If not, prepare to participate in the vendor's upgrades or make a different selection. As indicated above, design stability is something you can't assume when dealing with commercial designs. Under MIL-SPEC rules contractors are answerable to the government whenever they want to make a design change, but in the commercial world they are responsible only to the pressures of the market; their product can change frequently and radically with no warning. most cases the government is lucky if the design stays the sa through production; over the life cycle there is almost bound t be radical change. The smaller the government's share of the vendor's production, the greater this tendency. You can deal

with the prospect, either by buying the design and creating our own "special," or locking into a firm "form-fit-function" baseline and rolling with the Internal changes. The latter might include signing up to the contractor's updates on the items you already own so they won't slowly become orphans, and, in the case of computers, also outdate our software. Market investigation should explore the potential stability of the candidate designs and the cost of keeping up with future updates.

(7) Will AF later need to modify inside the form-fit-function envelope? If so, prepare to buy into-the vendor's design or go for development. Do you anticipate that you will want to make internal changes to a commercial design during its life cycle? We're used to that with MIL-SPEC designs, but in order to do it with commercial equipment we must know what we're starting with, and the only way to do that is, again, to buy the design. In this and the above buy-the-design situations cover that prospect during the market investigations and competition phases; if you wait until you're in a sole-source position it's almost certain you won't be permitted design access, or the cost will be so high you won't want to bother. The best choice in such a case will often be development.

(8) Good prospects for product longevity, vendor support? If not, you should not select that product. If you must select it, plan for its early replacement. There have been situations where by the time the prime contractor was ready to start production, the commercial designs they used in the prototype phase were no longer on the market. If a product is a year or two from being discontinued when selected, its prospects for a long and successful life cycle are small. Market surveys should require that offerors address the potential longevity of the commercial lines they intend to use. While candidate products should have been on the market long enough to have been proven, those with waning life expectancy shouldn't be selected. That will be a tricky judgment call.

(9) Is substitution possible without a major system impact? If not, re-evaluate the system's overall design to reduce such an impact. Despite our best efforts, products leave the market or otherwise become subject to replacement. Try not to let system design become so dependent on the presence of one peculiar commercial item that the whole system must be replaced if that item's no longer to be had. Catching things like that should be emphasized in the preparation of system specifications, as well as during market investigations, source selections and design reviews. If they can't be avoided, funds should be projected for a replacement system about the time the system presently being acquired starts to field.

(10) Can the AF live with the inherited support conditions? If not, pick another product. It's essential to take a long, hard logistics look at any proposed commercial design. No front-end advantage is worth living with something whose components are too

big and/or fragile to evacuate for repair, whose organizational-level exchangeables aren't interchangeable, or which is otherwise impossible or uneconomic to support. Logisticians from the Air Logistics Centers and the operating/maintaining commands must be allowed input on these aspects early enough to affect the selection process. Don't walk into unacceptable logistics hazards.

(11) Is there a competitive base for repair and support? Avoid the sole source trap if possible. Regardless of how careful you have been in its. selection, you will probably never be able to equip for full organic repair of a commercial design unless you, again, buy that design. Barring something so radical, recognize that the Competition in Contracting Act will make it very difficult to attach yourself to the original manufacturer for the entire support period. While for some items such as television receivers the service network is essentially in the public domain, service for many specialty items is available oniy from the original source. Market investigations must include questions about the commercial repair/support base for any proposed design so you can gage your chances for competing those services during the life cycle. If they are poor, perhaps you should look elsewhere.

(12) What are the contract repair/support considerations? If unacceptable, COTS is not a viable alternative. Since you will probably be dependent for repair/support on one or another contractor, ascertain whether operational needs will permit that. While contract support might be satisfactory in peacetime, will surge potential permit it in a wartime scenario? Can reparable be evacuated to a contractor in time to support the pipeline? Will the cost for such readiness be prohibitive? The answers to these questions might steer you to the development alternative.

(13) Is it the lowest-cost alternative? If not, don't use it unless there are other overriding considerations. Don't always assume that COTS is the least costly solution. Lower front-end cost is sometimes the only justification for selecting it, while life cycle cost is sometimes ignored. If the advantage of total cost is lost there may be nothing left to recommend COTS. Your market investigation should not take the approach that COTS is the only acceptable answer, but should be used to determine which alternative is the most satisfactory answer. There have been cases when an "olive drab commercial" product was not only less expensive, but forced fewer performance and support compromises than COTS.

APPENDIX 2

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